

SKETCHING IN VR FOR LANDSCAPE ARCHITECTS

- Exploring new possibilities



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Abstract

The sketching possibilities in VR are getting increasingly more available for people without in-depth programming and computer skills. Previous research has shown that using VR in the sketching process by landscape architects increases the understanding of spatiality, reduces the cognitive load, enhances communication, and gives confidence to the user. To understand the field a literature study was undertaken and interviews were conducted. To get new practical insights an applied sketching session was performed and documented. The hardware used was Oculus Quest 2 and the software was a plug-in for SketchUp called VRSketch. The method used for the applied sketching was inspired by auto-ethnographic studies where one interacts within a given environment while at the same time observing and documenting ones own reactions to that environment. In this study the environment is VR and the activity being performed and observed is sketching in VR. An open mind to all sorts of results was kept to make the most out of the methodology. This method compliments past studies and whilst it doesn't give results which necessarily reflect what other people would experience, it indicates directions for future research. Some of the results were consistent with previous studies and others need further research. Future investigation could explore: having multiple users in a VR setting at the same time, exploring the possibilities with different levels of abstraction, the different types of intuition, to use a checklist to get started but not to get creative, and to generally expand the academic discourse as technology advances.

Preface


So many people have been invaluable in the writing of this thesis. I've written it in 5 different cities with views spanning from the Baltic seas to the mountains of the Pyrenees. I'm very grateful for everyone that has accommodated me.

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Glossary

VR = Virtual Reality, digital glasses that immerses the user in a created digital world.

AR = Augmented reality, digital glasses that you can see the real world with, and on top of it, there's a layer of digital creation like Pokémon go.

Conversation = sometimes refers to communication between the designer and the design and not between people.

CAD = Computer program to make blueprints and technical drawings in. Really good to help you make things on the correct scale as it is always measuring the length of the lines.

CAAD = Computer-Aided Architectural Design

VRSketch = an extension for the 3D program SketchUp that sends the 3D model into Virtual Reality.

Software = The program in the computer

Hardware = The computer itself

SketchUp Warehouse = A library of 3D models that everyone can download into SketchUp

Lag/Lagging = When the software has to load and the user has to wait until being able to proceed with the work, often due to that the software is too advanced for the hardware.

1. Introduction

1.1 Background

How can Virtual Reality (VR) be used in Landscape Architecture? And more specifically, can one use it as a creative tool for sketching? VR is a way to immerse oneself in an artificial environment. Right now the most common way of doing this is by wearing a headset that mainly covers the wearers' eyes. The headset has screens inside it that project pictures to the user's eyes. The technology makes the pictures move with the movement of the wearer's body making the person feel immersed in another world.

When growing up and taking art classes I always liked working with models a lot more than painting. What also was distinctive in my creative process was that everything got physically big. When starting my first year as a Landscape Architecture student I was excited to work with something as big as the outdoor environment, I also made a physical model in our first studio course. Ever since that model I have not felt like either the time or patience has been available to execute a second physical one. When then going into SketchUp I was excited but I also felt quite limited by the two-dimensional screen. The possibility to take SketchUp further into a Virtual Reality (VR) and immerse oneself in a 1:1 scale feels like a huge possibility and very exciting as it gets as big as it can be.

Various studies have reviewed how VR is used in Landscape Architecture. De Freitas and Ruschel (2013) made a comprehensive survey of 200 articles published in the last 11 years in ACADIA conferences on how VR and AR are used in Landscape Architecture. They observed that the most common research areas were design methods (46%), architectural theory and history (23%), and performance evaluation (20%). They found

that most studies emphasised tool appliances in visualisation, theoretical discussions about the technology, and how to use it in education, collaboration and practice. Portman et al. (2015, p. 380) reviewed the possibilities of using Virtual Reality environments in Architecture, Landscape Architecture, and Urban Planning. They found that in Landscape Architecture VR applications have been growing over time. They say that in 2006, 28% of the private landscape architects in Germany were using VR and 7 % of the public authorities used 3D simulations and confirmed that it had a positive effect on the development of landscapes. VR was implemented in site planning, landscape restoration, parks, and recreation planning, green infrastructure planning, residence landscape master planning, and more. If comparing VR in Landscape Architecture with VR in architecture and urban planning there are fewer immersive environments made of non-existent landscapes and more of already existing ones in Landscape Architecture. They say that it's because in Landscape Architecture VR is used a lot to see what people feel about the landscape. They point out the following areas as ready for development within VR in Landscape Architecture: Efficient validation of virtual landscape modeling and simulation, Botanically correct and highly detailed vegetation, creating walkthrough experiences, and finally more research on what VR contributes and what to be cautious about. They also say that the greatest challenge for Landscape Architecture and VR is to get beyond descriptive visualisations and have more multi-sensory experiences. Their overall conclusion is that more research and education in VR is required. In 2016 Mengots wrote a review on how digital tools are being used in the field of Landscape Architecture. He found that VR is very suitable for both the early and final parts of the design and to communicate with both professionals and clients. He found it very suitable for small-scale projects and suitable for

large-scale ones. They say that the reason for it not being used in Landscape Architecture is the same reason it's not used in design, it's too expensive and too time-consuming (Mengots, 2016). Song & Huang (2018) have written a discourse about how Virtual Reality can be used when designing landscapes. They conclude that there are unlimited ways to use VR in Landscape Architecture. It can be used to quickly construct landscapes for customers to experience and for designers to free their minds and innovate and transform the industry. They say that the only possible obstacle is if technology doesn't advance. As seen in these studies there has not been much written about the early parts of the design process in VR and it has been pointed out as a relevant area to study.

My theory is that VR could be very useful in, and add a new tool to the sketching process for landscape architects. To validate this assertion, several sources of information about the subject have been collected. Further, an experiment with VR was made to explore the possibilities of how it can be used as a sketching tool, in which I'll analyze my process with the simulation. Lastly, I'll do interviews with people who've been similarly working in VR to see what they think about it and how they prefer working with it. This will lead to a deeper understanding of the subject and answer the question raised.

Lombardo (2018) has written his master thesis on how Landscape architects perceive VR. He made a model in three different grades of realism and then let 18 professionals in Landscape Architecture experience it in VR and answer questions about it. In his discussion, he tries to answer why VR is not used more than it is today (only one of the questioned Landscape architects had used it professionally before). He says that the most common explanation of why VR is not used more often in Landscape Architecture is because the innovation has

not yet been established and that in general Landscape architects are slow at adapting to new technology, it's a technical barrier. One participant also says "Landscape architects already have a lot to master. It is a broad field. We can't master everything." which indicates that many landscape architects might have a big interest in another field and want to prioritise their focus on learning those other fields rather than VR or other digital tools. People are also worried that it will take a lot of time and therefore cost a lot of money. But with the prospect of many improvements for the final design (for example better predictability and improved design outcomes) presents a big enough incentive for it to be worthwhile. One participant says that "(time expenditure) will likely increase a bit, but you get that back in the final result. It's not like you would normally sit for 45 hours and study the lines of sight. You just wouldn't think that hard about it. Although time expenditure is increased, VR adds more value". Something else that can stand in the way of using VR professionally is the whole conception of what VR is and what it is meant to be used for. For example, VR is commonly used in games, which might excite people about using it, but could equally mean that they do not view VR as a serious work tool with high potential. (MacFarlane et al. 2005, p. 347). This might be the reason why there is so little written about it in Swedish architectural magazines (when searching for "VR" in the database ArtikelSök only four articles were found). Many of the scientific articles about VR are also highly technical, adding a barrier for people outside the field of technology who want to learn about its possibilities. Accessibility has been the major issue with VR where cost and difficult technology is, according to Castronovo et al. (2013, p. 24), the major things to get past when deciding whether to use an immersive system in a project or not. George et al. (2017) agree with this. Today (2021) advanced equipment

can be much cheaper and more user-friendly and there are many easy-to-use and intuitive software available. It's even possible to have multiple users in a VR environment at the same time. Multiplayer for Tiltbrush was released on the 21st of February 2021 and has an 86% five-star review, from reading the comments people seemed very positive towards it. The only article I've found that analyses this is by Schubert et al. (2019). As my study is not a collaborative one I have decided to not include more information within this field.

It is worth remembering that technology moves forward and evolves extremely quickly. It is my hope that the thesis will be helpful to the overall discourse regarding working with digital tools in a creative way, highlighting possibilities for landscape architects to think about the application rather than the technology itself. As Lawson (2006, p. 282) says, thinking about what to do rather than how to do it. VR is something that can give us the possibility of being in a fully immersive model without having to build one physically. The thesis will

focus on the experience of working with and in VR during this early and experimental stage of the design process and what kind of value it could add to projects.

I do not have any earlier interest in gaming, and what I've learned about computers and software comes primarily from University studies and the will to understand this further. The drive comes from my vision of possibilities for the integration of VR and the field of Landscape Architecture. According to Hermas et.al, (2018) VR is a technology that is becoming increasingly more available for people with little experience in how to use technology. Since I'm not very interested in the technical part of the software and hardware that I use but rather the possibilities that they have to offer, I will not go into more technical details than necessary.

1.2 Purpose

To contribute to and inspire the field of Landscape Architecture about how VR can be used by landscape architects to sketch in 3D and human scale.

1.3 Goal

To write a literature study about different areas that are relevant for sketching in VR and to investigate how VR has been and can be used in sketching to complement traditional methods. In addition to this, the aim is to contact and have conversations with people who have worked with VR professionally to get a different perspective of the possibilities of VR.

To apply sketching in VRsketch with the VR-headset Oculus Quest and observe myself as I experiment with the design of a public square. The self observations complement earlier studies by exploring what comes up instead of the specific questions asked. This approach will provide new insights of the possibilities VR has to offer in explorative sketching and Landscape Architecture.

1.4 Research questions

- What are the advantages and limitations of sketching in VR?
- Is prior knowledge in VR required to work intuitively and creatively within the medium?
- How does VR change the relationship between spatiality and the landscape architect during the sketching process?
- What can be learned from performing an explorative sketching process in VR?
- What is the future of VR-use in sketching for landscape architects?

1.5 Method

To come to a conclusion the subject was researched in three different ways, through literature studies, interviews, and experimentation. Here follows a brief explanation of the methodologies.

1.5.1 Literature

To collect literature material I have searched for scientifically reviewed articles in SLUs library and google scholar. I have read student works which have inspired me and led me to relevant books and articles through The Snowball Method (Ahrne, 2015) In the middle of the researching process I found out that there is a conference every year called The Digital Landscape Architecture Conference, who publish a journal called The Journal of Digital Landscape Architecture (JoDLA). This turned out to be my most valuable gateway to a lot of newer research in the field. The references I've kept are those most relevant to my subject and contain facts that enrich my thesis.

When searching for scientific articles, student works, and books, I used the words: VR, Landscape Architecture, design, sketching, spatiality, design, intuition, creativity, process, and more. It turned out to be problematic when searching for words like design and sketching because they are used as a metaphor or analogy in many other fields which led to a lot of search results. I used the search engines Primo, Web of Science, and Google scholar. When reading the student works on related themes I looked into their sources and used them to get deeper into the subject which turned out to be very successful. When using the search engines the articles that came up were mostly very old and outdated. When I found The Journal of Digital Landscape Architecture it gave me access to new and fresh material.

1.5.2 Interviews

To get a hands-on idea of how it is to work more professionally with VR I got in contact with and interviewed professionals in the field of architecture. The interviews were executed in a semi-structured way to leave space for sidetracks and a more engaging interview (Ahrne, 2015, 40). The people chosen for the interviews were people that worked with VR in the field of architecture in different companies and ways to get a wide spectrum of inputs. Parts of these interviews are included in the contextual research and complements the literal sources. Transcriptions of two of the interviews and notes from the third are available in the appendix. The limitations with qualitative interviews is that they only show one persons perspective which can't be broadly applied.

1.5.3 Applied Sketching

The practice based research element of the thesis, where explorative sketching is done inside VR while observing oneself, creating a proof of concept. For this I had to be objective at the same time as performing the experiment, and therefore I've developed my own methodology. I did this by reading about different ways of observing the self, and by reading texts where similar tasks were performed. The method that I developed for this task involves experimenting in VR consciously, sketching traditionally and writing down thoughts and feelings about the experience. The method also contains a small part of self-reflection on

previous life experiences to give the reader an understanding of the writer, and therefore a way for the reader to relate to the material. This method complements earlier studies on the same subject (Hill, 2019) by exploring what comes up instead of the specific questions asked. The program used is VRsketch and the VR headset used is Oculus Quest. The advantage of this approach is that the data that comes out is rich and exactly what the person wanted to express, it's not what the author interpreted

from observation or interviews but the first-hand feelings expressed by the author (Anderson, 2006). The limitation with this approach is that it's hard to evaluate whether the findings are something that everyone would arrive at, or just something that the person involved concluded (in this case me). But it can be seen as an indication for what could further be studied in the future. This methodology will be further explained at the beginning of the relevant chapter.

1.6 Structure

After the introduction (Chapter 1) the thesis continues with the contextual research split into two parts (Chapter 2). The first one is about conceptual aspects of the experimental part of the design process for landscape architects; creativity, intuition, sketching, and spatiality. After each section, there will be a reflection that relates the subject to VR and Landscape Architecture. The second part of the Contextual research is about technology focused on VR in the field of design and Landscape Architecture. This part elevates how they can be used in the explorative part of the design process. the sketching process. In the contextual research parts of the interviews are also included to bring in a perspective from the professional point of view and not just the academic.

After the contextual research follows a chapter that contains method and result from my Applied Sketching (Chapter 3). The Applied Sketching contains a more thorough explanation of the

method; working process, how I choose the hardware and software, how I made the basic model, about my area, and my background. The results from the Applied Sketching are presented with text, photos, and videos. The result is split up into three parts, one for every new design started. Then follow reflections that came up once the Applied Sketching was over.

The discussion (Chapter 4) deals with connections between the Applied Sketching and the contextual research and how to go further in the research and then the conclusions (Chapter 5). After that the sources (Chapter 6) are collected in one list. The last part of the thesis is the appendix (Chapter 7) containing transcriptions of interviews, my unedited field notes and sketches and the checklist I used in the applied sketching.

1. Introduction
2. Contextual research
3. Applied Sketching
4. Discussion
5. Conclusion
6. Sources
7. Appendix

2. Contextual research

The contextual research is based on a selection of literature, articles and interviews that handle different parts of my inquiry to give an overview of what is known from before. It's separated into two parts, the first one, conceptual aspects, handles creativity, intuition, sketching, and spatiality. These are important things to understand when working with sketching in VR in Landscape Architecture. The second part is about technological aspects and mainly looks into what has been done in sketching within VR before, but also some other sources to get an indication of other aspects that are relevant for sketching within VR.

I chose to focused my study on the conceptual aspects as these are commonly used features in Landscape architecture. It is possible to chose other aspects but these are the ones I have chosen as the point of departure. I chose to combine them with VR as it's an impressive tool and my theory is that VR is highly compatible with sketching as the newer and more accessible technology has an element of intuition allowing one to work with it as a creative tool.



Figure 1: Visualisation of what tools and sources that's been used in the writing

2.1 Conceptual aspects

This part investigates the four conceptual aspects; creativity, intuition, sketching, and spatiality. Creativity was chosen because the focus of the exploration is the creative aspect of the design process that is investigated. Intuition was chosen because it's an important aspect of designing which often gets ignored or forgotten in discussions. Additionally, data programs need to be intuitive so that Landscape architects can quickly feel confident about working with them. Sketching was chosen as it is the common tool among landscape architects when approaching the design process and this is specifically what VR would complement. Spatiality was chosen as it is an important aspect of Landscape Architecture and it is the feature most commonly associated as a possibility within VR.

2.1.1 Sketching

Sketching is a commonly used tool for designers in the explorative part of the design process. The following section contains an overview of sketching, how it has been studied, and how it's been used.

What is a sketch?

The sketch has been described in many different ways depending on who you ask. Some examples are: As a way to create an idea (Corner, 1992, p. 144), as a process that brings clarity to an idea (Birgerstam, 2000, p. 164, p. 166), as a trace of a process (Birgerstam, 2000, p. 164, p. 166), as something that is made quickly and that summarizes the whole picture (NE, 2020), as an aesthetic organization (Nord & Birgerstam, 1997, p. 6), as a way to discuss with other people (Nord & Birgerstam, 1997, p. 6), as a way to declare and remember what one has seen/ experienced (Dahlman, 1998, p. 26), and as a method for analysis (Lindau & Nyman, 2019, p. 26). These different ways of using sketching describe partly how a sketch comes to life and partly what kind of function a sketch can fill. Further Krupinska (2016, p. 135-136) means that the design process is very individual, multi-dimensional and a complex creative process.

Lombardo (2018) questioned when in the

process professionals in Landscape Architecture would use different levels of realism in the VR environment that he presented to them. They responded that they wanted to have the highly realistic version also in the early part of the process. He was surprised by this. In contradiction to this Ekström (2019) highlights in his master thesis about VR-experiences that when having too high realism the focus shifts to the wrong things, for example, details and not the overall structure. But he also means that it can be difficult even for designers to relate to abstract white blocks. Garner (2000) points out that sketches can look very bad but have a really good underlying thought and then be the cornerstone of a whole project and vice versa (p. 2). He also highlights the promising possibility of there being more than one person at a time working on a sketch and the possibility of working further on someone else's sketch as an important function in the design process. And that it's something that everyone can do and doesn't necessarily require learned skills, unlike using a digital program.

What's the function of sketching?

Birgerstam (2000) is a psychologist that's especially interested in intuition within the knowledge process. In her book "Skapandets handling - om idéernas födelse" (translation: "The action of creating - about the birth of ideas") she interviews people that work with sketching and asks them to analyse how they do it. When she interviewed the architects about the sketch she noticed that they usually started talking about it in verb form (sketching) instead of the noun (sketch) (p. 164). She thinks that the reason for this is because the important thing is not the tool or the result but the process of learning, understanding, and changing something. The sketch should never be the finished product, it should reflect a thought process and experimentation. (p. 171) The interviewed people further think that a sketch doesn't have to be something physical but can be an evolving idea or a conversation, as long as it experiments with different scenarios (p. 172). Nystrand (2019) interviewed professionals in Landscape Architecture about VR in his master thesis. One of the senior landscape architects commented that it took her ten years as a working professional to see spaciousness and dimensions "pop out of the paper" when sketching in the plan but in VR it could be seen and experienced straight away. Lenngren (2012, p. 58) interviewed the architect Åge Langedrag in his thesis BIM för Landskapsarkitekter (BIM for Landscape Architects). In the interview, Langedrag says that 3D-models are a universal language that everyone understands and that they are therefore a great tool for communication.

3D

Sketching with physical models in 3D has been analyzed by Borselius (2014) in her master thesis. When doing the model she used the scale of 1:200 and a variety of sources for inspiration. She used some days to do the model and used her different sources of inspiration to come

up with different results. She concluded that working in a 3D model was very good when looking at spatial aspects and how movement flowed in the space. The flaw she saw in her work was that it was very time-consuming to build the model. She compared it to SketchUp and concluded that to do the same base as she did with paper would be much faster to do in SketchUp.

What digital sketching could be

Seichter and Schnabel (2005, p. 199) mean that in the early design stages it's important to use a medium that mirrors the interactivity and complexity of the site and the proposed design. This is to not limit the exploration and communication of urban problems. In their studio experiment, they show that Augmented Reality (AR) allows for this and further that it enhances communication when the media "relates to the process of thinking, creating and understanding".

A number of writers have explored the possibilities of sketching with the help of digital tools. Problems that they've mentioned is; limited knowledge of the software makes the process difficult to execute (Bergene, 2009, p.68; Bilda & Demirkan, 2003, p.49; Lawson, 2006), that it doesn't show the normal fuzziness of a sketch (Lange, 2011), and that one does not have the absolute freedom that is there with traditional sketching with pen and paper (Špaček et al., 2016). Krūgelis and Gediminas (2018) further found that if the software is taught early on in the education the students learn how to deal with more advanced tasks, hence sketching. Belesky (2020, p. 241) says that to have a more creative process with digital tools, the tools need to be integrated so one can work seamlessly between them and they also need to be intuitive, flexible, and accessible. Vries et al. (1998) predicted that the design process needs tools that have a high degree of interaction.

He based this on the fact that a designer can exceed 20 traditional sketches an hour when working on a design. He means that CAAD tools “force the user to think on how to achieve something rather than what to achieve”. But that VR has potential as it gives the designer tools for having an interaction about spatiality in the design decision process. He says: “VR is the ‘natural environment for prototyping and creation of shapes. Immediate feedback, spatial representation of objects, and ease of creating and changing objects better support articulation of the designers’ intentions”.

Reflection

Accordingly it becomes apparent that there are many different ways of defining and using sketching. Some examples are summarisation, experimentation, and discussion. All are practical to use when creating and developing ideas in a design process in Landscape Architecture. If sketching can be described as something more

open it could be possible that it wouldn’t have to be only about drawing with pencil on paper, if seen more as a creative process one could also include other forms of doing this in, for example jamming for dancers and musicians, humming for singers, put down bullet points for writers, make mind maps for planning, improvisation for actors, prototyping products for designers and to do test runs of software and workshops. The experimentation in this thesis will be focused on visual sketching in VR but maybe this perspective allows for being a bit more open-minded when approaching the issue. Maybe in the future when we compare sketching with new technology we will understand and find new functions of sketching that we have not thought of yet in the existing context that we live in. The research highlights the valuable parts of sketching and what digital programs are missing. These things can indicate important factors that need to be fulfilled in VR to be able to use it as a tool for sketching.

“The creative user needs not a tool to think for him rather than an aid to think ahead.”

- Seichter, 2003, p. 10

2.1.2 Creativity

Creativity is the basis for creating new things and is a field that has been studied across different disciplines throughout the ages. This section contains a summary of how creativity has been observed in these different disciplines, and what has been written about creativity, from a broader perspective; people like Eagleman and Brandt and more design focused approaches like Lawson.

What is creativity?

