

Workshops in a Virtual Space

A design study of online education towards enhanced collaboration

Frida Edstam, Björn Engman Otréus, Shameer Kumar Pradhan

For Design of Sustainable Infrastructure and Urban Transformation
(TRA20/21)

Chalmers University of Technology
Sweden
December 11, 2020

Contents

1	Introduction	4
2	Background	4
2.1	Project Team	5
2.1.1	Frida Edstam	5
2.1.2	Björn Engman Otréus	5
2.1.3	Shameer Kumar Pradhan	5
2.2	Problem Definition	6
2.2.1	Space	6
2.2.2	Environment	6
2.2.3	Information	6
3	Aims and Objectives	7
4	Research Methods and Processes	7
4.1	Phase 1: Defining Project	8
4.2	Phase 2: Exploring the Present	8
4.3	Phase 3: Concept Generation	9
5	Literature Study	9
6	User Research	10
6.1	Students	10

6.2	Student Counselors	12
6.3	Teachers	13
7	Proposed Solution	15
7.1	Limitations of the Solution	15
7.2	User Requirements for the Solution	16
7.3	Solution Design	17
7.4	Main Activities Performed in a Virtual Workshop	18
7.4.1	Informal Interaction	18
7.4.2	Presentation	18
7.4.3	Collaboration	19
7.5	Implementation Details	20
8	Discussion	23
8.1	Group Work	23
8.2	Impact on the Thematic Blocks	24
8.2.1	Space	24
8.2.2	Environment	25
8.2.3	Information	26
8.2.4	Flow	27
8.2.5	Resources	27
8.3	Sustainable Development Goals	27
8.4	Ethical Aspects	28

8.5 Recommendation for Future Continuation	28
9 Conclusion	29

1 Introduction

At the end of year 2019, the pandemic of COVID-19 was first discovered (Folkhälsomyndigheten 2020). Like the butterfly effect, it got discovered in China and weeks later it swept the world like a tornado and changed everything (WHO, 2020). The pandemic has resulted in lockdowns and social distancing, higher education had to change from traditional education into digital education in just a few weeks' notice (Chalmers University 2020). Luckily the technology for digital meetings were somehow already there to save the day. Unfortunately, the technology is far from good enough to replace traditional educational methods.

Students and teachers are getting depressed and the quality of education are falling due to the need and lack of physical contact as the herd of animals' we humans are.

Almost a year has passed since Covid-19 was first discovered, and a second wave of the pandemic is once again sweeping all over the world (World Health Organisation 2020). The news tells us the vaccines are close, but is this the end of Covid-19? And will there be other pandemics? No matter what, we can't rely on resolutions for severe and undefined issues that we can't control.

2 Background

This project has been conducted as a part of the course TRA105 Design of Sustainable Infrastructure and Urban Transformation at Chalmers University of Technology. The course aims to provide a platform for students from different programs to work together on cross-disciplinary authentic problems, connected to the five areas of space, flow, information, resources and environment.

Further, a short background follows on the interdisciplinary project team and a definition of the problems focused on in the project.

2.1 Project Team

This project has been conducted by an inter-disciplinary team of three students from Chalmers University of Technology: Frida Edstam, Björn Engman Otréus, and Shameer Kumar Pradhan.

2.1.1 Frida Edstam

Frida is a 2nd year student, originally from Sweden, within the master program Industrial Design Engineering at Chalmers University. Through her education, Frida has gained knowledge and experience on creative work and problem solving through the use of design processes and methods. Further, she believes that in order to create truly good solutions, taking on a user-centered approach is of great importance.

2.1.2 Björn Engman Otréus

Björn is a Swedish 1st year student within the master program of Design and Construction Project Management and a bachelor's in civil engineering, both at Chalmers University. Björn is interested in the digital transformations that are both in the construction industry, but also in general. As an example, people all over the world have recently (the last year) started to work or get taught online due to the pandemic. This could and will affect the future development and planning of cities.

2.1.3 Shameer Kumar Pradhan

Shameer is a 2nd year graduate student in master's in software engineering and Technology program at Chalmers University. Born in the Himalayan republic of Nepal, Shameer is active in startup communities in western and southern Sweden. He is a board member of Chalmers Entrepreneurship Society. He believes in developing efficient and user-friendly solutions to problems people and the world faces. Shameer is also an avid reader.