According to Eagleman and Brandt (2017) at Stanford University, creativity and strive for innovation comes from the way our brain is structured. Thoughts have to pass different parts of the brain when processing things. For example, we can't only use the walking part of the brain when walking, we also think about how it looks around us, where we're going, and why we're going there (p. 307). This detour of thoughts in the brain creates Bending, Breaking, and Blending. So what are Bending, Breaking, and Blending? According to them these are the different ways to be creative and innovative. Eagleman and Brandt mean that we get inspired by things around us and then do the three B's. So what do they mean with Bending, Breaking, and Blending? Bending means changing it slightly but keeping the original thing, for example, Monet's over 30 different paintings of the Rouen Cathedral, same object but all the paintings look different (p. 73) (figure 3). When referring to Breaking they mean to break

something down into smaller pieces to make something new out of it. This is done very easily for us and can be seen when we create acronyms for so many things, from countries (UK) to expressions of happiness (LOL) (p. 123). Finally Blending is when we mix things and ideas. For example, when Eiji Nakatsu got inspired by the kingfishers' beak (the shape of the beak helps it fly faster). Nakatsu, observing this while bird watching, got inspired by the bird and applied the idea of the shape into his design practice, thereby inventing the bullet train (p. 137) (figure 2).



Figure 2: Kingfishers beak and bullet train (<https://www.pinterest.ru/pin/226024475031238958/>)



Figure 3: Monets paintings of Rue Cathedral (Public Domain)

But how far can one go with creative and innovative ideas? Can you go too far or stay too safe for the idea to work in society? To explain this Eagleman and Brandt (2017) compare the situation with going different distances away from the beehive. If the bee goes too far away from the beehive it might risk dying, but there might also be a chance to find a meadow full of flowers to feed the whole beehive and make it thrive. But if the bees always stay at a safe and close distance to the beehive then the nectar will not be enough for the beehive to expand and flourish. The same applies to people. In the book he mentions people who at their time invented things that were so groundbreaking that no one understood the value of the creative idea or invention, but years after they died it became very well known and used. Much like when Aristoteles tried to enact the theory of the earth being round but getting huge resistance from the society at the time. Going too far can make your peers think you're a bit crazy but it might pay off if you find something great. at least in the long run (p. 163). To avoid this it's important to be on the edge between familiarity and novelty.

Lawson (2006, p. 145) has focused his studies on creative thinking among designers and states that creativity is when you come up with new ideas. He means that design is the field of work that's seen as the most creative. Designers work with conversations to come up with ideas and designs. With conversations he means an exchange between the designer and the paper, the creative process. He means that digital tools today often don't allow for our mind to creatively express ourselves, but are complicated and distract our focus into how to draw a line instead of how that line affects the final design. When digital tools are used for representation only and don't help the design process he calls it computer-checked design

or computer-visualized design, rather than computer-aided design as it does not help us to develop the design but rather just represent it. What he misses among the digital tools is what he calls a two-way communication between the person and the tool. In the future, he thinks that new technology like AI will help us to have a more two-way conversation but at the moment it's difficult (p. 282). Lawson's (2004) thoughts about VR is that they are usually used for the final part of the design and thinks that the reason for this is because that's when most projects have money for it. Schnabel et al. (2001) confirms that it's more common to use Virtual environments for evaluation rather than in the process but manages to prove that VR is a very good tool to use when developing the early parts of the design. They found this by observing students who used virtual environments in a design studio. The students reported that they felt like they communicated directly with their model and that they weren't just a distant scale-less designer (p. 398). They experienced the two-way communication that Lawson talked about.

How creativity is studied

Törnqvist (2011, p. 4) focuses on the different points of departure that one can take while studying the creative process. He uses the four P's as an explanatory model. The P's stand for Product, Person, Process, and Place. Product is the study that analyzes the new products that arise in creative fields like architecture, art, science, literature, music, philosophy, and technology. Person is referring to the study of people doing creative things, often concerning personal traits like age and field of work. Process is the study, made mostly in the field of psychology, of the creative process. Place is studies which examine if the place or setting chosen for the work affects the result.

Successful denominators

The common denominators of successful creativity that Törnqvist (2011) has collected is: To have skills - sufficient knowledge of your field is important to be able to ask the right questions. Good communication - to be able to share information and have contact with people. The scale - small organizations nourish creativity. Being generous, equal, and competitive - a friendly working environment tends to nurture more creative ideas both at seminars and by the coffee machine. Good leadership - the leader should understand the work, have a broad view of the researcher's skills, give constructive criticism and create a healthy social environment while keeping a bit of competition. Sometimes the physical environment is shown to have an effect on creativity, especially if expensive equipment is needed to execute the work. Further, it's a personal question if people want a chaotic or a more orderly environment. The areas in between the workplace (entrance areas, and break areas) create conversations that lead to creativity. It's also important to have a balance and combination of playfulness and discipline. (p. 117)

Eagleman and Brandt (2000) mean that to enhance your creativity one can follow this advice. Trying many different concepts before deciding what to do will push you forward and create more options to choose from when making a final decision (p. 183). Trying again even though you fail because if you don't try nothing will happen (p. 200). Try new things outside your discipline to give you new perspectives and mix ideas (p. 216). Take risks because even though this idea has never been tried before it could be just the right time for it now (p. 225).

Lawson (2006) states that people who come up with world-changing ideas have often described

that they had a eureka moment. Lawson says that this usually comes from proper research and understanding of the subject, trying different ideas, and usually a lot of struggle, then when pausing and maybe working on something else spontaneous eureka moments occur (p. 149).

He further brings up the subject of creative personalities and says that intelligence seems to play some kind of part in being creatively talented, but being highly intelligent doesn't directly mean that you are highly creative. In the field of design, both convergent and divergent thinking is needed in equal measure. It is therefore important to be creative but at the same time think of the function. One can not just take a creative idea and pursue it because it's visually pleasing, the design also needs to function with the world (Weather, gravity, etc) and the people who interact with it (p. 153).

Reflection

From the literature study about creativity, it has been found that creativity is a function of the fact that our thoughts have to go through our large brain and pass other thoughts on the way to becoming an idea. To explain creativity one can use the three B's; Bending, Breaking, and Blending. They explain different ways that we come up with new ideas by slightly changing, taking apart, and mixing thoughts into something new. It also seems to be important to have a feeling of how far to go with the idea, if one goes too far you'll probably be seen as crazy and the ideas might not be useful in real life applications. But if you don't go far enough it won't be very innovative. If VR encourages these features it will probably be experienced as a more creative tool.

Studies made on creativity usually focus on Product, Person, Process, and Place. When examining successful creative processes it has been found that it's important to have skills, good communication, a small scaled workplace,

a friendly environment, good leadership and sometimes it's essential to have proper equipment. The order of the environment (chaos or clean) doesn't seem to affect creativity overall but is more of a personal preference. Having other people to discuss and have fun with during the very important breaks, also tends to facilitate more creative environments leading to eureka moments. This can be found in the kind of work environments that have these characteristics, for example, new and innovative tech companies and small underground art and design studios.

High intelligence is not a requirement for being creative, but it's a quite common trait. Maybe this is because when our brain has more quantity of knowledge to go through, more dots can be connected and Bended, Broken, and Blended. In Landscape Architecture, we use a lot of different kinds of knowledge, for example, what we learned from books, personal experience, and emotional reactions which can all be stored and made accessible in the brain, leading to high creative output.

*“Creativity is
intelligence having fun”*

- Albert Einstein

2.1.3 Intuition

To understand why Landscape architects sometimes make choices in design without seemingly any underlying basis it's important to understand intuition and how our experiences change the way we look at things. The following section will explain intuition from different professionals' points of view.

What is intuition?

Intuition can be described in different ways. The Cambridge dictionary (2021a) has two definitions of intuition, the English: “an ability to understand or know something immediately based on your feelings rather than facts” and the American: “an ability to understand or know something without needing to think about it or use reason to discover it, or a feeling that shows this ability”. Both appear to define it as an ability to understand, which could be connected to some kind of knowledge. They differ from each other in that the English version empathises the word immediately and compares feelings vs facts. The American one focuses more on not having to think and that it leads to discoveries (Cambridge dictionary, 2021a). Krupinska (2016) says that intuition is the basis for coming to conclusions about design without really knowing why, which Birgerstam (2000) defines as knowledge beyond the language and Johnsson thinks that “with the help of intuition we can make a choice without being able to present why it's good”. (Smedberg, 2020, 45). Krupinska (2016) states that intuition can not be learned and it's rather something which spontaneously stems from experience. In this thesis there are two areas where intuition is relevant. The first one is within technology, and investigates whether the software and hardware is intuitive to work with or not. The second one is in creativity and examines whether the design process comes intuitively.

Why use intuition?

Moore (2010) says that even though the design process is seen as something mystical

which cannot be taught, she disagrees with that perspective (p. 58). She thinks that this perception of the design process comes from the fact that we expect the physical space itself to magically give us the answer of what it should become. This means we could simply trust our senses, what we are feeling, and how we react to the space and from there approach the design with help of our intuition. She says that we should rather trust our senses and intuition in the design process than hard knowledge which is usually trusted in science (p. 20) because our senses and intuition is the pre-linguistic way of reacting to our surroundings and therefore something natural to use in design. She further finds it problematic that we divide things into subjects (senses, different types of knowledge, ways of collecting information, and learning) and thinks that it causes a limitation and confusion in the learning process that is connected to intuition. She means that we feel intuition with our senses and that the dividing of the different senses (smell, sight, taste, feel, hear) makes us not sense the entirety, and not value the full potential of our senses and thereby our intuition.

How intuition is used

Lawson (2006) is part of the third generation of design science. The third generation bases their supposition on that design is a special way of thinking, a way where some things are understood intuitively. When he studied intuitive thinking he found out that architecture students have a special way of solving problems. He found this by having architect students and science students solve the same problem

and compare how they proceeded with the assignment. He found that what the architects did differently from the science students was that instead of finding the underlying rules the architects went straight for several final solutions and tested them out, they thought about the problem and the solution simultaneously (p. 43). He calls this analysis through synthesis, which is based on intuition (p. 198). The actions occurring during analysis through synthesis are, according to Lawson (2006); formulating, representing, moving, bringing problems and solutions together, and evaluating and reflecting. Formulating is a way of looking at the design problem from different angles to understand and identify it. This helps to understand what's the most important part of the design and also where problematic areas might emerge. Representing is the way one chooses to represent thoughts and ideas, it can be with sketches, models, words, etc. Moving is when thoughts and ideas mix into new possibilities. This action brings clarity in what to go forward with and what to leave behind. Bringing problems and solutions together is a continuous negotiation process throughout the design process. Evaluating is the fact that one needs to make both subjective and objective choices, considering their pros and cons even though most things aren't measurable to know when to finish. Reflecting is to think about why one made choices and to be critical about them, to see what one's core values are and how they affect the design. These actions do not occur in a specific order but are integrated.

Reflection

According to the literature study about intuition, it seems like intuition is a kind of knowledge we can not learn by reading about it, we can learn that it exists but not earn it. To earn it in the field of Landscape Architecture we need to go out in the world to observe, feel, and use spaces and ultimately understand them. Designers use intuition in the creation part of the design process and do something that's called analysis through synthesis. This means to try out solutions at the same time as doing research and is a way of learning and thinking. If VR allows for a high level of intuition then it will be better adapted to the way of learning that designers are used to working with. If this is fulfilled it will probably lead to a higher usage of the software.

In Landscape Architecture, there are so many things to have skills in, everything from natural features like how fast a tree grows and where the sun casts shadows to social features like how people tend to use an outdoor environment and how to prevent crime. Therefore learning digital tools for many landscape architects seems secondary (Lombardo, 2018) but if it's very easy and intuitive to use then it will be far more accessible. In the future it's possible that the digital tools that we use are fully intuitive, thereby making the process as smooth and unconscious as walking and breathing. That then lets us fully use our primary knowledge, and our creativity and intuition doesn't get restricted by the tool, maybe it will even be enhanced by it.

2.1.4 Spatiality

To understand the possibilities of VR and how being in an immersive environment can be advantageous for the understanding of space, now follows a section about spatiality. What spatiality is and how it can be used in sketching.

What is spatiality?

According to the Cambridge dictionary (2021b) spatial is explained as “relating to the position, area, and size of things”. Robinson (2004) explains that the experience of spatiality is created from our senses and that the physical size and form of the landscape defines the qualities of a place. Our knowledge and memories alter the perception of how we experience the place. Hall (1990) says that the understanding of space also depends on how we as human beings interact with it. If you sit, stand, or walk past a place you might understand it differently. In addition to this Eckerberg (2004) means that people need to be able to move around spontaneously to be able to fully interpret spatiality in a virtual environment. When experiencing a place you’re not only experiencing its dimensions but also temporally as time is always present. What makes us aware of time passing by in the short run is people and animals in motion, and over a longer spectrum of time, it’s the physical changes in the landscape, for example, trees changing over the seasons and growing. (Hall, 1990 see Ekström, 2019, p. 29)

The architecture consultants Spatial Experience summarise the definition of spatial experience like this: *“A spatial experience is a multi-sensorial and simultaneous experience that involves built environments, people, context, and purposes and is capable of enhancing emotional connection within space. A spatial experience condenses a complex assessment of atmosphere, feeling and ambience, together with a set of specific personal evaluations, that are then translated into a judgment concerning*

the nature and character of the space being experienced. In fact, people are able to grasp the atmosphere in a built environment before consciously identifying the elements that create that atmosphere, which highlights the power of positive spatial experiences. When entering a new space, one can be emotionally and mentally impacted by the architecture, art work and all of its elements even before understanding the architect’s or artist’s intention” (Spatial experience, 2021). The description sheds light on the entire impact that spatiality has on us as human beings and our attitude towards our surroundings.

Working with spatiality in models

When exploring to find a design in a physical model the model must allow for quick changes in the spatiality, so as not to have to make new models for every change. (Mills, 2011, 40) Digital models have the advantage of being very modifiable. It’s also easy to jump in between scales in a digital model and inside a VR immersion. In VR it’s also possible to relate to the surroundings with your own body, which according to Nystrand (2019) lets the people who experience it understand the personal feeling of the design rather than the spatial measurements and dimensions.

Does VR meet these requirements of understanding spatiality? According to Radaczewska et al. (2019), they could see a correlation in the responses from the people between the real world and the VR world when it came to spaciousness and enclosure. They explored this by comparing subjective environmental appraisal of the real world with a

simplified version in VR. To be able to measure this they recruited volunteers on a public square and let them answer subjective questions. Then they had a VR simulation of the same square that they let other people visit in VR and answer the same questions. From the analysis of the answers it became apparent that people experienced the same amount of spaciousness and enclosure in VR and in the real world. They also found that the same place in VR and the real world was perceived as equal in terms of subjective evaluations, for example, pleasant-unpleasant and boring - interesting. where they diverged is that the respondents experienced VR as more public and ordered than the real world. Additionally, more quantitative research suggests that the physical distance we perceive is not correct. Ryu et al. (2007) researched how people experience VR and tried to evaluate if they experienced the length of the corridor the same in VR as in real life. They did this by letting people guess the length of the same corridor in VR and real life. They found that distance was perceived shorter in VR than in the real world with 20-40%. Renner et al. (2013) made a review on papers that investigate how egocentric distance (from yourself to an object) is perceived in VR. They found that distance is perceived shorter in VR than in the real world, but that adding a vertical element and a scale figure makes it easier to evaluate the distance.

Beckman¹ is an architect that works a lot with VR as a communication tool. In our interview, he told me that he thinks that one of the advantages of VR is that it gives a better understanding of space not only for the architects but also for the client. He says that VR can be seen by architects

as a threat to their pride in understanding space from reading a map. He also highlights that understanding spatiality can be very difficult even for architects.

Reflection

According to the findings in the literature study about spatiality, it was found that spatiality is not only about dimensions but is closely connected to the experience, interaction with space, and the relation to our own bodies. This is something that I've never thought about before, as my perception was that there are just dimensions and that those then create feelings, not that feelings can change the way we experience dimensions. This is closely connected to what Moore says about intuition and readings of a space, we shouldn't think that the space should magically give us the answer but rather that we should trust our own intuition. This might be a reason for why it's so hard to understand spatiality because it changes depending on our mood and what we do. It could be that spaces should be tailor made for different moods and situations to a greater degree. It's important to have a flexible structure in a physical model to be able to experiment with it. This might indicate that a digital model is superior to a physical one when using it for sketching because of the adjustable nature of most digital programs. It was also found that VR can be a great tool to understand basic spatiality, especially if additions like moving people and changing weather are added. But there is a contradiction to whether the feeling of the distance is correct or not, which will be further elaborated on in the discussion.

1 Pelle Beckman, Owner of Beckman Strandberg, Voice-call interview, 9th of December 2020.

2.2 Technology - Sketching in VR

Here follows the section about technology. The focus is not on the technical aspects but rather how technology can be used and what possibilities they bring to the field of design and Landscape Architecture. The main part focuses on previously written things about sketching in VR for different fields of design. Then follows some extra parts as a complement. The reason for not only looking at sketching in VR for landscape architects was that there is not enough written about this specific field, therefore information was searched for and interpreted from different fields that seemed relevant.

The earliest scientific articles written about using VR in the early explorative stage of the design process were written in the '90s. The early articles feature a lot of discussion on how the software and hardware are built as the authors were very invested in the field of technology. One of the articles is written by Donath and Regenbrecht (1996). They made VR equipment for architecture students in the sketching-process. They purposely made the equipment intuitive and easy to use which meant the students knew how to handle the equipment seconds after starting to work with it. The software allowed the students to free-draw in the immersive space by a digital pen that drew tiny cubes. They used a pen as a tool instead of a controller to emulate the process of traditional sketching. They explored different ways to develop the sketching experience, they gave the students different tools for making different shapes in the space, much like having different kinds of brushes. They also explored with what kind of things the tools created, the cubes were one but they also explored with rectangles that one could pull and push (Donath & Regenbrecht, 1996). They concluded that the students responded positively to working in the immersive environment, the experience of going around the virtual structure was the most spectacular for them. They also found that working with controllers that looked like a pen was preferable as students associated it with traditional sketching. The students stayed in the

simulation for up to 3 hours but on average one hour. Sometimes they laid down on the floor during the session. The results were so good that they decided to keep using VR in their design studios at the Bauhaus University Weimar.

Bertol (1997) wrote the book *Designing Digital Space - An Architect's Guide to Virtual Reality*. The book is full of complex explanations of the data behind the VR, but there is a reflecting part in the end. There she writes that VR is extra interesting because of the possibilities of defying the laws of nature, for example; gravity, walking through walls, and teleportation. Also, Larsén¹ described these possibilities as an interesting experiences in VR and something that he felt made the experience more creative, because of all the embedded potential.

Garner (2000) asked in his paper the bold question if sketching is still relevant in virtual design studios? His definition of sketching is to draw things by hand on paper. When analysing the characteristics of sketching he highlights some things that appear to be important functions of the sketch. The dual function; communication of information and creative exploration. The possibility of capturing emerging concepts and

¹ Niklas Larsén, Interior design architect at MER and Obeon, video-call interview, 2nd of December 2020.

holding them in a state open for development. That they help by contributing to the cognitive transformational process in the brain that is central to creativity and the emergence of ideas. (Fish, 1996 see Garner 2000). That sketching gives support to both the definition and the resolving of design problems. According to Garner, common among all kinds of sketches is that they are simplifications of reality i.e. hold some kind of abstraction and function. To compare a traditional sketching method with one in VR they had two groups working with the different methods and then comparing the results. They could see no apparent difference in the quality of the end result between the groups. The digital groups tended to make fewer sketches but they collaborated on and continuously tweaked those sketches more than the group sketching traditionally. Garner (2000) concludes the paper by expressing that design is about making, sharing, and changing. He highlights that there has been a shift in perception of what sketching is, it's not anymore a thing you can be highly skilled at but rather a part of the process that makes us think about a design problem and developing design solutions. This development of design solutions needs to be very free and easy to do and at the time when Garner wrote this, year 2000, sketching with pen and paper was very much easier than in VR. He also says that VR at the time had a built-in visual style which limited personal expression. To do all sketching in VR he thinks would be to work against the point of sketching. He instead highlights that the potential with sketching in VR is to keep the advantages and move away from the traditional studio practices of sketching, i.e. to not support the generation of sketches as an output but rather to support the processes of sketching but in virtual models.

Schnabel et al. (2001) have written a paper called The First Virtual Environment Design Studio. They studied how collaboration

functioned with VR when being in two different parts of the world, Germany, and China. They did this by using VR to look at the design and simultaneously chatted about it in text. The results found were that it was possible to work collaboratively with their tools and methods. It appeared that the virtual environment enabled the students to experience their design decisions differently from a non-immersive environment. The students reported that they felt like every stroke they made had a direct impact on the design and that this gave them a stronger sense of interacting with their model- *“being part of it and not only the distant scaleless designer”*. The authors report the communication and collaboration worked much better than anticipated and that the students had intense discussions about the design.

Fiorentino et al. (2002) made a study about the possibilities of using VR creatively with the software SpaceDesign while designing cars. The study is mostly about how to make the equipment but also assess how one can work with the program creatively and as a tool for communication. When experimenting with the program they loaded an external simplified model to use as reference. They tried to do something they called rapid prototyping, which was a way of sketching in VR but found it too time-consuming to be worth pursuing. They found that the combination of Virtual and Augmented Reality allowed for intuitive sketching and to have that early-stage of the design process digitised created a more coherent process with less repetition. This also allowed for professionals from different disciplines to share a common model whilst using personalised tools and being able to work together. According to Eagleman and Brandt (2017) this is a great way to spark creativity and come up with new solutions. Fiorentino et al. (2002) thought that these simulation applications in the future can be more effective

than conventional methods because they think they give a better understanding and possibility to investigate the model in question. They also say that VR gives valuable visual feedback regarding the perception of shapes. In their conclusion, they wrote that SpaceDesign was good because it was easy to learn for different groups of professionals and that all of them were able to collaborate on the same model which led to fewer instances of miscommunication.

Rahimian and Ibrahim (2011) experimented with the sketching abilities in VR. They did this by comparing pairs of students who created one design in traditional sketching and a month later used digital sketching. In their digital sketching session they used Photoshop first and then moved the design into the 3D program Claytools with a VR application. To measure the sketching ability and effectiveness they used a combination of an objective and a subjective method. The objective method was to record the pairs whilst they were working, and then when looking back at the video, counting the students cognitive actions. They used the same coding scheme as Suwa et al. (1998) and Kim and Maher (2008) which contained actions like: *“To create a new design element or a symbol (drawing circles, lines, textures, arrows, etc)”*, *“Looking at virtual or physical 3D model while rotating it”*, *“To move pen on the paper or board without drawing any thing”*, *“Creating a new space or object in between the existing objects”*, *“Associating a interactive function with a just created element or space or a spatial relation”*, *“Goals to apply already introduced functions in the new situation”*, *“Proposing an idea of the problem or a new opinion”*. In total there were 63 actions monitored. After collecting all the data they conducted a comparative study between all the different pairs and compared the work of each pair in both methods. The subjective methodology was to have the researchers observe the students’ behavior

and let the students evaluate the different techniques. Through the work, 13 hypotheses were stated and 9 confirmed. They were not able to prove that the 3D sketching interface was able to: Improve perceptual design activities, Improve designers’ situative inventions during the conceptual architectural design phases, Stimulate designers’ gesture actions during the conceptual architectural design process, and Strengthen the links between designers’ gesture actions and their spatial reasoning. What they did find and manage to prove statistically was: That when the student pairs worked digitally; There was a significant increase in the occurrence frequency of external cognitive activities compared to traditional sketching. That it can reduce the need for performing too many of the least important cognitive design activities. That the designers were spending the same amount of time doing apparently nothing. That the designers attend to their designed elements and spaces more than what they do in traditional sessions. That the designers discover tacit design facts more than they do in traditional sessions. That they had improved functionality and thoughtfulness of design activities. That the reflections between design interfaces and the designers’ mind are rather high in 3D sketching design sessions compared with those in traditional design sessions. That design team members shared design ideas more frequently than what they did in traditional design sessions. That design conversations are more argumentative and critical than those in traditional design sessions. The more subjective findings that they observed were that when the pairs used the traditional sketching methods they created more straight lines and were generally more conservative in their design. When they used digital media they created more curved and complicated structures. They think that the reason for this was that when sketching manually the pairs imagined that they had to make the model physically afterwards which

made them do things that weren't too difficult to do with glue and paper. Other things they found were that the students worked more efficiently when using digital tools, that the designs were also more detailed in the digital sessions and diverged more from the first sketches than the traditionally made ones. When observing how the communication and collaboration worked they found that in the digital sessions conversations were more about what they had created and in the traditional sessions the discussion was more about what they were going to make. An obstacle they found was that during the digital session, they were not able to work on the design simultaneously which they could in traditional sketching (i. e two people sketching on the same piece of paper at the same time). They conclude that the pairs had significantly improved spatial understanding, improved their collaboration, performed more actions, were more likely to find unexpected spatial features and relationships, identified more problems, and shared more ideas when working digitally.

Chamberlain (2015) had Landscape Architecture students work exploratively with VR in SimCity and ESRI's CityEngine. They let the students experiment with the two different softwares and then asked questions about their experience. They found that SimCity was very easy to work with, so easy that the students didn't need any coaching. The experience became a reference for the rest of the course. CityEngine was much more difficult for the students to learn, both because of its complicated nature but also because there was no entry-level support on how to use it. They questioned if the software helped their career and society. They conclude that both programs helped the students to evolve their critical spatial-thinking skills, engage with problems that have an unknown outcome, and take bigger risks in their designs.

George et al. (2017) conducted a study to examine the use of VR in the conceptual phase of a student project. The task was to take a parking space for one car and turn it into a micro public park. They had 29 students participating in the project and they were split into five groups of five to six people. Each student spent about 20 minutes in the simulation, using the VR-software Tilt Brush. The immersive environment could only accommodate one person at a time so to collaborate they projected the view of the person in the immersion on a screen for the other group members to see. This was something that made the students feel that it was difficult to collaborate on the design and described it as frustrating. But the observers noticed that this made the students develop their verbal communication skills more, which they thought was a positive outcome. The first thing they found through the study was that it was very easy for the students to learn the program and that using immersive 3D reduced the cognitive load, i.e. they did not have to imagine it in 3D when painting it in 2D. The students themselves reported they found the work to be intuitive and easily adoptable and nearly all the students reported that they were comfortable with the interface within a couple of minutes of using the software. The students also reported that they understood better how their design impacted the space in a three-dimensional way, which made them recognize design opportunities that would be hard to find in 2D. They felt greater freedom of expression and a more holistic perspective on the design. Some comments they made were: *"much more aware of the space between the elements and the space they took up."*, *"[design] by feel on the site"* and *"quickly create ideas to support what you are imagining in your head."* The students did not report feeling that their design decisions were constrained by the VR which the author expected because new technology many times does constrain students. Instead, they found that the design suggestions

were very versatile indicating that the tool used is very flexible and not constraining in the conceptual part of the design process. They would use VR to design again in the future if the equipment were available. The authors predict high possibilities for the future use of VR in the design process; they think that the possibility to do things quickly on a 1:1 immersive scale gives the students a way of designing in-situ (on-site), which could transform the design experience.

Sleipness and George (2017) also conducted one more study with the same method and the same number of participants but with the software SculptrVR. The difference between the programs is that SculptrVR works with cubes as the design element and TiltBrush works with brushstrokes. In this study, they found that students thought that VR significantly impacted their approach to design and especially their spatial considerations and freedom of expressing different options. Freely moving around and interacting with the immersive environment enabled students to discover parts of their design which could be improved on as well as to add details to parts of the design that worked well. This software also highlighted the same limitation of communication when only one person can work in VR at a time. Here they describe the limitation as so problematic that the group design almost turned into an individual design activity. The students also reported that the software was not as intuitive as they would have wished for and that the cubed graphic was limiting when wanting to make curved shapes. Another hurdle that they found was that it was difficult to initiate the design in VR, much like a blank canvas. The students expressed that they wanted to work more back and forth in between paper sketches and VR sketches. Comments that the students made about the possibilities of spatiality *“better understand how important scale is, even in*

simple design tasks.”, *“was easier to get a feel for dimensions and the relationships”*, and *“more aware of the space elements take and that every step of the design process affects actual space”*. The students also expressed things like *“It felt really different to be in the space. I didn’t have to think of how wide a space was. When I [was] working with the VR, I was on site. I was going by what I felt on site.”* and *“I absolutely love designing in 3-D! I felt so alive and connected to my design! I could literally experience whatever I imagined!”*. This made the authors cautious as the students were not actually on the site. Therefore they emphasised that there are missing elements when working in VR, such as smells, winds, weather, sounds, wildlife, and interacting people.

Song and Huang (2018) have written a discourse about the application of VR in Landscape Architecture in China. They spoke about VR generally as well as from their personal experience. They discussed the use of VR for representation, analysis, and design. They say that in design the advantage of using VR is that one gets a sense of being there, that one can interact naturally and intuitively, that the possibility to gain a perceptual and rational understanding of the virtual environment enhances creativity, that designers get a perspective that is more in line with the user experience, that it’s easy to edit and compare design options, and that it enhances communication. All of this helps prevent the technical and conceptual bottleneck which usually occurs when designers don’t have an intuitive software to work which faithfully represents their landscapes. Further, they say that if it’s possible to compare, analyse and modify design elements in a dynamic way at any time, then we can more efficiently meet the requirements of landscape design. The workflow of experience-compare-edit can be realized as a whole through VR by directly editing the

design. They believe that as VR technology advances then VR will further contribute to freeing designers' minds and empowering them to use the technology boldly.

Hill et al. (2019) conducted a study to analyse how VR could be used in the early parts of the design process. They did this by observing ten students who in four days created a design in VR, using the application Tilt Brush. After every session, they rated qualitative and quantitative statements about how they felt about the process. The authors then visualised the answers in a diagram showing how the students' experience evolved across the four days. The assignment for the students was to develop a city master plan and a town center. What they found was that the learning curve of working in VR was there but brief. Verbal communication between the person working in the virtual environment and the rest of the group was perceived as difficult, but the group felt better able to express their visual design ideas to each other. One comment is frequently quoted where the interviewed student replies: *"It was great for saying things graphically instead of with words, which is often hard for me"*. In general, the students also reported feeling like they got a better understanding of space and the three-dimensional aspect of their design while working in VR. They would use it again for similar purposes in the future. The authors found the feedback across the four days to contain various contradictions. For example Limited Team Collaboration and Improved Communication of Design Ideas got a high rating. But while the first decreased over the four days the second increased, leading the authors to conclude that the students learned to work in this way during the process of the experiment, which thereby changed how they experienced the process. A marginal amount of the participants voiced that they favored VR for developing a concept in comparison with more

traditional methods because *"it took less mental effort"*, *"it helps you remember what is on-site and you see things that trigger your memory of what you saw and experienced when you were at the site,"* and *"you can understand the energy of a design and how it feels."* Overall they think that given the fast evolution of technology they are confident in the possibilities of using VR in Landscape Architecture.

Further, Hill (2019) wrote his master thesis on the subject. The thesis contains the previous study and one that is more focused on a smaller site scale. The same questionnaire method was used in both studies. The findings made in the site-scale study were mostly similar to the ones on the master-planning scale. They found that the learning curve was exponential in that there was a brief learning curve in the beginning, and the software got progressively harder to use once more advanced elements such as details and precise ideas needed to be communicated. But once the participants got over that they were able to use the tool in a very efficient way to express the spatial and three-dimensional nature of their design ideas, as seen in figure 4-6. The students reported finding it difficult to collaborate verbally, highlighting the different ways of communication, leading the author to think that working in a virtual environment is helpful to people who find it difficult to express themselves verbally and who prefer to do it visually. Students also reported that the constructive criticism they got from fellow students was more helpful than usual because their fellow students understood the design better. The designers also felt that they better understood the spatial components of the design when working in VR, and were better able to interact with them. This was highlighted by comments like; *"seeing 3D is quicker to understand,"*, *"understanding spatial relationships of the site and architecture was made easier in VR,"*, *"I was able to make*

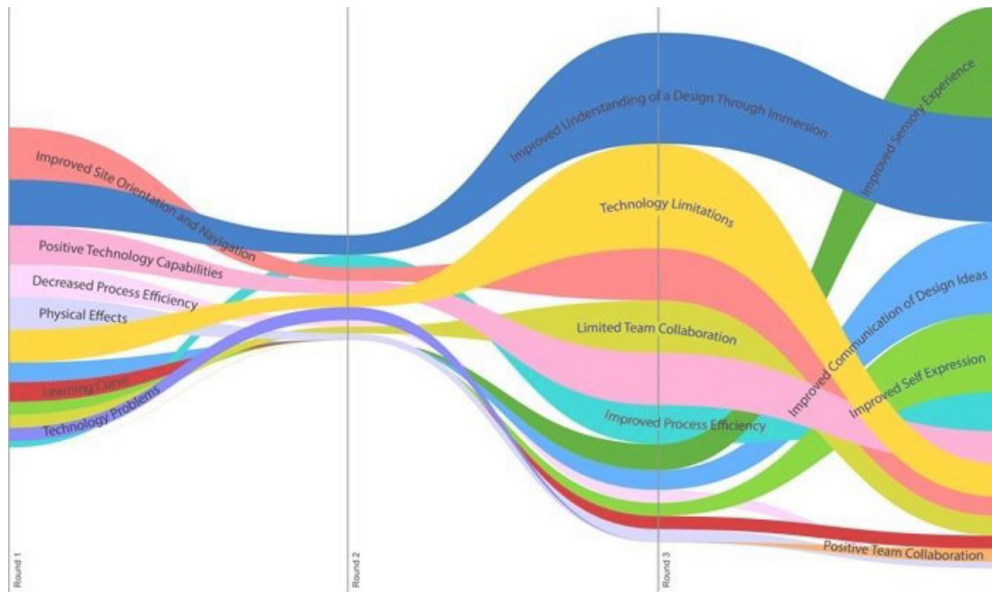


Figure 4: Hills' (2019) answers from the master plan study. He collected statements four times (vertical lines) during the participants design process. One colour is one type of statement where the most common statement is put highest up in the diagram.

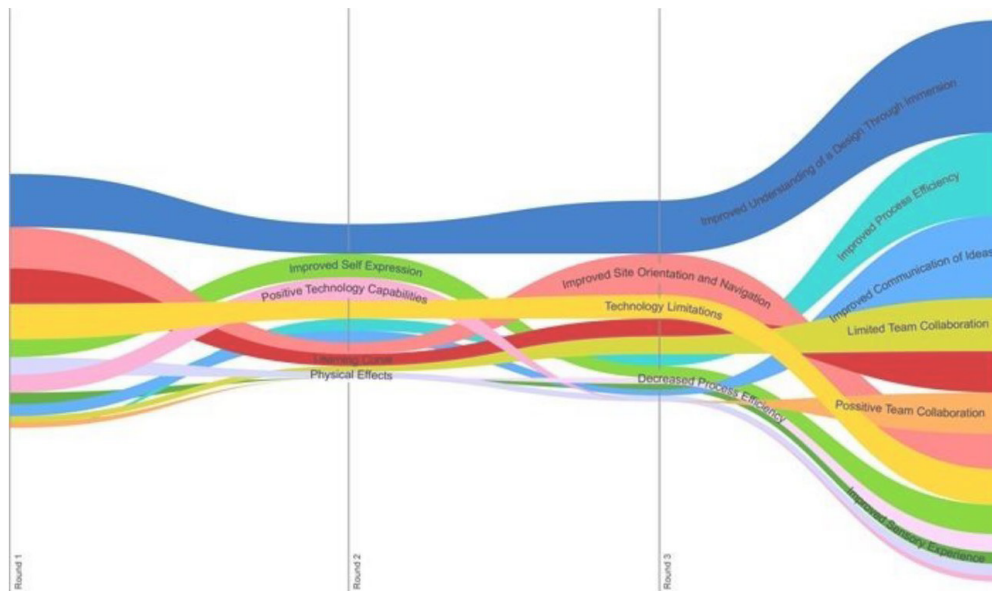


Figure 5: Hills' (2019) answers from the site-design study. He collected statements four times (vertical lines) during the participants design process. One colour is one type of statement where the most common statement is put highest up in the diagram.

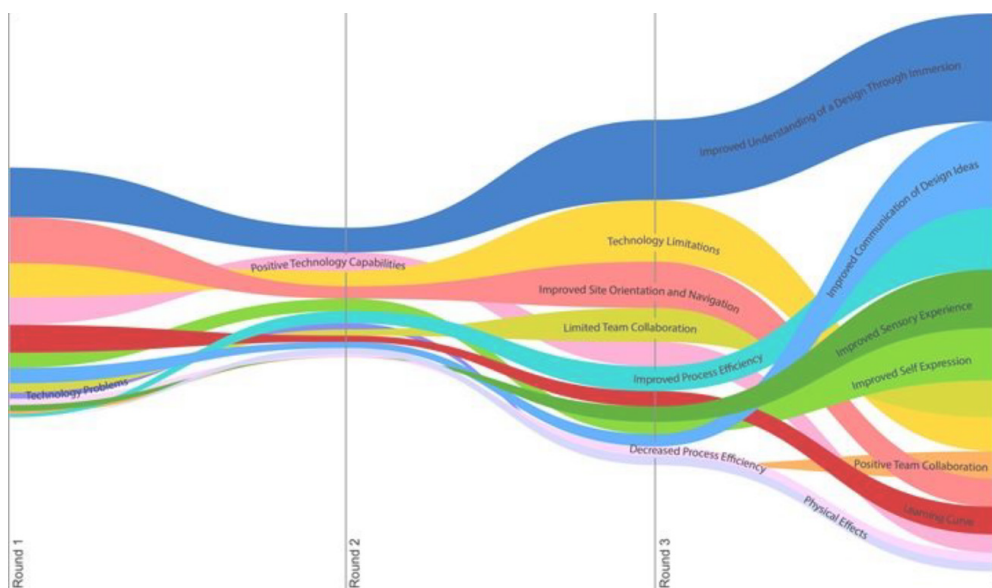


Figure 6: Hills' (2019) answers from both studies combined. He collected statements four times (vertical lines) during the participants design process. One colour is one type of statement where the most common statement is put highest up in the diagram.

better informed decisions.”, and *“understanding topography was easier in VR, and was helpful for laying out paths and trails.”*. The physical effects that students reported were dizziness and an uncomfortable headset. The former disappearing with more usage and the latter continuing throughout the project. There were contradictory answers to whether VR made the process more efficient or not. Most people thought it made the process more efficient but those who didn’t reported that painting elements in VR took longer. What the students missed in the software used were more precise measurements tools, tools common in other design software (like circle, square, push, pull, and so on), and difficulty in refining the designs. The author thinks that these comments come from the students’ very limited experience with the software and hardware. He concludes that the benefits of using VR in the design process outweigh the limitations.

In the comparison of both studies Hill (2019) sees that there were no reports of technical issues in the site-scale study. The reason for this, he thinks, is because the site-scale study was the second study executed and by then the students had learned how to work the tools. Despite this they also observed that the learning curve was steeper in the site-scale project than the master-scale one. The statement that the students rated the highest in both studies was *“improved understanding of a design through immersion”*. Another thing that was apparent in both studies was that the students rated *“Improved site orientation and navigation”* highly in the first questions and then lower as the project went on. The author thinks this was due to the designers becoming more familiar with the area and therefore not needing to orientate so much in the later rounds. They also reported that throughout the four days in both studies their process efficiency increased as they got more familiar with the tools and in the master

planning study, decreased process efficiency got a lower score with time. The thesis is concluded with: *“it [VR] can be used as an effective design tool to supplement traditional design methods in the analysis and concept development phases of the Landscape Architecture design process at a variety of scales.”*

To further understand the study and to learn more about sketching in VR an interview with Hill² was conducted. He expressed that if he could have done his study differently he would have analysed more than one design team and he would have collected more data about the participants experience. Today he works at OJB in California and works closely with the president of the company, where one of their common practices is that they brainstorm and sketch something that Hill then quickly creates in 3D to then send into VR. Hill says that the best thing with VR is the ability to be immersed, to freely walk around and follow your intuition. He says that working with a the third dimension and VR adds layers of depth to the design because of the deeper understanding of spatiality. He talked about being able to respond to the sensation that one gets from the design directly when working in VR.

Eren & Yılmaz (2020) did a study on Landscape Architecture students’ attitudes towards digital and conventional drawing techniques by observing them and giving them a questionnaire on how they felt during the work. They concluded that students who worked with digital tools in an early phase of the project saved time, corrected their mistakes more easily, improved their self-confidence, and were more involved than usual. They also found that working digitally limited the students creativity as the digital tools didn’t have as good

2 Drew Hill, Project Landscape Architect at OJB, Video-call interview, 5th of September 2021.

coordination between the hands and the brain (p. 25). It's worth noting that VR wasn't the only digital tool used in this study.

Larsén³ is an interior design architect who works at Obeon and MER where they work a lot with VR. He and his colleagues use VR as a tool in the explorative process. They use VR by bringing the sketches they have created in programs like CAD or by hand into VR continuously throughout the process. He says that this saves them time on preparing presentations throughout the process. Instead, they just show the model to the client in VR and the client can look around wherever they want. Larsén also finds that using VR can save time because of the possibility to find and solve problems early on in the process. Further, he says that VR democratises the process of design as everyone understands it better than 2D visualisations, leading to better informed design decisions. He thinks that VR is very creative as you can do exactly whatever you want and even defy the laws of gravity. He also mentions that when the 3D model is finished he gets the same satisfaction as when the place is built in real life because it's so similar. 3D models allow for looking at a project from any desired angle.

Communication in VR

Communication is mentioned as an important aspect in both creativity and sketching (Seichter & Schnabel, 2005; Lawson, 2006; Törnqvist, 2011; Lenngren, 2012) and is often brought up in texts about VR. The studies that highlight this are usually focused on public participation. Boonen et al. (2019) wrote a paper about why and how to make immersive environments to understand kids and teenagers' interests. They

saw the potential of VR; as something that could be used as a presentation and dialogue tool, as a participatory research tool, and as a (research by) design tool. The discussions seemed to easily cross in between the physical aspect of the area and the more social themes. Further, seeing the simulation on a screen is not the same as being in a virtual environment, it's a little bit like trying to discuss a design where one can only see the plan and another person can only see perspectives. But on the other hand, the rest of the group gets to see the simulation from any preferred angle which is a great opportunity. They also found that; VR becomes a very individualistic experience if not sharing what the person with the glasses sees on a screen, that if there is too much information in the model it gets confusing for the user, that the use of VR-headset generated enthusiasm among the young participants and made it easy for them to get participants to want to join the project, that it's more exploratory than solution-driven, and that it has potential for future research. For the future, they hope that immersive environments can create and support a more in-depth dialogue about the spatial quality that brings up not only the physical layers of design but also the many invisible ones, like social layers that also affect the environment. When Interviewing Beckman⁴ who is an architect that works a lot with VR as a consultation tool with his clients. He told me that one of the advantages of VR is that it's so communicative and he says that his clients feel safer with the design when they have seen it in VR. Leeuwen et al. (2018) examined how effective it is to work with public participation and VR. They worked with members of the public for three weeks and found that the instant visualisation that comes with 3D helped to bring ideas to life and to fuel creativity, not only for

3 Niklas Larsén, Interior design architect at MER and Obeon, video-call interview, 2nd of December 2020.

4 Pelle Beckman, Owner of Beckman Strandberg, Voice-call interview, 9th of December 2020.

amateurs but also among professionals. They also found that when they compared people who looked at the same design but some on a flat screen and some in VR, the people who used VR remembered more details but it was not more accurate. They conclude that this is because of the level of engagement that VR creates. Griffon et al. (2011, p. 291) point out the risk of using VR with people who have little experience with it is that they can get manipulated easily by using different levels of realism. Boonen et al. (2019) point out another risk with people who have little experience in the field. They say that if you are not able to handle the tools you get very left out, for example, if you have close to no prior experience of technology. But they think that the engagement and level of interest from the younger population towards participatory research outweighs the fact that some people get left out. This form of communication obviously differs from the kind one uses during the design process. What it shows is that using VR encourages people to be more verbally communicative with each other thereby developing their communication skills.

Nystrand (2019) have written his master thesis on how to make a VR model for visualisation in Landscape Architecture. When he let people experience the model he found that the immersive environment had a wow-effect on people and that they were very amazed by it.

Reflection

According to the contextual research made on the possibilities of exploration in VR, it seems like many things they mention as an advantage with VR correlate with the elements that associated with creativity, intuition, sketching, and spatiality. Using VR in the early stages of the design process makes the users keener to explore and to try bolder ideas. The experience of how communication and collaboration works seem to differ quite a lot but the result seems to

be on the more positive side. VR is experienced as easy to learn and intuitive to work with. A reason for this is said to be that the cognitive load is smaller as we don't have to imagine the three-dimensional form. VR can help you during the process even if you can't work inside it, as it enables you to check the design throughout the process and helps to understand spatiality and the effect of the final result.

To enhance creativity it's important to try many different things according to Eagleman and Brandt (2017) and Törnqvist (2011). Rahimian and Ibrahim (2011) have further observed that the design gets bolder and differs more from the first sketch which implies that VR is a tool that makes people think outside the box and explore creative options.

Hill (2019) found a contradiction between verbal and visual communication in his study. The participants reported that verbal communication was more difficult when someone was in VR but also that it was easier to express visual ideas. This might indicate that it's easier for people who find it difficult to express themselves through words to express themselves in VR. It can therefore add to the democracy of expression in a group project. Difficulties in communication sometimes also force people to work harder, leading to better results. This could explain why communication is experienced both as challenging as well as effective when working in VR.

According to Lawson (2006) it's important to not think about how to do something but rather think about what to do. If that's the case then VR should be a good tool to work with as it reduces the cognitive load of translating 2D sketches into 3D models in the head, allowing the designer to focus on the function (George et al., 2017).

3. Applied Sketching

To further understand the possibilities of working with VR as a sketching tool I executed an experiment of a design problem in VR and then analysed my own experience while doing it. Pictures with a play button in the bottom right corner are videos that can be looked at directly in the pdf if using a proper pdf reader

3.1 Method

As previously described in chapter 1.5.3 I chose to do both the exploration and the observation myself. This can be seen as a limitation in the study but it's also a different approach than previous studies (Hill, 2019; George et al., 2017) and will therefore lead to different discoveries. My result will be regarded as less scientific than the studies of Hill and George but it will add another kind of perspective and understanding of the process. By following this method I hope to learn things that I might not have learned if I was only asking people questions. In this method I have all the information and experience about the process in my head, I don't have to pull fragments of the experience out of someone else by asking questions but get a more holistic perspective.

I executed the experiment in my 26 sqm flat, and I had about 3x2,5 meters of working space (figure 7-8). It would have been preferable to have a larger working space to get a stronger sense of spatiality (Eckerberg, 2004, 220), but due to the Covid-19 pandemic, it did not feel ethical to leave the apartment more than necessary.

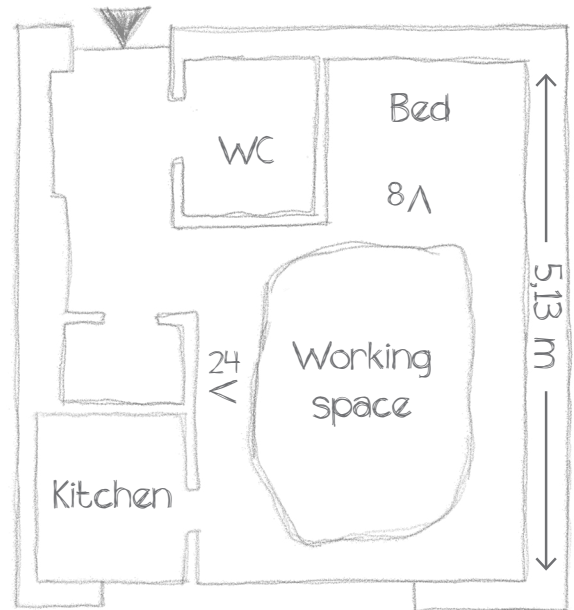


Figure 7: Plan of my flat where The Applied Sketching was executed, and views for figure 8 and 24



Figure 8: The working space and me in it

3.1.1 Tools

3.1.1.1 Software

I've chosen to state exactly what software and hardware I used during my experiments because when I read research papers on the use of VR it helped me to understand the limitations and the possibilities of their equipment when knowing what they used. Also, pictures of participants using the equipment and the final result helped me understand how they designed in VR.

I chose to work in SketchUp because it is a tool that I have prior knowledge of, which made the learning curve a bit less steep for me. The software also has scale and thereby the ability to measure things which were requested in Hill's (2019) study. Further, according to Mills (2011, 118), SketchUp is a good tool for sketching but has its limitations when it comes to adding details and other advanced features when used by designers inexperienced with the software. This I think will not be a significant barrier as I'll work more in a conceptual manner. I chose to work in VRsketch because it met my requirements of being able to alter the design from inside VR and not just to look at and walk around in it. It was also possible to easily zoom in and out and transport myself to a 1:1 scale, which proved to be highly useful. I've not worked in VRsketch before this thesis.

3.1.1.2 Hardware

I worked with the headset and controllers

called Oculus Quest 2. They are wireless and do not depend on having a strong gaming computer to work from. All I had to do was to send my file via the plug-in from my Microsoft Surface pro-2017. It is not as strong as VR connected to a gaming computer but as I don't have one it was the best alternative, I borrowed the equipment from Spelens Hus in Malmö and from a friend. Because of that, it is a little bit less powerful. It makes the design lag a bit sometimes and interrupts the work flow.



Figure 10: Oculus Quest 2 headset and controllers



Figure 11: How I wore the headset



Figure 9: VRSketch logo (<https://vrsketch.eu/>)

3.1.2 How I made the basic model

I made the 3D model using a 2D AutoCAD file that I got from the Landscape Architecture firm Tyréns, which contained an early version of the master plan. I added it to SketchUp and pulled the buildings to the heights that are referred to in the detailed development plan. I added the trees and lowered the street for cars by about 15 cm, the pedestrian streets and the square remained the original height. I added some colours and textures to give myself some feeling of depth Maruhn et al. (2019) and also some scale figures and a bench for scale (Radaczewska et al., 2019), Garner (2000) says that sketches can be very bad looking but keep a lot of valuable information, I therefore did not focus much on trying to make the design pretty but rather focus on the spatial elements

I then sent this model into VR and continued the work there.

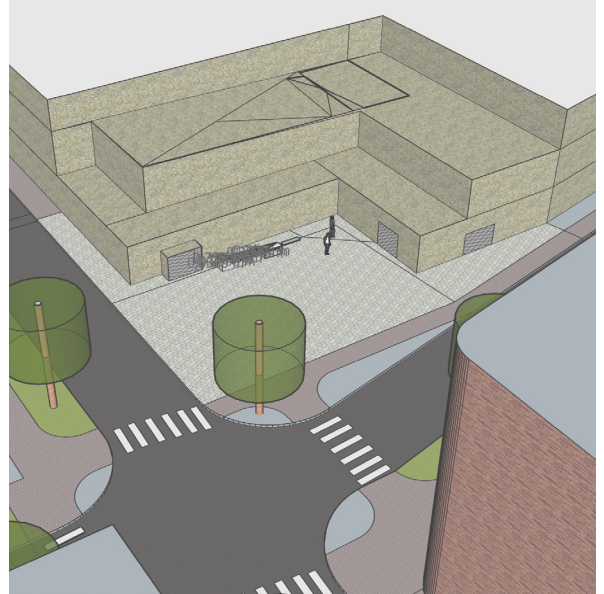


Figure 13: Birds view over the square



Figure 12: View over the square

3.1.3 Working process

I sketched in the VR simulation and documented my own experience. It turned out to be very difficult to find information about how to execute this scientifically so I had to develop my method which is a combination of methods from different fields. It is a sort of auto ethnographic or phenomenological approach but instead of observing oneself in the context of a culture, I'll observe myself in the context of the VR tool. I call this a "*structured introspection while executing a task*". I used Wingrens (2009) doctoral thesis *The Artistic Practice of a Landscape Architect: Knowledge Development through an Autobiographical Study* and the book *Autoethnography* (Adams et al., 2015) as inspiration for my method.

When doing the applied sketching in the simulation I decided to divide the time into three shifts. First I spent time in the VR-simulation and when getting tired and nauseous (Donath & Regenbrecht, 1996; Lombardo, 2018; Hill, 2019) I switched to working with traditional sketching, and lastly I wrote down notes of my experience. I call these shifts: The VR-Shift, The Traditional Sketching-Shift, and The Writing-Shift. I then repeated this process over and over again with different subjects in mind. The VR-shift also got longer with time as I got more used to working in VR and less nauseous.

3.1.3.1 The VR-Shift

In the VR shift, I focused on a certain aspect of the arrangement of space and explored how it felt to approach this certain aspect in VR. To choose the aspects to look at I used a checklist made by Stebbins (2016, p. 90) that contains criteria which are meant to be used for evaluating squares. I got inspired by this and picked out the relevant criteria for my project. I chose those that I thought were good to elaborate on inside VR and which were possible to work

with when the placement of the square was already set (see the checklist in the appendix). I used this checklist as a starting point in the first sessions of sketching to not get stuck on a blank canvas. Then I let go of that and sketched more freely in my last session, much like Lawson's description of the design process: Start with some work, take a break and then good ideas emerge. When approaching the sessions I also had in mind values that have been highlighted as core values for the municipality. I also kept in mind predictions of sun, shadows, wind, amount of people, peoples movement, spatiality, and environment. In total I made three design suggestions.

After every VR shift, I saved a copy of my work to later be able to compare the progress and the outcomes with one another. I also recorded the process with the inbuilt program in the Oculus Quest headset.

3.1.3.2 The Traditional Sketching-Shift

When sketching traditionally I looked at the same aspects as in my VR shift. This step is executed because it has been proven that switching in between sketching mediums increases brain activity (Bilda & Demirkan, 2003). This is also executed to have something in the process that I'm familiar with and feel comfortable doing. The sketching was done on a Microsoft Surface Pro 2017 with a stylus pen. I used the software OneNote and sketched on top of very basic maps made in AutoCAD. See the sketches in the appendix.

3.1.3.3 The Writing-Shift

I wrote down what I did and how the simulation felt and what tasks were manageable and which ones were more challenging. This is where I collected most of the material for the introspection and created material that is used in the result. See my unedited notes in the appendix.

To remember what I did in the simulation and to reflect on it I used following questions to get me started with the writing:

- What aspect did I look at?
- What were the pros and cons when looking at this aspect in VR?
- How did it feel like this time?
- Was there anything else to add?

In addition to this, I sat down and analysed what I've been through with the awareness of who I am and where I come from, and how it can affect the result of how I felt and what I managed to do, and my conclusions. I'll use these questions from Autoethnography (Adams et al., 2015) to understand myself:

- Who are you? Answering this question involves sharing details about your personal background, institutional affiliation/ sponsorship, and any other information regarding your cultural, ethnic, or personal identity that participants might find relevant to working with you.
- *What are you doing and why? Answering this question includes telling your personal story of what brought you to the field (i.e., the topic, site, and/or occasion), the methods that you will use in exploring this field, and what you hope to accomplish with the project.*

- *How did you choose your site/occasion/ participants? Answering this question includes disclosing how you came to this topic, site, occasion, and group of participants (e.g., by way of personal recommendation, advertised event, or causal encounter).*
- *How often and how long will you be/stay in the "field?" Answering this question includes detailing how much and how often you would like to participate in events, observe others, and conduct interviews.*
- *What will you do with the "results" of your project? Answering this question includes describing the form the stories, information, and experiences you gather will take, how this information will be shared, and the anticipated audience(s) for this information.*

Answering these questions includes detailing how you will remove, alter, or safeguard identities, details, and happenings in public (re) presentations of your work. (Autoethnography, 51)

This will give the reader a deeper understanding of why I thought and experienced the applied sketching in the way I did, and also helped me further reflect on why I did what I did. See the reflections of myself in 4.1.4 My personal background.

3.1.4 About my area - Västerstad in Hjarup

Västerstad became the project area that I worked on because it is a project that the office (Tyréns) that I did my intern-ship at could share with me. They provided me with the early parts of the CAD plan of the overall area and also pointed me in the direction of documents with analysis on the area. I got the opportunity to choose from different parts of Västerstad. I decided to work on a square quite close to the railway station. I made this choice because I knew that vegetation and irregular forms in the landscape would make the file large thereby slowing down the program and making it lag. I also wanted to work on a small scale to facilitate the potential of VR to experience space by comparing it to the physical body (Nystrand, 2019) which would probably not be as present on a master plan scale.

Västerstad is a new part of the village Hjarup that's part of Staffanstorp municipality. Hjarup has a train station that makes it possible to get to the university city Lund in 4 minutes and one of the largest cities in Sweden, Malmö in 8 minutes. Västerstad will expand the village on the west side of the train station. On the site today there are industrial factories and farmland that will become Västerstad. North of Västerstad, there is an area called Jakriborg built to replicate an old Hansan city. Västerstad is affected by the noise from the railroad and also by some major roads nearby. It's surrounded by crop fields. According to the development plan (Fogelberg, 2019), the municipality intends the area to be very commuter and family-friendly. When explaining the vision for the area the municipality highlight the fast bicycle track in between Malmö and Lund and that they want to have separate cycle and car roads throughout the area. When talking about kids they say that "the kids will get the leading part when designing the area" and that most needs that kids

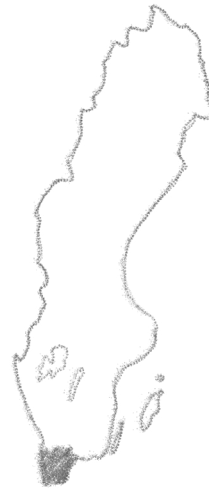


Figure 14: Sweden with Skåne marked in the south



Figure 15: Skåne with Staffanstorp marked

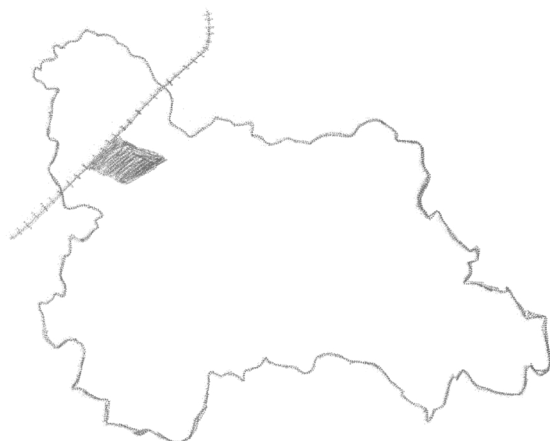


Figure 16: Staffanstorp with Hjarup marked in the Northwest and the railway.

have should be tended for in close proximity to home. For example; helpful neighbours, friends, kindergarten, school, playgrounds, food store and transportation of choice. They also mention that the area should be playfully designed (Fogelberg, 2019).

In addition to reading the development plan I also undertook a field visit where I cycled from Malmö to Hjärup and then biked around Hjärup and walked around the area that will become Västerstad. The area was fully under construction during the visit, see Figure 18 and 19. Therefore it was hard to get an impression of what it was like before. I therefore turned and walked around Jakriborg, figure 20. It's an interesting place that was built in the beginning of the 21st century but mimics the style of a city built in the 18th-19th century. I had never been there before so I looked at it with fresh eyes. My impression of it was that it's quite odd but I really liked the street pattern with the small pedestrian short cuts measuring as small as one meter wide in some places. The colours of the houses were also beautiful and the ground materials were nice to walk on as it was mostly cobblestones and gravel and could in my opinion be brought in as inspiration for the new area Västerstad.



Figure 17: Hjärup with Västerstad west of the railway and the trainstation



Figure 18: How Västerstad looked like at the site visit



Figure 19: How Västerstad looked like at the site visit



Figure 20: The large square in Jakriborg

3.15 My personal background

I was born in 1995 and I remember that when I was around 8 years old we got our first stationary computer. I used it to play children's games. My family would be considered middle class and both my parents have gone through university and both my siblings seem to be also heading towards getting a university degree. Growing up my father and brother were the driving forces to bring new technology into my life. When I was in my teenage years I had the impression that computer games and computers were something that most guys used and I was not particularly interested in the field, but the enthusiasm that my brother and father had nonetheless rubbed off on me and I had a lot of fun playing, for example, the Sims and Wii.

The city I grew up in is considered a middle-sized city in Sweden. It has around 60 000 inhabitants on approximately 30 km². When finishing school I moved out of there as soon as I could. First I lived in Norway with some friends for a year and after that, when I didn't get admitted to the Landscape Architecture studies, I went to London for another year. In London, I had many friends who worked with data (AI and other forms of programming) which helped me understand the possibilities of technology. During this time my mother also advanced from being a teacher into becoming a headmaster for students aged 12-15. As a headmaster, she worked a lot with the digitalisation of the school which later led to her winning a prize for her efforts. This made me realise that digital tools are not just for people who are deeply interested in coding and games, but can also benefit anyone who sees the possibilities and advantages of using them, and how they can help people learn.

When I later started studying at the Swedish

University of Agricultural Science I found it very weird and backward to have so many analogue tools and I longed to learn programs like GIS, AutoCAD, SketchUp, and Adobe. Even though I struggled a lot with all these programs when the courses for them came along I still appreciated them and saw many possibilities for advancing my work. When learning new software I'm not one of the people who always rush through exercises nor do I always do them very carefully, it differs from day to day. The possibilities I saw were, for example, to be able to draw plans in scale more efficiently with CAD instead of using a ruler, to make advanced analysis with GIS instead of overlapping papers and holding them to the window, and to be able to sketch things on top of pictures in Photoshop instead of making brand new sketches. I especially liked SketchUp because of its intuitive nature, and because it was the only 3D program we learned and I've always liked to work in more than two dimensions. 3D for me leads to a deeper understanding of an object and its effect on the surrounding.

When later getting a job in the field of park maintenance I understood how little the digital tools that exist get used in that field. This made me think about the possibilities that could be explored if digital tools were used more widely.

These experiences led me to write this thesis and I hope it can shed some light on who I am and where I come from in terms of my attitude towards technology and my experience with it. I hope that this thesis will be an inspiration for other people to see and use the possibilities with technology just like my friends and family inspired me.



Figure 21: What Västerstad looked like during the site visit



Figure 22: A small street in Jakriborg

3.2 Result

I ended up doing three different sketching sessions in VR. Following are my results from the sessions, my thoughts and how I experienced the sessions in terms of creativity, and how difficult the software was to handle. It might seem like parts of the result should be in the discussion but if it's things that I thought while sketching I included them here. If you are reading this on a paper or don't have a pdf-reader that is comprehensive with the videos you can also watch them here:

<https://johannawahlstrom.myportfolio.com/thesis-vr>

Figure 23: First session.

Features: Attempting to teleport myself into the model but failing and landing far away from it. Moves to the square by holding two buttons of the controllers. Finally get to the square and looks around. (Video: 50 sec)

3.2.1 No. 1 - Following checklist session

During the first session I followed the checklist from Stebbins (2016) rigorously. I started with the first criteria on the list, and then I reflected on my experience with the help of traditional sketches and text. This process was then repeated until the end of the checklist. Even though I followed the checklist I quickly realised that it was hard for me to focus on just one criteria from the checklist at a time. I imagine that that comes from the intuitive and spatial qualities in VR and my eagerness to explore more of the tools' possibilities. The following are elements that I found and experienced as worth including from my first sketching session in VR.

It was interesting to experiment with and directly experience how the height of buildings affects the spaciousness and the feeling of the square. To do this I had to be in a doll house scale and then zoom into a 1:1 scale to see the result. Here I realised that I could not change the height of the houses, and most other things from the 1:1 scale but mostly had to sketch on a more zoomed out scale. The 1:1 scale worked more as a reviewing step of what I'd just done. On the other hand I felt that the possibility of quickly reverting in between different scales felt very creative. When I could zoom in and out and change things and then go back to a 1:1 scale and see the result of my actions in less than a second I could quickly review my design choices and make new ones if I was not happy with the result. To me it made the design process feel more dynamic. To change the street

level was interesting and it showed quickly what a big difference a few centimetres make. I also experimented by making the ground into a slope, inspired by Piazza del Campo, which made a huge difference in the dynamics, and made the square feel much smoother. In terms of spaciousness, I felt like the square looked very much smaller on the map than what I experienced when I was on it in the virtual environment.

At first, I imported a bench and two scale figures from SketchUp Warehouse to work with. The scale figures were good to have there because it gave me another sense of scale and size and gave me a perspective of how people would use or fill the space. This in combination with moving myself into different places was a good way of understanding spatiality. The bench was just annoying and restrictive. I found that it worked better for me to make abstract shapes, a simple white cuboid that I easily could change the dimensions of proved to be highly functional as benches, statues, bins, and more. I could work more in a way where I think about how volume affects the space. For example the volumes created barriers that led people in the direction which I wanted to lead them in and created different amounts of shadow in the space. Then I could decide afterward what function that cuboid has, like a bench or a bin - much like building with LEGO but more flexible. Working with these cuboids also made me think more abstractly which was hard when I had the finished bench.

The physical aspects of working were heavily noticed in the beginning. I had issues with the headset not sitting tightly on my head and therefore causing the screen to be dizzy when moving around which made me very nauseous and gave me a headache. I solved this by putting my hair in a mid-height ponytail and using it to hold the headset in place, kind of like a hook, see figure 12. I also quite quickly got tired of standing up all the time. This led to me doing most of the design sitting down (figure 24). This made it feel a lot like playing with a doll house.



Figure 24: Sitting down and working

Almost all the standard tools that exist in SketchUp were also available in VRSketch. One tool that I have not used much in SketchUp but used a lot in VRSketch is the freehand drawing tool. I used it to paint things that I found hard to make with boxes, mostly details. I also tried using it for writing notes but it proved to be too annoying. The reason why it was annoying was that every time a line with this tool was finished the screen kind of readjusted, which felt like testing different strengths in glasses at the optician. This made me dizzy and I got into the habit of closing my eyes every time I finished a line with this tool to avoid the uncomfortability. Another issue with the tool is that the line gets thicker when zooming out and thinner when

zooming in. If I created a surface by making lines and then zoomed in on it the surface was not filled anymore, rather looking like a net of lines. Another tool that I used a lot was the push and pull tool. This tool allowed me to change the dimensions of buildings and blocks, enabling me to quickly review decisions about the spatiality of the design. On day three I felt very confident with the tools in the program and found them almost by reflex, I didn't even have to look for them. Adding walls was much easier to do in SketchUp and was something I avoided doing in VR, this somehow was a restriction because I didn't directly do everything that I imagined while sketching in the virtual environment.

Working with the checklist had its issues and it's advantages, I will now bring up findings I did while working with the checklist. I noticed that often when I started working on the next item on the checklist I got ideas of what I could have done with the previous one. I decided to follow these impulses and ideas and for a short time break away from the checklist. After three days of learning the program and testing around with help from the checklist, I feel like I've come to some kind of endpoint for this design. In my opinion the design now looked very chaotic and boring. I think this is because of the quite strict checklist that I chose which didn't really leave space for thinking outside the box. What the checklist really helped me with though was to get a point of departure, to remind me of important elements to take into consideration, and to give me a sense of security that I would at least produce something.

I questioned myself on how I could understand if VRSketch is a good tool for experimentation and decided to start from the beginning again and this time not strictly follow the checklist point by point but still keep it in mind.

Figure 25: First Sketching Session.

Features: Swapped the SketchUp Warehouse bench with cubes and sketched lines of direction. Experiments with having balconies on the roof and outdoor seating for cafés and restaurants. Took away benches and put in plantbeds around the edges, introduced an abstract statue that doubles as unofficial seating. Made vegetative arches to mark the entrances of the square. Looking at the model from different angles and editing the style of some benches. (Video: 9 min 35 sec)

3.2.2 No. 2 - Checklist liberated session

When restarting I once again designed by following the checklist but instead of following the order of the checklist I added the aspects I remembered in a random order. Afterwards I checked if I remembered everything by reading through the checklist. I also tried to have a theme in mind and decided to focus on kids as they are mentioned as a main focus group in the detailed development plan for the area. I tried to add things that kids can jump, slide, swing, and climb on without disrupting the flow of the square. This time I felt like I was being more creative and trying to think more about what kids would like to do. I don't know if this is because I'm learning the software better or if it's because the theme was more open for interpretation. Maybe it's a combination. Having the guidelines was nice as a starting point but maybe they were a bit obvious, after 5 years of studies I feel like I know what needs to be in a square.

It was much harder for me to remember to take reflective field notes and observe my process during the second and third sessions. I think this was because I was more engaged and occupied

by the work and forgot to sit down and reflect. As a result I had to reflect after the sessions instead of during. During the process I had a lot of issues with lagging. This was because of different reasons and can be seen in the videos as a circle of rainbow colours circling around the controller. I felt like there was more lagging when I recorded my process and therefore I choose to record less of the process than I first planned to do. I first had planned to record all of it.

I felt there was nothing wrong with the spatiality in the model. If I tried to reach something I was always able to grab it. I also once accidentally teleported myself up on the roof of a building which gave me a height scare. This could probably indicate that the sense of spatiality closely mirrors the real life experience of spatiality.

In the end I still wasn't happy with the result and still thought my design was chaotic and boring looking. Therefore I proceeded to make a new design again.

Figure 26: Sketching session 2.
Features: Experimenting with one scale figure but having issues with lagging. Was sitting down at the moment so I teleported myself around to different places where one could sit to feel the different experiences.
(Video: 2 min 21 sec)

Figure 27: Experimenting with shapes outside the model.
Features: To further understand why the model lagged so much and to understand the tools better I went outside the model and experimented with surfaces and the “mitten tool”. Realizing that the round shape processed much slower than the square ones.
(Video: 5 min 39 sec)

3.2.3 No. 3 - Freestyle sketching session

As I felt so good about restarting the design process the second time I did it again in a third session. This time I left the checklist behind me and focused entirely on making a square that a child would like in combination with something that would be good for the environment as that is also mentioned as an important aspect in the detailed development plan.

What I came up with was a sunken square that doubles as a rainwater collector. My thought was that this would enable a water element that kids would like to play with. At first I used the new space dynamics and created stairs, but that felt as it was something that had already been done and my focus also drifted to focus on other things (see figure 29). Instead, I experimented with irregular shapes and imagined them as slopes instead of stairs as I thought that they could be fun to run in and safer to fall on as there would be fewer edges.

To learn the tools a bit better and not get too distracted by the lagging I experimented a bit outside the model with a small surface (Figure 27). This was a lot of fun and helped me better understand the limitations of the program, for

example that circles made the program lag a lot. All the waiting felt frustrating rather than creative. I also felt like I couldn't do anything else while waiting. I think this was because taking the glasses on and off feels like quite a big thing, there is some kind of adjustment that is being done, not just with the eyes physically but also mentally. It is like going from one world to another, like time travel or teleportation is usually described in science fiction. The readjusting is especially impact-full when one happens to be in the simulation while the sun goes down. It's like jumping in between three worlds, the daytime one, the digital one, and the night one.

Afterwards it was realised that it could have been interesting to create a big blue surface under the model that I could have lifted up and down to see what spatial impact different amounts of rain would have on the square. Another insight made after the session was that the last design that I made, was when I felt the most creative. I also think that it's highly visible that I worked in a virtual environment as a large focus in the design is on volume.

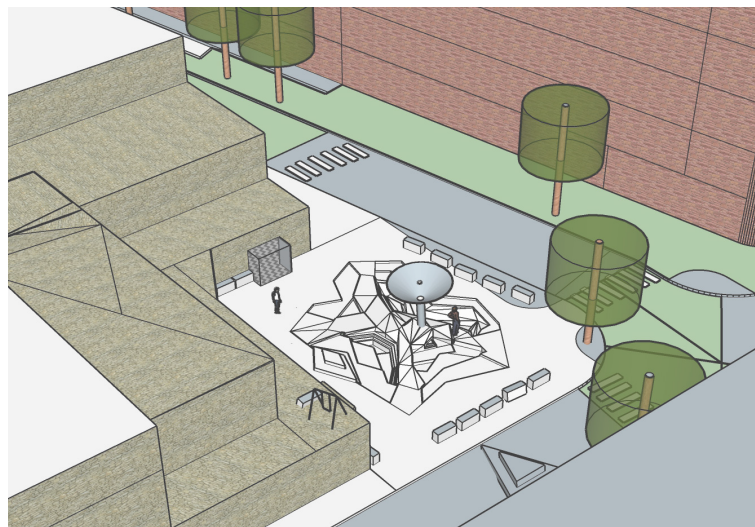


Figure 28: Last sketching session

Figure 29: Sketching session 3.

Features: Made a sunken fountain with stairs to the bottom. testing how far the scale figure would fall and trying to pick up both scale figures at the same time. Realising that the road is gone and trying to fill it in by making lines. Experimenting with the ground and what feeling different heights and angles created. Exploring what it would be like if the fountain was a tree instead. Wasn't able to teleport myself to a 1:1 scale in the end while recording because of the lagging.

(Video: 9 min)

Figure 30: Last sketching session.

Features: A sunken element of the square but with a more crooked shape. To enable people to walk through the square there are elevated bridges that cross the sunken terrain. Tried to create a dynamic form, did this by experimenting with volume. Placed one scale figure on top of the bridge to get a sense of space. As I imagined the sunken feature to be a water collector during heavy rains I tried to illustrate this by painting blue lines at the edges. I created a water collector outside the model because I imagined it could create a fun element for kids if water would ripple down like tiny waterfalls. I had also tried to explore what it would have felt like with a willow tree in the middle.

(Video: 16 min 58 sec)

3.2.4 Reflection

I felt that working in the model made me more confident. I have noticed that I'm often doubtful about whether my designs will work at all in real life because it is hard for me to visualise what they will look like. The immersive environment took me many steps closer to reality and the confidence that that brought enabled me to make braver decisions and try a wider range of different options than I normally do. What would have made me even more confident would have been if I knew the program better which I wish I did. If I had more time and knowledge of the tools I would have tried to experiment with lights.

I noticed myself doing all the three B's in the simulation. I bent things and ideas, I broke down things and bonded two or more ideas. The ability to play with no gravity also makes it fun to go far out of the comfort zone and try crazy ideas. The playful element when having the model as the size of a doll house also encouraged me to play around with different elements.

At my intern-ship I worked further in VR, I used it to show a 3D model in progress to my colleagues and we talked about how we could change the design. I shared the screen from my headset to Microsoft Teams. It was very appreciated and we changed some elements of the design which were harder to see just on the

map. They expressed that it was very cool and I felt like we could have a good conversation about the design. The wow-factor that Nystrand (2019) talks about in his thesis was in other words here too even though I'd made a much simpler model than him. Even though they thought it was cool to see the model from the screen they didn't get the whole immersive experience. It would be interesting to see how it would be to work with more than one person at a time inside the same model in VR.

On the third try, I started more freely and allowed myself to be bolder. This felt the most creative. But I'm not sure I would have been able to feel safe in doing this if I wouldn't have done the first and second try. Maybe the first ones were part of the negotiation that Lawson (2006) talks about, which was necessary to go through to be creative in the final design.

I think that my excitement over the program made me like it more and maybe that made it easier for me to learn and work with it.

The street disappeared sometime in-between session 2 and 3. When being in the simulation I didn't think it was a big problem but when looking at the pictures of it now it looks unfinished. It's interesting how when being in VR I didn't perceive it as a problem.

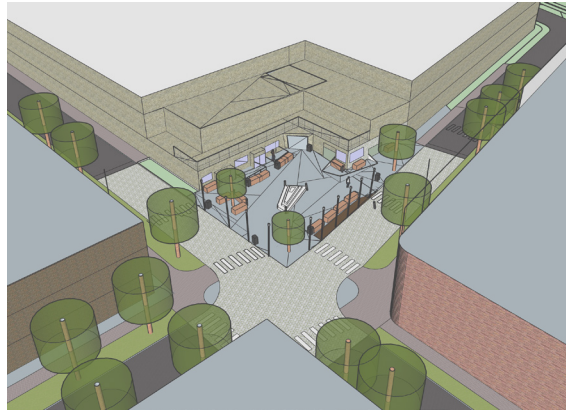


Figure 31: Sketching session 1 - Drone view



Figure 32: Sketching session 1 - Street view

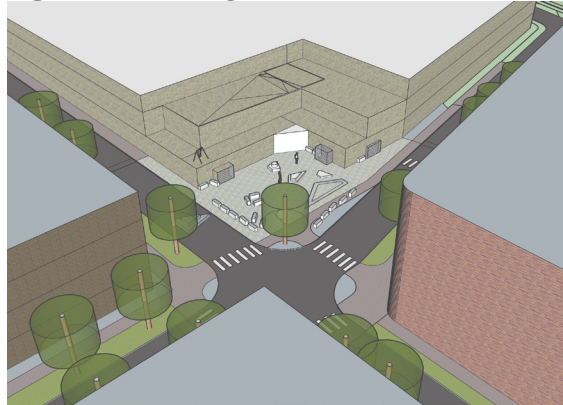


Figure 33: Sketching session 2 - Drone view



Figure 34: Sketching session 2 - Street view

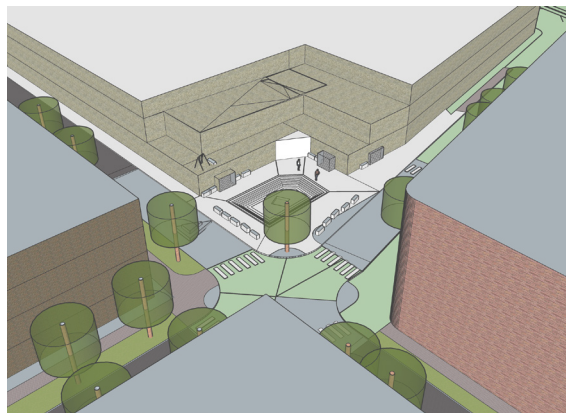


Figure 35: Sketching session 3a - Drone view



Figure 36: Sketching session 3a - Street view



Figure 37: Sketching session 3b - Drone view



Figure 38: Sketching session 3b - Street view

4. Discussion

The focus of this thesis was to analyse VR as a sketching tool for landscape architects. The discussion is centred around the five research questions and elaborates on them in five separate sections.

Before going into the research questions a few words about the methodology of the applied sketching will be brought up. The method used for the applied sketching is not one that gives an answer to how most designers in general would experience sketching in VR. It rather provides an analysis of what I found, felt and experienced. This can then be used to indicate and shed light on issues or interesting paths to take in further studies that are often missed in studies where participants are asked specific narrow questions. To give

the reader a chance to further understand my experience a chapter about my personal background was incorporated, which doesn't reflect all of my personality but gives some kind of insight. Another issue with my method was that the more I got involved in the creative process, which was what I wanted to analyse, the less I was able to methodically observe my own actions and remember to take notes. Which probably indicates that observing oneself is not the best method to use when analysing creativity.

4.1 Research questions

The first part contains discussion around the 5 research questions and will compare the findings from the applied sketching with the contextual research.

4.1.1 What are the advantages and limitations of sketching in VR?

From the findings in the applied sketching, one advantage of sketching in VR is the understanding of spatiality. The feeling of being there and experiencing how different volumes physically alter the space was very valuable both in the experiments and also in the learning and understanding as a new landscape architect. This finding is consistent with that of Donath and Regenbrecht (1996). Rahimian and Ibrahim (2011), Chamberlain (2015), George et al. (2017) Sleipness and George (2017) Song and Huang (2018), Hill et al. (2019), Hill (2019) and Hill¹. But George and Sleipness (2017) also highlighted the risk of seeing VR as a copy of reality, as you are not at the location but in a simulation. They mention missing out on smells, winds, weather, sounds, wildlife, and interacting people. Radaczewska et al. (2019) had scale figures in their experiment but were unable to prove if it gave the same effect as real people. Moving scale figures that act irregularly can probably be more widely available in the future. When immersive environments are advanced enough to be an exact copy of reality, do we then have to be cautious about not actually operating in the real world? Will there still be a difference? A guess is that a virtual environment will always be somehow controlled. Even though we to some extent control nature today (with hedges for example) we still can't control that things grow spontaneously without our involvement. It is possible for things to happen spontaneously in programmed worlds but behind that there is still a design creating spontaneity through code, thereby not fully spontaneous but rather intended. Is this spontaneity relevant for designing in VR? Might that be a question around VR that will be studied in the future? Another difference

between the real world and the virtual one is consequences. In a virtual world it doesn't matter if there is an earthquake or if flooding occurs, we can always restart the program. In the real world natural disasters can lead to consequences that leave long lasting scars on the landscape. In this way VR can always full fill our wishes. This freedom of possibilities enabled by the software has been described by Larsén (2020) and Bertol (1997) as one of the advantages with VR that leads to creativity.

The accuracy and viability in the dimension and scale (the software provides dimensional details throughout the design process) were something that both enhanced and limited the sketching abilities. When doing everything in the correct scale one loses the conceptual abstraction that often is used in the early phase of the design process. The loss of abstraction is not mentioned in any of the texts I have read but many have mentioned that when working in VR you can save time as you don't make spatial mistakes (Rahimian & Ibrahim, 2011; Hill (2019); Larsén², Eren & Yılmaz, 2020). Maybe these mistakes are sometimes due to not following the correct scale when creating abstract sketches of ideas, but what do we gain from working with abstract scales? It's for future studies to deal with. Maybe a reason why this aspect of abstraction has not been brought up in other articles is because they have used TiltBrush or software very similar to TiltBrush which is more abstract than VRSketch. Interestingly though the participants in Hills' (2019) study highlighted that it would be helpful if they had measurement tools available inside

1 Drew Hill, Project Landscape Architect at OJB, Video-call interview, 5th of September 2021.

2 Niklas Larsén, Interior design architect at MER and Obeon, video-call interview, 2nd of December 2020.

the model, which was available in VRSketch. VRSketch or similar software is probably useful when you know what you want to do but not how you want to do it.

Lawson (2006) talks about the importance of thinking about why we do something and not how to do it when sketching and working creatively. He means that sketching with pencil and paper allows this fully as it is something we've always known how to do and therefore doesn't require additional thinking or processing. What I felt during the applied sketching and also found by Hill et al. (2019) and George et al. (2017) is that VR and 3D models makes one think less of how to do something as you don't have to transform your design in the head from 2D to 3D. A connection to this might be what Hill³ says, that VR leads to a deeper understanding of the spatial elements.

One barrier to using VR is the well documented nausea that many people experience. The phenomena was confirmed in this study as well as others (Donath & Regenbrecht, 1996; Lombardo, 2018; Hill, 2019). What was very surprising was how quickly I got used to the VR and that I quickly built up tolerance to the nausea. Initially the expectation was that it would be possible to stay in the simulation for only about ten minutes but in the end I spent around an hour in it.

Aspects that have been found to limit the sketching process are if you don't have enough knowledge of the used software leading to absolute freedom (Bergene, 2009, 68) (Bilda & Demirkan, 2003, 49) (Lawson, 2006) (Špaček et al., 2016), and if the result is not fuzzy like

a traditional sketch (Lange, 2011). As VR has been reported to be very intuitive (George et al., 2017; Hill, 2019; Donath & Regenbrecht 1996 etc.) it could indicate that it's a tool that leads to freedom in the design. VRSketch did not feel very fuzzy but TiltBrush that George et al. (2017), Sleipness and George (2017) and Hill (2019) used in their studies have a much more fuzzy style.

Schnabel et al. (2001), Fiorentino et al. (2002), George et al. (2017), Hill et al. (2019), Hill (2019), Boonen et al. (2019), and Beckman⁴ says that VR is a good tool to enhance verbal communication. Rahimian and Ibrahim (2011) also point out that when using VR the students communicated more about what they had created and not what they were going to create. During the applied sketching I did not communicate with anyone else as it was performed as an individual task. When I later took a break from writing the thesis to do my intern-ship I used VR to show 3D-models to my colleagues. This really sparked communication and a discussion about the design that handled many aspects just like above writers have said. Showing the VR also created the wow-factor that Nystrand (2019) talks about which is interesting as his virtual environment was a finished and rendered project with a lot of details. This could suggest that it's not how the model looks but rather the actual immersion that creates the wow-factor.

If VR transforms the design experience (George et al., 2017) there might be a shift in the future of the way we approach designing, when working in VR. Or it might lead to new insights into how designing works.

3 Drew Hill, Project Landscape Architect at OJB, Video-call interview, 5th of September 2021.

4 Pelle Beckman, Owner of Beckman Strandberg, Voice-call interview, 9th of December 2020.

4.1.2 Is prior knowledge in VR required to work intuitively and creatively within the medium?

From reading and thinking about intuition in the context of this thesis I have realised that there are two different expressions of intuition that are central to consider. One involves the digital tools and determines whether they are intuitive to work with or not. The other one determines if designing and creativity comes intuitively or not. These two types of intuition are probably quite intertwined and I think that if the digital tools are not intuitive it's difficult to be creatively intuitive. The tools inside VRSketch and the headset and controllers of Oculus Quest 2 were very easy for me to understand and thereby very intuitive. This helped me as an inexperienced user to quickly get into working which facilitated intuitive designing. Donath and Regenbrecht (1996), George et al. (2017), Fiorentino et al. (2002), Hill et al. (2019), Hill (2019), and Hill¹ have confirmed this by reporting that the students in their studies learned to work in the medium almost instantly when they put the headset on. From the applied sketching it was found that if one has an interest in VR but not much prior experience it's easy to work with as it's so intuitive.

How VR functions as a creative tool is more difficult to say. One finding from the applied

sketching was that how creative the software felt varied depending on where in the process you are. If being at a stage of the design process where a high level of abstraction is demanded then VRSketch is not the best tool as a lot of focus in the application is on scale and dimensions. When working at later stages when spatial elements need to be set then it's a great tool. This was evident in the applied sketching as when I got past the conceptual idea stage and into the stage of how the physical arrangement were to be composed, that's when VR was really helpful and reassuring. When looking at other studies which have analysed working creatively in VR it's hard to determine whether they had an idea of a concept before starting to design or not (Donath and Regenbrecht, 1996; George et al., 2017; George and Sleipness, 2017; Hill, 2019) It was also when I started to go outside the box in session 3 that I could notice myself doing the three B's (Eggleman & Brandt, 2017), indicating that I had a more creative process.

The fact that I knew that some things were easier to do in SketchUp than in VRSketch resulted in me not performing those actions and therefore I felt that I didn't fully follow my intuition. This is not something mentioned in the other studies.

1 Drew Hill, Project Landscape Architect at OJB, Video-call interview, 5th of September 2021.

4.1.3 How does VR change the relationship between spatiality and the landscape architect during the sketching process?

For me it has always been difficult to fully understand spatiality but VR really brought this aspect to life and showed what consequences my design interventions had on the overall feel of the place. This further led to a sense of security with the spatial elements. That VR gives a sense of security to junior landscape architects was also mentioned by Eren and Yilmaz (2020)

The scale figures that I imported into the model were very helpful in understanding how the space and dimensions related the general public and not just myself. As seen in Figure 26 and 28, I was even exploring with the scale figures imagining how they would walk somewhere to get a better sense of the space. The sources that describe understanding of space in VR and that have analysed the accuracy of it have usually not had a context. Maybe this is crucial to understanding of dimensions and the reason why I felt it was so accurate.

Even though I felt that the bench (seen in figure 23) was only annoying it might have influenced me in selecting the size of the blocks when I created the rest of the benches. Or this might have restricted me and made me think

less of what dimensions I actually wanted and just followed the intuition I had from seeing that bench.

If one defines spatiality as something that also contains time like Hall (1990; see Ekström, 2019, p. 29) suggests, then that could be connected to why it feels like a big step to take the headset on and off. Being in different spatial environments might feel like being in different times. This could then be the reason why I had the sense of going in-between different worlds.

Ryu et al. (2007) and Renner et al. (2013) found that distance was perceived as shorter in VR than in real life. However, the findings of the current study do not support the previous research. In this study distance felt very correct in relation to my own body.

I identify a connection between Moores (2010) thoughts about intuition and Robinson (2004) and Halls (1990) thoughts about spatiality. The common ground in their thinking is that they both connect these elements to the senses. Both aspects are then highly connected to our senses and might indicate that they have a big impact on each other.

4.1.4 What can be learned from performing an explorative sketching process in VR?

The reason for working with this method was to allow for unexpected findings and outcomes.

It's difficult to evaluate exactly what a checklist does for creativity. For me it was a good reminder and became an assurance that I would create something, but when following the checklist properly I did not feel very creative. But maybe I wouldn't have felt equally creative in the later sessions if I didn't start off with the checklist to ground my process. The kind of process preferred probably differs from designer to designer but my process went in line with Lawsons' (2006) saying that creative eureka moments usually come after a lot of hard work. This might indicate that the primary sessions were necessary to ignite the creative process. In hindsight I wish that I had spent less time on following the checklist and rather had sped through it to get to the more creative sessions. That it felt difficult to take field notes in the second and third session for me indicates that I was more in the flow and the process when doing them, therefore being more creative. This probably indicates a flaw in the method as it increasingly got more difficult to observe myself as I got more into the process and thereby more creative. Sleipness and George (2017) reported that the students felt that it was difficult to start the design from nothing, which I never felt.

One found limitation was that when being in a 1:1 scale one can not reach objects far away. This probably comes from being used to be able

to edit the entirety of something straight away. An example is that from the one to one scale one can not change the height of the roofs. It would be interesting to see future technology where one could stretch the arms out into the infinity to reach things beyond the reach. A complication with that would probably be that then one doesn't have the body to relate to anymore (Nystrand, 2019).

As I made less notes in the last sketching process it was a bit more difficult to remember and observe in retrospect how the process worked there. But from looking at the design it can be suggested that I was thinking more outside the box in the later sessions (figure 30-37).

From doing the applied sketching it became apparent for me that it was not the tool in itself that was creative but rather the way I chose to approach the design. This makes me question whether it's actually possible to evaluate whether a tool is creative or not? From my study the experienced level of creativity seems to depend a lot on how one approaches the task and not as much on the tool itself. But also in what medium one prefers to work with. Of course the basis of the program can be argued to need some kind of intuition to be able to work with creatively but from there on it seems from my study that it's more about the process than the tool.

4.1.5 What is the future of VR in sketching for landscape architects?

As learned in the introduction of this thesis landscape architects have a lot of subjects to master and thereby tend to niche their personal knowledge. This is thought of as the reason why VR with its high potential is not used more in Landscape architecture (Lombardo, 2017). George et al. (2017), Song and Huang (2018), and Hill et al. (2019) expresses that they see many possibilities of using VR more in the future. In the study of George et al. (2017) the students report that they would use VR again if the equipment were available. What could be expected from VR in the field of Landscape Architecture is that it might be used as a tool within a niche crowd of professionals that are interested in the field. On the other hand all landscape architects working with design today use computers in some way. In other words much like computers have been adopted widely by the industry, it is possible that VR one day might also be widely used.

For students, junior landscape architects and landscape architects that find it difficult to understand spatiality VR can boost confidence and help understand spatial composition. This

can lead to avoiding decisions about the design that doesn't work in 3D (George et al., 2017; Hill et al., 2019). I also wonder in studies like Eren and Yilmaz (2020) what the attitude about digital tools in general is at the university where the study was undertaken. This probably has a huge impact of what the students think about the experience but is not mentioned in the text.

For those that are interested in the field, the opportunities are many. There are many programs today that allow for sketching in VR, the ones I have mentioned in this thesis are mainly VRSketch and TiltBrush. The intuitive aspect of VR that allows the user to look and move around freely is something that can be very useful in Landscape Architecture. This allows for experiencing the same kind of spontaneity in movements as in the real world. A new feature that is becoming more common and that has been requested by professionals for a long time is the possibility of multiple designers working on a model simultaneously. This might be the change that takes VR from being a tool mainly for reviewing design and gaming to actually working creatively with.

4.2 Limitations regarding my work

If I would do the study again I would explore the possibilities of more than one designer working inside the simulation at the same time. It would also be interesting to see what a group of three or four could come up with. I imagine that in a group of four one pair could study themselves and each other but also be studied by the other pair and their results could be compared. I would also make sure to have a larger space to perform the applied sketching as the small space I had restricted my ability of moving around which might have restricted my understanding of spatiality.

It was difficult to find studies that analysed sketching in VR. Therefore studies with different focuses had to be included in the contextual research. I have looked to extract relevant data for my field but their findings might not be applicable in the field of sketching in VR.

This paper does not evaluate whether this sketching method is better or lesser than any other sketching method, rather, it's seen as a new tool that can add something extra. Further, this thesis doesn't evaluate the quality of the result that this method would lead to.

I have very limited knowledge of VR. Before approaching this thesis I'd only used the equipment three times, once in a gaming context trying different games for about 30 minutes and the second and third time during the Landscape Architecture day in Alnarp using TiltBrush

for about five minutes and then experiencing a landscape made by a student, also for about five minutes. This has meant a steep learning curve during the work with this thesis but it also gave an indication of how hard/easy it is to learn this program and use it for sketching. An advantage that came out of this was that I had to do extensive research of other fields which created a more nuanced study that differs and stands out from most other works written about VR to this day. Even though I had limited knowledge in the field I was very interested and fascinated. This has probably effected the general result from the applied sketching but this is also an aspect that has been taken into account and allowed for in the method. But I'm also imagining that most people who want to work with VR are somehow fascinated by it.

Because of my limited knowledge in working with 3D models I was not able to include moving scale figures or changing weather and time algorithms. This might have affected my sense of spatiality in not being as versatile as it could have been.

During the work with this thesis, there has been an ambition of finding good examples of how one can use VR in Landscape Architecture and less focus on the potential pitfalls. This approach however has not discounted the critical thinking and critical voices which have been brought into the text to insure that a critical approach has been maintained throughout.

5. Conclusion

5.1 Findings

This study aimed to further explore the possibilities of sketching in VR for landscape architects.

The method used doesn't answer questions regarding the general experience of sketching in VR but can highlight and indicate new and qualified directions for future studies. It was also found that the method of analysing oneself systematically is not compatible with creative work as when one gets into the creative flow, observation becomes disruptive to the process. When looking to observe a creative design process it's probably a good idea to have at least one more person who can help out by documenting and facilitating the self reflection of the experience.

From the contextual research it was found that the use of VR reduces the cognitive load as the user doesn't need to translate their design from 2D to 3D whilst working. It was also found that the use of VR required the designers to communicate more verbally, which was challenging at first. However they developed their verbal communication skills during the process. Some designers also felt that the use of VR enabled them to express visual ideas with greater ease than with words. What other studies have said about the future of VR in the field of design is that it might change the design process. This might give new insights into how designers work. Other authors have predicted a positive future for VR and have found that the technology is rapidly developing

Consistent with previous studies, this study found that VR is easy to learn for beginners. The reason for this seems to be the intuitive nature

of the software and hardware. As found in other studies VR also boosted the designers confidence when it came to the understanding of the spatial components of the design. The reason for this is that it provides a clear understanding of what the real life design will be. It was confirmed that the immersive sensation of almost being at the site is very powerful, but it's important to remember that one is actually not at the site. Using scale figures in the virtual environment was found both in this and other studies to help understand other peoples perspective.

In The Applied Sketching it was found that VRSketch is not ideal if one wanted to work abstractly because of the dimensional nature of the software which in a way limited creativity. It was also found that a suitable process used for approaching the design is more essential to increasing the sense of creative flow than the tools used. Something else that limited the work was that when I knew that something was easier to do in different software I did not engage with that element which limited me in exploring different options and fully following my intuition. The intuitive nature of the software and the intuition used in creativity are two different subjects but they are connected. It was also found that nausea subsided quicker than expected. Another finding was that when working on a 1:1 scale in VR it was not possible to change larger structures of far away objects. This could be achieved by having more than one person in the simulation at the same time. The checklist was found to be helpful to get started with the design process but not to fuel creativity. Hopefully VR will be used more in the future to increase the understanding of spatiality in the field of Landscape Architecture.

5.2 Suggestions for future studies

Designing: A natural progression of this work is to analyse having multiple users in the virtual environment sketching at the same time. It would also be interesting to see studies where VR is included in the whole design process, from analyse to final proposal.

Practical: A natural progression of this work is to be in a larger space. This would enable moving around more intuitively and freely, designing on a 1:1 scale, and get a better spatial experience. It would also be useful to have scanned height data of the existing place to get a more correct sense of the terrain.

Conceptual: When it comes to the more conceptual aspects, the following studies would be helpful: How our mood changes the impression of spatiality. How to create a creative process and what makes a process less creative. A comparison between different methods for visual sketching would also be interesting.

Technological: Desired technological advances from a person non-technical person would be for multiple users, less lagging, less motion sickness, more lightweight headset, possibility of stretching arms, and to have a pen or maybe gloves as controllers.

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6.1 Image sources

If nothing else is mentioned in the text all illustrations, photos and videos are created by me.

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7. Appendix

The appendix contains the checklist from Stebbins (2016, p. 90), my unedited notes from the exploration, and transcript of the interviews with Niklas Larsén and Ulf Hedlund. Notes from the interview with Pelle Beckman and the agreement of publishing and archiving.

7.1 Chosen parts of checklist from Stebbins (2016, p. 90)

5. Structural Enclosure

- Have at least one edge of the plaza space defined by a building wall or facade.
- Have entrances to the space enter at different angles to create a sense of completeness to the plaza walls when viewed from within.
- Introduce architectural elements such as crenelated edges, colonnades, arcades, or vaulted portals along at least 25% of the surrounding walls.

6. Partially Define the Plaza

- Limit wall heights to below average eye-level, 5 feet, 7 inches (1,5m), allowing views inside the space.
- Beyond linear features, employ a variety of different features to define the plaza edge: columns, planters, pavement changes, seating islands, etc.
- Define the plaza with 60% of these edge features, which is enough to imply the space within.
- Plaza edges and subspaces can be defined by slight elevation changes within 3 feet (1 m).

8. Plaza at or Near Street Level

- Locate the urban plaza inside of a busy pedestrian corner.
- Keep the elevation of the urban plaza within 3 feet (1 m) of street level.
- If the plaza exceeds 3 feet (1 m), face the edge toward a busy pedestrian path, common gathering space, bandstand, or public fountain within view from above.

9. Keep the Center Open

- Avoid installing prominent landscape features such as fountains, monuments, or statues on the central axes of the plaza space, and definitely not in the middle.
- Observe or model pedestrian flows in the plaza space, then locate these features inside the irregularly-shaped spaces that are found in-between this circulation.
- Install prominent features along building walls, which also avoids pedestrian pathways, but also to enhance the building walls of the plaza.

10. Hard Surfaces for Sociability

- Urban plazas are defined by 50% or greater hardscape materials, and the most sociable plazas in Europe are typically 100% hardscaped. Therefore, this recommendation should exist in-between. The City of Austin design guidelines recommend 30% of the plaza surface be softscape and plant materials. Therefore, the recommendation here is the inverse: a minimum of 70% hardscape cover for urban plazas.

12. Sociable Seating - Fixed

- Include 1 linear foot of fixed or loose sitting space for every 30 square feet of plaza space.
- Locate and face fixed seating within 20 feet of human activity.
- Have half of fixed seating at a higher vantage point.
- Introduce more than 1 cluster of seats.
- Locate seating in respect to climate.
- Design sittable corners on stair seats, rather than terminating into wing walls.
- Orient benches or seat walls toward each other, or at 90° bend.
- Design seat walls with multiple bends.
- Include curved seat walls or benches with two sides or a continuous curved seat wall.

13. Sociable Seating - Loose

- Include 1 linear foot of fixed or loose sitting space for every 30 square feet of plaza space.
- Mix the style, material, and sizes of loose seats throughout the plaza.
- Locate a bench beside the entrance of at least half of the businesses facing the plaza.
- Provide at least 4 chairs for each food vendor that is offered inside the plaza (see Food Vendors).
- Space dining tables within 4 feet of each other.

15. Devices for Triangulation

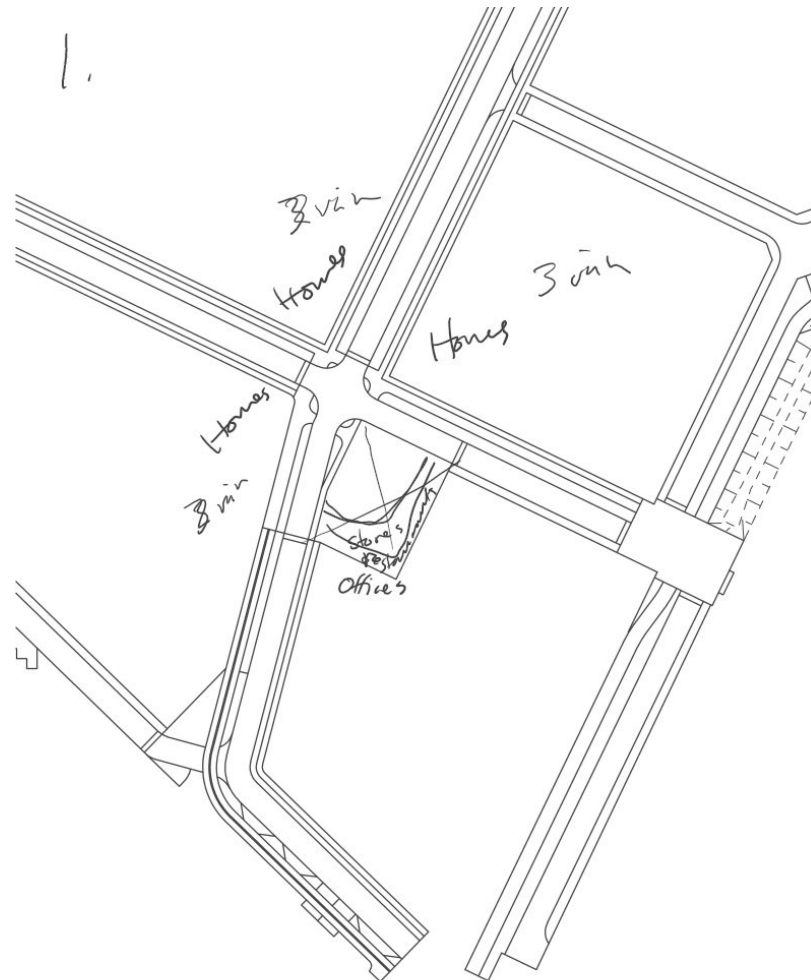
- Introduce a major device of triangulation in the plaza. Prerequisite: Ensure each device adheres to the locational constraint outlined in the pattern Keep the Center Open.
- Half-point for each additional device, up to 2 points total.s
- Allow at least 2 street vendors to work in the space.
- Space is allocated and/or design considerations are made to accommodate street vendors and/or street performances.

7.2 Unedited notes and sketches from the applied sketching

The first time entering the model with a purpose. It was hard to keep the focus on one thing. To explore the heights of the houses was fun, to quickly see the difference of the building heights was interesting and gave some perspective on how unthoughtful I've been about that before.

It was difficult to write things on the walls because the screen became dizzy and so did I. But I found that it was easier if I did it in cursive handwriting.

I feel like the best way of modeling things inside VR is probably to have a giant perspective, and then go into the 1:1 scale and see what the changes in the design led to.



5. Structural Enclosure

- Have at least one edge of the plaza space defined by a building wall or facade.
- Have entrances to the space enter at different angles to create a sense of completeness to the plaza walls when viewed from within.
- Introduce architectural elements such as crenelated edges, colonnades, arcades, or vaulted portals along at least 25% of the surrounding walls.

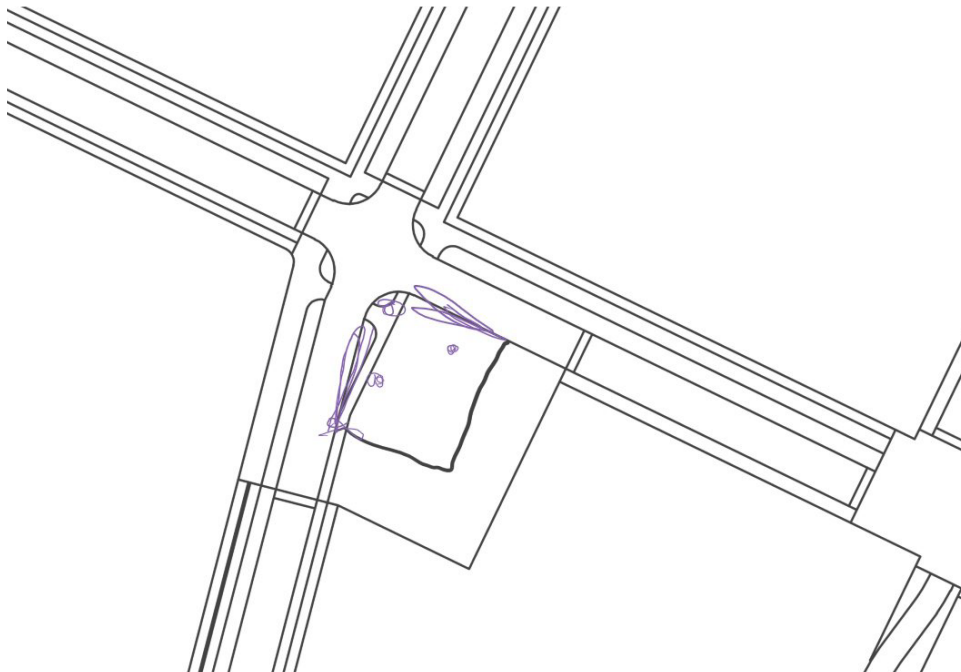
Starting to learn to zoom in and out when doing changes in the design. Think I missed recording or failed to save this first part. I'm mostly sitting down doing this now.

It's problematic that I can't change the size of the sketching tool, now it makes the lines very small when I zoom in.

I figured that I can use a ponytail to keep the headset in place which made the whole experience much more pleasurable.

I recognize that I Get ideas about the previous thing I tried to focus on when doing the one after, I allow myself to follow my impulses and add things after hand.

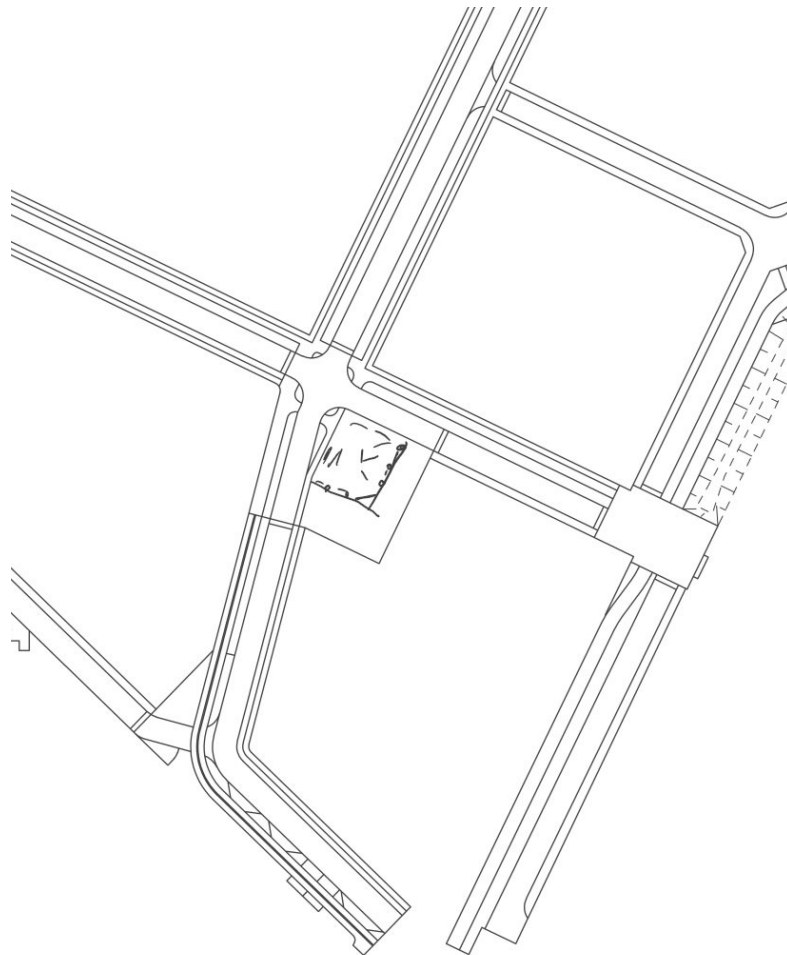
Interesting how it looks so small on the map but feels very large in the model.



6. Partially Define the Plaza

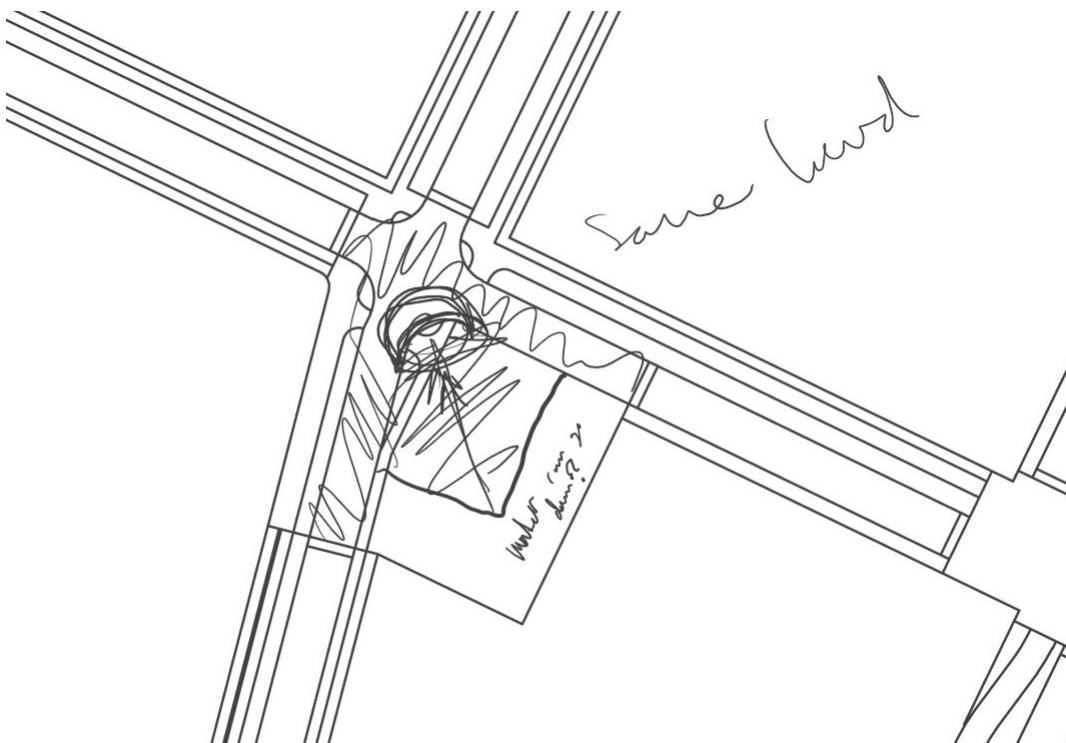
- Limit wall heights to below-average eye-level, 5 feet, 7 inches (1,5m), allowing views inside the space.
- Beyond linear features, employ a variety of different features to define the plaza edge: columns, planters, pavement changes, seating islands, etc.
- Define the plaza with 60% of these edge features, which is enough to imply the space within.
- Plaza edges and subspaces can be defined by slight elevation changes within 3 feet (1 m).

Started putting out benches and got very caught up in that. Realized that it was better to have more abstract shapes to play around with than the bench from the warehouse.



9. Keep the Center Open

- Avoid installing prominent landscape features such as fountains, monuments, or statues on the central axes of the plaza space, and definitely not in the middle.
- Observe or model pedestrian flows in the plaza space, then locate these features inside the irregularly-shaped spaces that are found in-between this circulation.
- Install prominent features along building walls, which also avoids pedestrian pathways, but also to enhance the building walls of the plaza.



8. Plaza at or Near Street Level

- Locate the urban plaza inside of a busy pedestrian corner.
- Keep the elevation of the urban plaza within 3 feet (1 m) of street level.
- If the plaza exceeds 3 feet (1 m), face the edge toward a busy pedestrian path, common gathering space, bandstand, or public fountain within view from above.

Was interesting to play with the height of the ground, it was not very easy and smooth to do but it makes so much more sense in this environment on how much it matters.

I feel like I've been mingy before when sketching, here I can test around much more and I feel a bit freer, I think it's because I know for sure what effect the things I create have on the environment. Before there's always been a grain of insecurity.

I feel like I'm getting more and more the hang on how to do this and I'm learning what is easy to do and look at. The tool push and pull are what give me the most ability to play around with square shapes.

10. Hard Surfaces for Sociability

- Urban plazas are defined by 50% or greater hardscape materials, and the most sociable plazas in Europe are typically 100% hardscaped. Therefore, this recommendation should exist in-between. The City of Austin design guidelines recommend 30% of the plaza surface be softscape and plant materials. Therefore, the recommendation here is the inverse: a minimum of 70% hardscape cover for urban plazas.

When going into the model again I felt like it looked very messy, so I took away some benches and moved them so they were placed along the edges of the square instead. I tried to put out more soft surfaces than the ones I already placed. But it was hard to not make it messy again. Also, I got some technical problems where everything is loading very slowly.

I feel much more comfortable in the simulation today, I find the tools almost by reflex and the process is getting smoother. Some things are not perfect in terms of the software, it lags and glitches sometimes but overall it's very good.

Börjar känna mig ganska nöjd med strukturen på platsen



12. Sociable Seating - Fixed

- Include 1 linear foot of fixed or loose sitting space for every 30 square feet of plaza space.
- Locate and face fixed seating within 20 feet of human activity.
- Have half of fixed seating at a higher vantage point.
- Introduce more than 1 cluster of seats.
- Locate seating in respect to climate.
- Design sittable corners on stair seats, rather than terminating into wing walls.
- Orient benches or seat walls toward each other, or at 90° bend.
- Design seat walls with multiple bends.
- Include curved seat walls or benches with two sides or a continuous curved seat wall.

I have already done this to a great extent, I put some benches in the afternoon sun and I put some in the morning sun, I put some along the walls and I put some in more groups. . I did some of the unofficial seatings higher and my idea is that the whole square will be a slope out towards the plantings and the road so the benches along the houses will be slightly elevated.

I feel like I need to go inside SketchUp on the computer now and do some changes because some things are simply not convenient to do in VR, like building new walls and basic structures that are hard to change.

I made changes in the elevation and it made a huge change in what it felt like walking across the square, I like it, it's more smooth now. Also, I think that if this square is more for sitting and meeting rather than shopping it's ok to have the slopes.

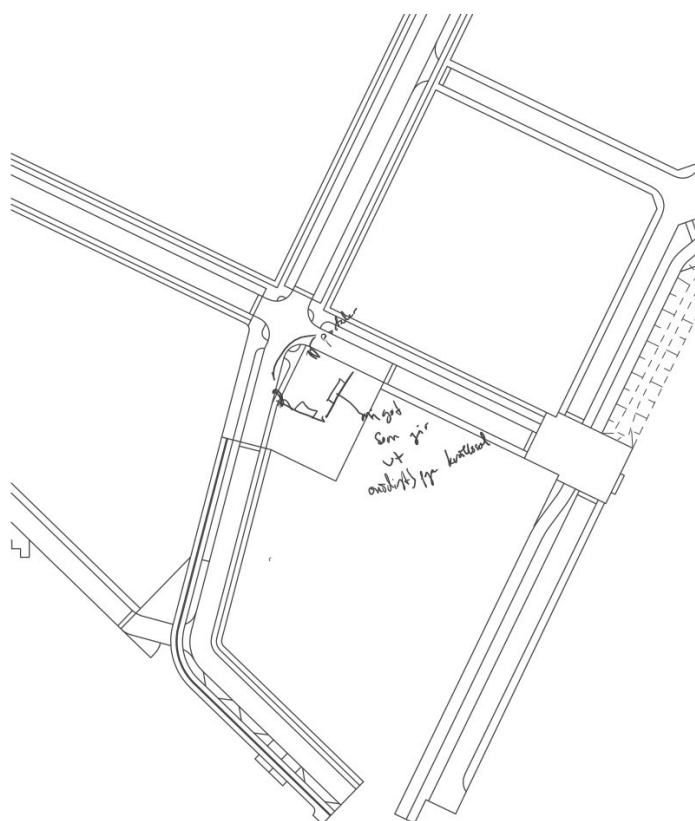
It feels amazing to be able to see the changes one makes straight away. It feels like a blessing. And to be able to look at it from so many different scales in a heartbeat creates what I would describe as an organic or dynamic creating process. I wish I was better at SketchUp, that's all.

13. Sociable Seating - Loose

- Include 1 linear foot of fixed or loose sitting space for every 30 square feet of plaza space.
- Mix the style, material, and sizes of loose seats throughout the plaza.
- Locate a bench beside the entrance of at least half of the businesses facing the plaza.
- Provide at least 4 chairs for each food vendor that is offered inside the plaza (see Food Vendors).
- Space dining tables within 4 feet of each other.

I made some space for a bar and a café or something similar. I'm just not sure if there will be restaurants that want to start there. Maybe with all the new houses, it will be.

Looks nice and cozy now, with a lot of seating but it misses lightning and trashcans. I wonder if I can make it very dark in the model and try different places for lights?



7.3 Interviews

The following are notes and transcriptions of the interviews that were conducted over video link and phone. The reason for not doing them in person was because of the recommendations not to travel during the Covid-19 pandemic.

To find people to interview I looked for professionals who worked for different companies and lived in different countries and had hands-on experience with using VR as a sketching tool. To find the people I searched for VR projects in different architecture firms, in the database ArtikelSök, and looked to see whether authors of scientific articles worked in the field today somehow. I then figured out if they still worked in the field, if so, I emailed and/or called them to book interviews.

I conducted semi-structured qualitative interviews (Ahrne, 2015, 40). I chose semi-structured interviews to be able to keep the discussion open for reflection and creative thoughts which I think suits the subject.

In the interview with Niklas Larsén and Pelle Beckman, the main questions were:

- How do you work with VR as a creative tool?
- How was the experience for you, did you like it or not?
- What did you find was profitable with this method? What do you see in VR that can be difficult to understand with other mediums?
- What advice would you give someone who wants to work creatively in VR?

The interview with Drew Hill was a bit more open, but the main questions were:

- Have you had any insights about your study after it was finished?
- How do you work with VR today?
- What's the best thing with VR?
- Do you have any advice for someone who wants to work creatively in VR?



7.3.1 Pelle Beckman - Architect - 9th of december 2020

We had issues with getting the video call softwares to work so we did the interview on the phone instead. This made it not possible to record it so I took notes instead. These are my unedited notes. As the interview was preformed in swedish so are the notes.

Hus arkitekt

Utvecklade egen mjukvara för att vara kreativ i grupp och själv

Pedagogiskt - för stakeholder

Intressanta affärsutmaningar

VR i tävlingar - samordningsnoden mellan dicipliner (järnväg)

Fördel:

- Kollar inte på saker i förhållande, finns fler fördelar med olika
- Få känsla för rymd
- kommunikativt

Oseriöst?

- Ja folk gör det, finns alltid där
- Folk känner sig fåniga, huvudbonad
- Hot mot arkitektyrket
- Vi kommer också va efter
- Beror vem man frågar,
- Sweco - digital teknik intresse - It-utveckling finns
- Bra arkitekter

Mindre bra:

- Man ska ha bra förutsättningar och tid
- Om man jobbar med folk som är nya kan man behöva lära dem - tid, annars står tekniken i vägen

Tips: Starka VR = Korta och välutvecklade, testa små grejer, spel och projekt.

Bra förutsättning lågt, Bra, för alla är nerds

Enscape

- Bra program
- Enklast väg för arkitekter
- Kan sälja snabb rendering

#VRMeetup: 2-3 år sen, februari 2017

#HTC Beroende av dator - finns Oculus Quest 2 - Behöver ej dator

Kreativ process/Skiss

- Verktyg som dem jobbat med att utveckla
- Webbaserat
- Har en tidig skiss på bordet
- Drar upp i datorn
- Allt är multiplayer - Med VR ipad iphone
- Allt i realtid
- Kasst att modulera i
- Testa runt är bra mellan program
- Att jobba mellan program och människor blir det kreativt
- Olika medium har olika potentialer
- VR har potentialen med rumslighet
- Kommer inte ersätta träd
- För att man förstår
- Trygghet till kund
- Känsligt
- Husarkitektens stolthet av att kunna förstå rumsliga kvalitéer, men svårt
- Kompetens ej så hög som man önskar
- Skicka kopia av arbetet

7.3.2 Niklas Lars'en interior architect at MER and Obeon - 2nd of December 2020

J: Hej! så jag tänkte att vi börjar med att du kan berätta lite om dig själv för att komma igång. det jag har fått fram i min research är att du är inredningsarkitekt och jag har sett ditt föredrag på Cementa dagen där du berättar om Alex-huset.

N: Ja men vad roligt, det var ju ungefär två år sen så det har ju hänt en hel del sen dess, men helt rätt, inredningsarkitekt från början. Är fortfarande med och driver MER som är inredningsarkitekter och för ett år sen startade jag Obeon som är som en virtuell marknadsplats för designföretag som nu precis har dragit igång. Så det som var det där huset har blivit mycket större. Och det som vi bygger där är egentligen en plats som man som arkitekt kan använda för att gå in och gå runt i olika design företags showroom och titta på produkter och möbler och ljus och allt som man gör på en mäsas egentligen. Så det är den ena grejen som jag gör och sen på MER, arkitektbyrån, så använder vi oss av VR som en visuell process egentligen i alla våra arkitektföretag där vi bjuder in kunden väldigt tidigt i en 3D miljö, eller bilder, eller filmer, eller VR för att kunden ska kunna vara med på resan på ett enkelt sätt som alla kan förstå och då är egentligen VR det optimala i förståelse för kan ju liksom gå in där och så ser det ut som vanligt.

J: Ja men precis och det är ju den där tidiga processen som jag skriver om i mitt arbete och jag är ju snart landskapsarkitekt och min tanke är att jag ska analysera hur Vr kan användas i ett väldigt tidigt stadium där man testat sig fram vad som funkar bättre och vad som funkar sämre? Så då undrar jag hur du jobbar med VR som ett kreativt verktyg?

N: Det är en så himla komplex och stor fråga. dels för oss, men vi tänker ju att det finns liv vi har vår kund eller beställare och det är ju väldigt lätt att skapa någonting för sig själv men det är svårare att förstå vad man menar och då är ju vr ett extremt bra verktyg i början för att förstå någon att fatta vad man menar. och det är ju väldigt så här i det virtuella kan man ju skapa saker som man inte kan göra direkt på riktigt, nu går jag mellan olika grejer, jag pratar bara från min egen du får applicera det som funkar bäst på dig sen.

J: Absolut

N: Vi skapar ju liksom, våra upplevelser som vi skapar, även i fall dem är djupt förankrade i , det känns ofta som en verklig plats sen lägger vi på lager utav saker och ting som inte finns på riktigt, det är saker som gör platsen bättre, härligare, lättare att förstå, det kan vara material som inte finns, alltså allt som kan nudgea mellan vad som är verkligt och inte och att det är ok i den digitala platserna att lägga på lager av överklighet för att försöka ah förstår, lite suddigt. Så i den kreativa processen så brukar vi ofta som arkitekter försöka göra som ett skal kan man säga och sen försöker vi gå in väldigt tidigt in i det virtuella, det kan vara en liten bit till exempel för att få förståelsen av ytorna och geometrierna och storlek på saker och ting för att sen lägga på lager på lager utav saker färger vad det nu är för att det ska bli en färdig produkt. Men det som jag tycker är väldigt intressant att prata om vr är just det att alla människor kan förstå ett

projekt, om man tar slussen som ett exempel , där har alla varit så himla och bråkat i tio år om hur det ska se ut, men jag tror att det ofta är att du förstår inte vad det är som ska skapas. om du väldigt tidigt kan bjudas in i den här processen på ett sätt som du kan förstå, vilket du kan i VR så tror jag att det inte hade blivit så himla mycket ovisshet och rädsla, eller man kan ta bort väldigt mycket sånt som då gör att projekten kan gå mycket snabbare egentligen. att man kan få med folk på tåget på ett helt annat sätt än vad man kan göra annars. det är väldigt svårt att bilda den där uppfattningen annars, vanliga människor, och knappt jag, kan förstå en planritning och se det framför mig hur det skulle se ut och en bild är också svår att greppa och jag kan tänka mig att det ni håller på med dels för era framtida beställare men även att kunna involvera oss vanliga människor i projekt är jätteintressant om hur man kan göra det inom vr så att man kan fatta vad det är.

J: När jag sökt artiklar hittade jag mycket om medborgarsamverkan, det finns mycket forskning om det, upplever du att det också funkar bra mellan medarbetare, alltså mellan er som sitter i projektet?

N: Ja men det blir också mycket bättre för att allt handlar ju om att när man skapar saker och ting tillsammans som en grupp så handlar det ju om att sträva efter en gemensam vision eller en gemensam ide och ju snabbare vi kan komma överens om vad det är desto bättre, vi måste ju hela tiden nu kan vi ju än så länge inte bygga och designa allting i den virtuella platsen utan vi gör det på samma sätt som vi gör allt annat vi skapar moodboard och skapar skisser och sådär så den processen är fortfarande kvar och den är enligt vår arbetsprocess så vr kanske inte är det första steget som man tar men som tex vi på MER ritade microsofts kontor i stockholm och då så la vi in jättesnabbt själva 3dn i det här nya kontoret som vi skulle flytta in i allting var egentligen nytt men vi började bjuda in deras anställda under kanske vecka 3 i projektet så att dem skulle få en känsla av vart det är nånstans och vad det är för storlek och kunna röra sig runt, sen fick dem komma in lite då och då och så hade vi lagt in mer information hela tiden som dom då skulle kunna ta åt sig så en sån process där man har så många människor som går runt i ovisshet i kanske ett par år dem visste ett år dem visste ett år innan nästan exakt hur allt skulle se ut och upplevas och de kunde öppna sina skåp och kika in där så när dem väl flyttar in sen så är det ju inget , det kanske känns lite tråkigt då man redan har varit där men just den liksom den tiden där folk är lite rädda och mår dåligt kan man ta bort.

J: Upplever du att man sparar tid ?

N: Ja absolut, jättemycket! asså du behöver inte hålla på hela tiden med så himla mycket presentationer och så där utan det är bara att gå in och titta. Du behöver inte förklara lika mycket utan det är mer så ah men kom in och kika och testa lite själva och när man kan gå in i det virtuella och testa själv och flytta på bänkar och möbler träd vad som helst så ah men det här är ju mycket bättre och att man då kan få med medborgare att vara med i den processen är ju väldigt intressant, jag tycker det är väldigt roligt att se vår roll som arkitekter som ett verktyg som andra kan använda sig av för att nå det mål som man vill komma fram till, det kan man ju även göra i det som du gör.

J: Ja absolut verkligen. Vad är fördelarna med vr, vad funkar bättre än traditionella metoder, då

tänker jag skissa i plan eller göra snitt men det har vi ju pratat en del om nu är det nånting du har att tillägga?

N: Nej, det finns faktiskt, man kan ju tänka sig att kostnaden blir högre initialt i denna typen av process fast jag vet inte om den blir det i längden då förståelsen nås mycket snabbare men annars så finns ju liksom bara positiva grejer tycker jag. Det beror på jag ser det ju som en demokratiserande process där alla fattar. så om man ser så att det är dåligt för dem arkitekterna som ser sin roll som en sorts enväldshärskare och vill att folk bara ska göra som dem säger men för oss som ser det på ett annat sätt så tycker jag att det bara finns positiva saker med att folk förstår vad vi gör.

J: Rent kreativt, jobbar ni bara i VR?

N: Nej, nej verkligen inte utan vi är ju väldigt mycket vanlig inredningsarkitektur.

J: Vad är det då ni tittar på i VR? och vad är bättre på papper eller cad?

N: allt som går in i Vr kommer ju från papper och cad egentligen det är bara en del av våran process, vi exkluderar inte det alls, vi kan inte exkludera det. Ofta är det så att arkitekten själv inte kan programmera det i vr utan det behövs en vr-utvecklare till det men som det ser ut nu med dem alltså plugins och så så kan du ofta titta på en 3d modell i vr, du behöver liksom inte ha en programmerare för att göra det, och det kan ju vara good enough för ett tidigare stadium, men det kanske inte ser så härligt ut men det kan ju vara en bra del i processen så vi har ju liksom inte exkluderat våra äldre tillvägagångssätt det är bara det att vi använder dem mycket mindre. och förlitar oss inte bara på att vi ska kunna göra en bra 3D skiss eller en bra rendering, många av våra kunder köper en vr upplevelse och sen tar man ut bilder och filmer från den för att kunna kommunicera i sociala medier och i kataloger och så där

J: Min tanke är att jag ska göra ett experiment där jag ska testa att dra i lite väggar och placera träd och så [N: åh vad roligt!] men jag är inte så erfaren. min tanke är att jag ska använda sketch ups vr plugin, [N: jättebra!] dra upp enkelt och sen jobba vidare i sketchup. [N: ah men det är ju skitbra] Har ni någonsin provat att dra upp väggarna? (inuti VR)

N: Vi har inte det i vårt system, vi har inte det själva att vi kan bygga där inne, men det vill man ju kunna göra, att man har alla verktygen inne i det virtuella och att stå där och skapa med händerna, och göra det för hand, det är ju superspännande. det vill man ju se hur det går!

J: Ja, jag kan ju skicka uppsatsen när den är klar

N: Ja men gärna!

J: Har du något konkret tips till folk i allmänhet om man vill jobba kreativt i VR, vad ska man tänka på?

N: Gud vilken svår fråga. Det är svårt att inte bli kreativ i VR, det finns ju alla möjligheter ett tu tre

och det är ju svårt för mig vi bygger ju mycket digitala platser som inte ska hamna i verkligheten utan bara något som ska vara en virtuell plats och då kan man ju göra hur sjuka saker som helst egentligen, där är det ju bara att köra, egentligen begränsa sin kreativitet som kreatör har vi alltid vart , eller det har ju alltid funnits ramar att begränsa sig med alltså saker är ju upp och ner alltså det finns kraft tyngdlag och allt sånt där, men i det virtuella finns ju inget sånt du kan ju skapa någonting helt unikt egentligen och det kan bli sjukt jobbigt på ett sätt att ett tu tre kan vi göra allt och jag tror liksom landskapsarkitekter och så kommer ju fortsätta vara landskapsarkitekter och så men i framtiden kommer ni ju även skapa virtuella landskap som vi kommer röra oss i alltså så som vi håller på just nu och då kan man ju liksom hitta på digitala landskap som är jättehärliga och häftiga och inspirerande så jag tycker att man ska både använda det som ett verktyg så som du pratade om det nu men även som ett sätt att se hur landskapsarkitekturen kan bli helt digital. Så bara sätt igång och testa!

J: That's the plan, hehe ja. Jag skulle egentligen ha börjat förra veckan på stället jag ska göra praktik på efter jul men utrustningen har inte fungerat.

N: vilka?

J: Tyréns

N: aha och då ska du börja testa i SketchUp

J: ja

N: Fan vad kul, skicka gärna över någonting, vore kul att se

J: Ja jag har fått ett litet torg i en liten kommun här i skåne som jag ska jobba med

N: ah vad kul, har dem då börjat?

J: Ja och sen ska jag få en 3D modell från vägavdelningen (den fick jag inte i slutändan) dem som jobbat med vattenhanteringen, det finns en park i stadsdelen som ska hantera jättemycket vatten så jag ska titta på ett närliggande torg.

N: ah vad spännande, om du behöver någon stöttning så är det bara att höra av sig

J: kul, det ska jag absolut göra.

N: känner du dig nöjd med svaren?

J: Ja, jag är jättenöjd! det känns jättekul, det har liksom bekräftat lite sånt som jag har hittat forskning om vilket känns skönt för det blir så himla vetenskapligt och stolpigt så man undrar om det verkligen funkar på riktigt så det känns skönt. Sen känns det kul också att det är ju på ett sätt självklart att det är kreativt, men när man läser om digitala verktyg så kommer det upp mycket

om att digitala verktyg är begränsande.

N: På vilket sätt då?

J: Ah men jag tror att det flesta har analyserat cad-grejer och att de är ganska gamla där folk inte haft 100% koll på programmen är min teori. och att dem har kommit fram till att det inte är så kreativt.

N: Ah jag fattar.

J: Hur upplever du att jobba i CAD?

N: eeeh, grått. Det är grått

J: upplever du det som kreativt?

N: Jag har alltid varit väldigt.... vi ritar ju allt i 3D och aldrig platt och jag har alltid gillat att rita modulera och skapa i 3D så jag tycker om det. jag tycker det är jättehärligt men det som är häftigt är när man tar Cad ritningen och stoppar in den i en spelmotor och att det blir vr och ljus och man kan va där inne och integrera med platsen och ta upp grejer, mycket av det vi gör alltså dem här helt digitala platserna jag får ju exakt samma asså, när den platsen är färdig får jag liksom samma tillfredsställelse som om den platsen hade byggts på riktigt. för den blir lika verklig för mig. och där kan man som kreatör verkligen göra det man vill. i verkliga livet är det ju så mycket skit och filter hela tiden som den måste gå igenom, som byggnormer och saker som inte funkar och sju år innan det är klart men här är det klart efter tre månader vilket är superhäftigt

J: ah verkligen, ja jag är så taggad på att börja!

N: Ja vad roligt! men sätt igång och hör av dig!

J: ja, det ska jag göra, tack för din tid!

N: Tack för idag! ha det bra!

J: Ha det fint!

7.3.3 Drew Hill - Landscape Architect at OJB - 5th of September 2021

J: So am I recording? Yes, let's start! I don't know how much I told you but I'm handing in my thesis on Friday and it's about sketching in VR basically. I have worked in a different program than you did, I have worked in a plug-in for sketch-up called VRSketch.

D: Yes, I'm familiar with it.

J: OK, great, and I have not done testing because of covid and everything, I have observed myself while working in VR, which has not been an optimal method to use but it's been something. I just have some questions, so I'm curious to know, because your study is one of my main sources in my thesis.

D: OK, cool.

J: Yours and Georges, BH? Benjamin?

D: Ben George

J: So I'm curious, did you like having any realisations after writing the thesis, like this could actually be relevant about sketching in VR?

D: Hmm let's see, I wish that, looking back, I'm happy with how everything turned out, I wish I would have maybe, I was kind of at a time crunch as well and you know didn't, had a limited time-window to make this happen and collect the data, I wish I would have had more time to expand beyond one design team. Because I was using, so I had two different projects, a large scale project and a small scale project, and I had one design team working through each project, and it was a handful of people, It wasn't huge, it was also hard from a data standpoint to have an efficient control group because design is subject to the designer, and if I would have had one group doing traditional process without VR and, and one group using VR it's not like one can compare those designs much, maybe you could find a way but the design would be different no matter what because they are different designers. So that was one thing that me and Ben were trying to figure out from a data collection standpoint, like is there a control group? or is it just the design group using VR and then compare it to their past experience without VR and that's what we ended up doing so it was kind of like the students already had a foundation of what their traditional design process was without VR and then they just used VR and compared it, so like; oh when I use VR these are the differences that I notice. From their point of view and then I asked them you know the series of questionnaire and recorded, at several points during the design process and recorded their answers and coded those answers into themes or, recurring themes whether it was beneficial or not. That's the way I decided to go about that. But I maybe wish I could have had two or more, maybe even up to 4 design teams working on the same project so that there would just be more data because if you look at my data there are, the second round of collection I wasn't very happy with because I can't remember exactly what happened but I either, I put out the survey but I don't think I got a lot of responses so if you look at the, I don't know if you remember, the graph that looks like a bunch of snakes going across the line,

J. Yeahyeye

D: it's like the second data collection is like this big and the others are bigger so it's a bit of a gap in the data but at least the responses still went with the pattern like the other data collection points had, those are just some thoughts that I had looking back.

J: And have you worked with, like I know now you work at, I guess it's OJB, I don't really remember but...

D: Yes

J: I can see in the background picture (Pointing). But have you worked more with VR in your professional life now?

D: Yeah, so OJB is very interested in VR and my thesis and their interest in VR was a major selling-point on getting me the job here so that was cool and you know they are really into it and they are looking on ways to expand more so primary things we do right now, we do a little bit of VR sketching but not much, I'm trying to expand that a little bit more and actually just had a meeting last week with the partners at OJB they put out like a little innovation competition to the firm and sent an email like; send us your sales pitch basically of innovation that you want to push forward and kind of like a shark tank style I don't know if you are familiar with that show?

J: Yes, we have it in Sweden too

D: So I put together little VR pitch to them, and I've talked about it many times, I've been here for two years and I've already on several different points in time like, Jim Burnett is the president and I work pretty closely with him and I've put him inside TiltBrush and got him to sketch some things in VR, We used Lumion for limited Vr capabilities, like you can export The VR panos, but I don't love those because you know they are not immersive they are just a photograph, you can't move around it so actually my sales pitch last week to the partners was that I wanna, like I talked about in my opinion the gaps that lumion has with VR. We have reached out to lumion before and asked them if they will ever you know have plans to ever develop further their Vr capabilities to have immersive capabilities so you can, you know move around and have a real time rendering scene and apparently their software is not built that way it's not written that way so they would have to completely overhaul it if they were going to do that so we're starting to look at alternatives for kind of later stages of design and more polished renderings that are real-time and that you can move around. I have a little bit of experience with gaming engines and I don't love them because they are a little bit more complicated like unreal engine, I don't know if you are familiar with that, a little bit more complicated I feel like it has a lot of code and you have to code a lot to be able to get a good output that looks realistic. So I don't love that program, I do wanna mess around a bit more with unity though because I mean it's still a gaming engine but it's not as coding intensive. An then we're experimenting with Twinmotion a little bit too, I mean Unreel engine or Epic games owns Unreel engine and Twinmotion but Twinmotion is kind of the downgraded version where not being a computer programmer is necessary, and it allows you to have immersive VR and walk around the design so that was, we're kind of all over the place with VR at OJB but they are very interested in

it and we have a library of four or five oculus headsets I mean we haven't really been able to use them much during Covid but we're starting to utilise them more as [bad signal]. So yeah we're kind of all over the place with really sketching programs TiltBrush mainly I haven't showed them VRSketch, we use a combination of sketchup and Rhino, and I actually use Rhino a bit more just because I'm more familiar with it, it's the program in school that I kind of gravitated to and then stuck with so we use a little bit of everything. Hopefully that answers the question, yeah a little scatterbrained but.

J: Haha well 7:30 in the morning for you right?

D: Yeah for some people that's not early, I'm not really a morning person so..

J: So like have you actually worked on a project in VRSketch? Or have you just tried around?

D: No, I've used TiltBrush on several of our projects to like, I'll put this SketchUp or Rhino model inside TiltBrush and then sketch on it, and then just kind of experiment with what is there. And then you know as far as our current design process goes well throw that into Lumion, we're pretty heavy on Lumion here just because, like we'll be in Lumion within one day of starting a project like Jim, he's very visual and he'll do a sketch and then he'll give it to me and be like put this in 3D and let me see what it looks like. And then from there we can export VR panos and kind of explore it more but like I said we're not to the point yet where we're immersively walking around in VR it's like oh we exported this VR pano here and we exported one 54 feet down there and then in the oculus headset we will be at that point and be able to look around and then move forward to the next VR rendering and look around there. But like I said I really want to expand that to be able to be utilising a program where we can freely move around conceptual designs.

J: Have you tried the multiple user TiltBrush? Multibrush? Or what is it called...? Came out this year I think.

D: Hmm I have not, So it allows for multiple people inside VR? Interesting. If you find the name of that program, let me know! Would be interesting to experiment with that.

J: Yeahyeye, I'll send it to you. Like I think, most studies that I have found have mentioned the loss of not being able to be more than one person in the immersive environment.

D: Yeah it's restrictive.

J: Yeah but I found these studies a little bit too late, I was like: Damn it I should have done a multi-user experiment but well, well. But I think also in VRSketch you can be more than one person inside.

D: Can you, OK. Well I knew you could have one person in Vr doing changes and then also someone at the desktop or laptop making changes with their mouse, I don't know if that counts as multi-user but hehe.

J: What I'm thinking of is to have more than one person with the headset on, like together inside and work.

D: Ok so that is possible in VRSketch?

J: I think so, I haven't tried it because I've only had one headset so i don't really know.

D: What school do you go to by the way, I forgot to ask.

J: Swedish University of agricultural science.

D: interesting

J: It is the only place where you can study landscape architecture in Sweden

D: wow, is that in Stockholm?

J: No, I am in Malmö, so it's south , almost as south as you can come, takes about 40 minutes to get t Copenhagen. And where did you study? because you're in California now right?

D: Yeah I'm in California now but I'm from Utah and I studied there at Utah state university. I did my undergrad there. Actually I didn't go to Utah state university planning on doing a Masters, what happened was that when I was in my second year there then they created this new program to have an undergrad and grad wrapped together as essentially one program but to combine it into five years. Like I knew that I wanted to pursue a masters but I didn't know if I wanted to do the masters in the same thing as I did my Bachelors. But then I thought it made sense and it was a way to skip one year of tuition, like it was still the same amount of credits, each year was a little more full but I ended up doing that there and then coming to California.

J: It's interesting because we only learn SketchUp, that's the only 3D program so all these Lumion, Rhino is just things I've heard about from someone else you know, so we're quite limited in a way there.

D: Yeah I would recommend, I mean there are so many different software types, it depends on what the place you work for use even if that is the career path, or if you go of and do your own thing, at least where I work they are pretty heavy into Lumion and I got pretty heavy into that at school so I already knew that but I think you could find a lot of software for free I don't know if Lumion does a free license but I think they might, If you have time I would recommend checking it out, Twinmotion and Lumion to see which one you like, they have different capabilities.

J: Yeah I'll definitely try to learn these programs just to kind of know shit.

D: You turn in your thesis, and when is your targeted graduation?

J: So that thing is the last thing I'll do, but the presentation, or what do you call it when it's a thesis?

D: Thesis defence, or at least that's what we call it here.

J: Yeah so I'll have the defence on the 24th of September, and then I'm done!

D: Ok, do you have like a December graduation or do you have to wait until next year.... Yeah do you know?

J: Oh! I was like; what do you mean? like a party? but you mean the thing with the hats and everything no? haha

D: Yeah the thing with the hats!

J: We don't really have that.

D: So they just give you your piece of paper saying that you made it?

J: Yeah, also like now with Covid, there are so many people who have taken breaks and you know worked for half a year and stuff like this so we're all on different, I know three more people in my, from when I started who will defend, but it's very different. But e will go out and have a little party hehe. Maybe get the hat hehe

D: Hehehe, What's your plan for after is there a certain firm of Landscape Architecture that you are interested in pursuing a career in?

J: I want to work more in VR, but there are not many options then, like there are some bigger Landscape architecture offices that works a little bit with VR, but it's not so much, so plan is just to get a job. But hopefully I'll find someone who is interested in VR and like that.

D: Nice

J: I'm also curious, what do you think is the perc of VR, what do you think is the best thing with it.?

D: I think it's the ability to be immersed and move around and evaluate design and add on to it, being able to freely walk around. A lot of our, A lot of the Landscape Architecture processes are very heavy in 2D sketching which is like it's great, you know it's a start, but there's only two dimensions there, and there is that third dimension which is just as important and when you extrude a sketch and apply volume to a 2D sketch there are so many other things to consider, and I feel like it's too common that we sketch in 2D and we're like; we figured it out this is the design, let's start the construction design or construction documents rolling, but it's like now that when you've only considered two spatial axis and that third three dimensional axis and being able to freely walk around it, evaluate it and respond, change your design responding to what it feels like in 3D is huge and I feel like being able to evaluate in VR a design, not just evaluate but actually design in VR adds so many different layers of depth to a project, to really understand it, you know and a lot of people can achieve a similar result by just you know modelling it in SketchUp or Rhino or whatever and just flying around their model, but you're still experiencing a 3D space on a 2D screen when you do that so it's not the same as experiencing it like you would in real life where when you look to the left or you look to the right and you see things differently, so to summarize immersion and free, having a free spatial relationship to walk to the left and walk to the right and look up, and experience it like it was a real object is the number one benefit in my opinion.

J: I also found like, that what I found was limiting was that I kind of like this abstraction, Because I kind of had a little project where I kind of sketched on a square. And that you kind of lose the abstraction thing that you can usually have when you are sketching on paper, have you thought about that?

D: So say that one more time, so abstraction...?

J: I don't really know how to explain it but like, there is like something that when you have everything in the correct scale it's like not abstract anymore, it's like somehow a little bit more difficult to be creative with the place when it's like, this is actually the scale, some way yeah... I felt like if I would sketch [traditionally] I could just do a conceptual thing which you can't really do in VR.

D: Interesting, I haven't considered that...

J: Yeah I haven't really considered it fully yet haha

D: Yeah that's interesting, so you know in some of the sketching that we did for the project, it's hard to say, I don't know how to say this, Yeah I guess the scale is right, it just depends on what you sketch, some of the students, I'll see if I can find, I have the presentation folder here if I can, here is an example, is it OK if I share the screen?

J: Yeah of course, do I have to allow it somehow?

D: No, do you see a power point presentation?

J: Yeah

D: So this is a sketch that a student did and it's quite something, like I don't know, so this background that you see with the homes over here that were kind of our base that we created using drones to you know, created this photogrammetry base, and then The students sketched this on it, and I guess that while the scale is correct I feel like this is pretty abstract! I don't know I guess it depends on how you sketch and how you chose to express yourself.

J: Maybe also TiltBrush is a little bit more, with the brush strokes gives a little bit more possibilities of working abstractly

D: There are definitely, I think TiltBrush is actually a really great abstract program because they have so many different brushes you can use, some of them are pretty crazy some of them I actually avoided entirely because they were like, neon, like techno colour, constantly changing colours and there were some like...

J: Yeah they have this fire thing right? Ha!

D: Hehe yeah and a lot of the students during the research letting them explore freely the program, it was hard to keep them on track because they were just doing crazy stuff, making fire fall from the sky, hehe, I don't

know I guess it depends on the program and the capabilities and the amount of different customisation you can have... have you ever seen... Let's see if I can pull it up, it's an Instagram page... She does these amazing sketches, I'll have to send it to you later.

J: is it in TiltBrush?

D: It is someone else's account but they use TiltBrush and create these really cool things, I have saved it so Ill have to go through my saved folder, Ill send you, do you have Instagram?

J: Yeahyeyey

D: It's like a Virtual VR artist and she like do these sculptures of peoples faces and it's incredible but it's, the brush strokes that she's using are very abstract and just its basically a bunch of different strokes, like a tiny little stroke her of colour and another tiny little stroke here of a different colour but when you stand back it all comes together like a mosaic of different patches of colour in space in different locations that create one sculpture with all these different points, it's kind of like abstract that comes real when you step back

J: Yeah! Like a monët? Hehe

D: Yeah exactly it's very impressionistic.

J: Also something I've been thinking about is like, so I kind of when I was, like before I started working I Had not worked much with VR before, tops an hour inside VR on different occasions, but what I think I realised when I was working in VR was like shit but now I'm standing here on a 1:1 scale but I can't reach out and change things at the same time, I thought it was more gonna be like walking around in the square and be like; well here I pull up a bench and there we do this but it was more like I had to zoom out and then move things around, more like a doll house kind of scale. And I was like: would be s cool if I could stretch the arm and then be like OK; these houses are gonna be taller, choff. But still be in correct scale, does that make sense?

D: OK, so still be on an eye level, like a 1:1 scale? Is that what you mean?

J: Yeah, to actually change like large structure while being on a 1:1 scale,

D: Yeah I guess that's more of a program limitation,

J: Yeah that would be cool.

D. Mhm that's interesting.

J: Do you have anything like, this would be so nice if it existed in some of the programs that doesn't exist? or like just a feature that you wish

D: Yeah so I, when I was doing the stuff I liked TiltBrush, But TiltBrush is, Have you used it before?

J: Yeah once.

D: Yeah it's very, very sketchy and I was leaning between either using TiltBrush for the research or using Gravity sketch I actually like the capabilities of Gravity sketch better, are you familiar with that program?

J: I have heard about it.

D: Yeah so it's basically just kind of the same concept where you sketch in VR but instead of just sketching painting basically you're using, it's more of a , there is more math behind each brush stroke and you can create surfaces and it transfers to other 3D and modelling programs better so you can take your stuff from gravity sketch and import it directly into Rhino and it preserves all of the math associated with the surfaces created and then you can manipulate it further in Rhino if you wanna to and it's all like pliable and as for TiltBrush you can still take that into Rhino or SketchUp or whatever but you basically have to export an OBJ file and then import that, but it's not like pliable material that you can move around easily it's a mesh when you bring it into a modelling software so, I, I didn't like in Gravity Sketch it's limited pallet of tools to paint, so like all you can do is like to draw a line or tube, it was very limited, where in TiltBrush there's a million different types of brushes and looks that you can get and so I chose TiltBrush ultimately because of that, I thought it was a better tool for expression because there were more tools to chose from, and I would really like to see a program which is kind of a hybrid in-between those two where you have this large pallet of tools to use and express yourself in sketch form but then you also something that is more precise where you can measure and create, and extrude a box that is three feet high or whatever and know that it's exact and that also can translate and export easily to modelling programs so that it's just a more seamless work flow I feel like right now TiltBrush in the research that I did, it's not like a seamless work flow, it's more like oh let's sketch a little bit in VR and that's really beneficial but then when I wanna go model that and ultimately when I want to make it into documentation then like, I have to redraw it somewhere else and I would If it's gonna be efficient and go into large scale adoption then that process needs to be more seamless for me. Creating something and then not having to recreate it later I another software and you just needs to transfer, those were some of my limitations that I found, one of the main ones were not having much ability for collaboration inside VR. From inside the outside kind of worked with people looking at the screen while the other person were inside VR, it was a little yeah it was good and bad and then the second limitation was scale, like you would draw something but you didn't really know if it was three feet high or whatever so those are the things like moving forward I would really, you know I think that there needs to be more development for software engineering aspects of things to create tools that better accommodate what designers need.

J: Mmm, yeah, I guess that when you are immersed if you are on a 1:1 scale you kind of have your own body as the measure...

D: Yeah, it's all kind of a guess game, you think it's about that tall and hopefully it is hehe

J: Yeah, it becomes more like you relate to the design, if you are on a 1:1 scale, but it doesn't work if you're zoomed out, yeah. Do you have any tips for people who wants to work creatively in VR?

D: hmm let's see, I guess one thing I might say and it's not an easy thing to accomplish because software changes every day and but it's like, it's such a broad spectrum of uses and types of applications of VR in Landscape Architecture so kind of like at one end it's the more sketchy and drawing, TiltBrush and Gravity Sketch, more loose conceptual drawings and there is maybe another mid area which is less about drawing and more about manipulating models and I would maybe consider that to be from my understanding what you are doing and then there is maybe another category, there is more categories than what I'm saying, but there is another category that's like photo realistic renderings, moving inside, Unreal engine, Unity, Twinmotion where it's like a polished rendered scene that you are able to immersively move around and yeah so it's like exploring all those different, yeah, categories and sub-categories and utilising VR immersively throughout the whole design process and there are so many different ways to do it like I guess that would be, it's one thing that I am still exploring and trying to work with the firm that I work with now to explore the ways of how we can do things differently and apply VR to and you know it's a constant thing, so in the coming weeks, like I told you about that pitch I had last week, maybe see if we can do things a little bit differently with VR in our process so I'll explore different software and see how they can fit into our existing design process, and yeah it's just constant change and constant adaptation and I would encourage you as much as you can to , explore all the different avenues of how VR might be used and keep pushing the limits of it.

J: mmm Then I just wonder, these graphs, you were scrolling past them before, the snakey graphs hehe, like is it possible that I could use them in my thesis?

D: sure!

J: Thank you!

D: yeah no problem, do you have them already? they should be here but if you need me to send you

J: They are quite bad quality hehe

D: OK, yeah I'm sure, I can send you like a box-link or a we-transfer link, does box-transfer work for you?

J: Anything works for me!

D: Yeah I'll send you these, I'll find them tomorrow, these look like they, this has been exported from InDesign, and the actual file,

J: Nice

D: no problem

J: Thank you, thank you Yeah that was all the questions I had, I'll send you the link to MultiBrush

D: OK, really appreciate that, and once your thesis gets up on the web send me a link.

J: Yeah sure, I've written it in English also so it will be useful for you too.

D: Cool, so you write it in both languages?

J: No I just write it in English.

D: Just English OK, cool. What other questions do you have for me?

J: I don't really have any other questions, that was it. Did you have any questions for me?

D: no I think I've asked all of them, kind of wanted to know about your background, but actually do you have any images from your research that you could share, if possible, I'd just kind of would like to see how the things went and..

J: yeah of course, well so what I have done, I don't have the full thesis here, but yeah, like a USP of my thesis is that I'm not very high-tech

D: That's OK

J: hehe yeah but so I'm kind of having the view; how is VR to work with if you're not very technically skilled and not know anything about programming and things like that. But what I've done is I have made a PDF with videos in so when I.. Gosh my computer is really slow... So there will be videos of me working inside VR inside the PDF.

D: So is that, are you doing that as an interactive PDF or is that an online published pdf?

J: No it will be an interactive PDF, it's just so heavy right now, I don't really know what to do..

D: I guess a thing you could try is that instead of having an interactive PDF you can publish it online, I think that button is on the top right of your screen, and then it will, I think the PDF will just be in your internet browser and then it won't actually contain the video files, it will just be like an InDesign link or something where it will be referencing a video from the internet instead of in-bedded in the PDF, just keep that in mind, we're trying to experiment a little bit with that too just to show our videos in our client presentations like little snips of renderings like video graphics.

J: yeah, that's cool, I'll definitely check that out.

D and J: [Small talk]

[Computer crashed]

We talked more on zoom on my phone but more in general, and we looked at the videos from the applied sketching.

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