2.2 Problem Definition

2.2.1 Space

The educational spaces at Chalmers campus Johanneberg are many. There are, for example, a wide range of different auditoriums and classrooms where lectures can be held, but there are also smaller sized group rooms where both tutoring and group works frequently take place. Due to the current pandemic, the education at campus Johanneberg is instead taking place online and remotely, with interactive teaching activities mainly utilizing the online space of the platform Zoom. With a shift from on-site to online education, the needs previously fulfilled by the physical educational spaces at campus Johanneberg, currently instead need to be fulfilled by these online spaces. Through this project, the problem of if and how the online spaces fail to fulfill these needs is further explored.

2.2.2 Environment

The study environment has changed since the pandemic of Covid-19, it has brought an increase of mental health issue among students (Fu et al. 2021) but also, a decreased motivation of both students and teacher due to social distancing. The big issues are that there is no end date of Covid-19, if it can mutate plus several theories that this is not the last pandemic in a near future. Previous mentioned issues make it very important and with a big concern whether how we can create an alternative (digital?) educational environment that fulfills the human needs and demands of interaction for a satisfied over all mental health.

2.2.3 Information

Education is a flow of information from teachers to students. Materials in printed books, web pages, audio books, videos are all information. Since the advent of the Covid-19 pandemic, impartment of education has been impacted significantly. This has led to the ways transfer of information from teachers to students, from various sources of information to readers, listeners, and viewers to be upended. Early in the pandemic, it was not

certain how education is to be provided to students. It was determined that lectures shall be conducted online through communication tool called Zoom. However, there are some downsides of online lectures. Online lectures and discussions are not as effective as physical ones. They appear to be awkward form of education as real-time interruption to ask a question or raise a point disrupts the flow haphazardly. Furthermore, for teachers, to be ‘talking’ to a void without seeing students is uncomfortable as well. They complain of having a jarring feeling when talking to a screen.

3 Aims and Objectives

The aim of this project is to pinpoint advantages and disadvantages in the present educational situation, by investigating the actual and perceptual change of the study environment by students and teachers since the pandemic of Covid-19.

This project is firstly connected to UN Sustainable Development Goals 3 and 4, but also a touch upon goal 13 (United Nations n.d.). The impact of social distancing and digitized education have led to increased mental health issues among students but also challenged the quality of education which this project aims to support. Side effects could result in reduced emissions derived from transport but also a new need and use of campus facilities.

The objective of this project is to challenge and develop a concept for a better digital space and study environment for mainly students but also teachers.

4 Research Methods and Processes

The process of this project can be divided into three project phases followed by a summarization phase, as visualized in Figure 1. Designing the process of this project, inspiration was gathered from design processes, in particular the Double Diamond methodology (Design Council 2020). The Double Diamond describes a design process in four phases, discover, define, develop and deliver. Comparing the three project phases of the project with the double

diamond model, similarities are found as discover and define correlates with phase 2 and as develop is somewhat embedded into phase 3.

Further, each of the three project phases included in the process of this project will be shortly presented and the methods included briefly described (see Figure 1).

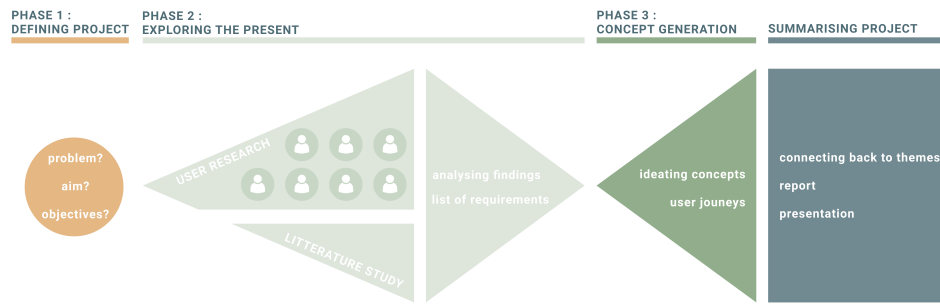


Figure 1: Project process consisting of the three phases Defining project, Exploring the present and Concept generation, followed by Summarizing the project

4.1 Phase 1: Defining Project

In the first phase of the project, the project was defined. The aim and objectives were set, and a first exploration of the problem was made.

4.2 Phase 2: Exploring the Present

Aiming to understand, rather than simply assume, the problems brought along with current educational context, Phase 2 focused on understanding

the present situation. Setting out to understand and explore the main users of the educational spaces at Chalmers, that is, teachers and students, six interviews were performed with students, teachers and student counselors, as visualized in Figure 2. The interviews were semi-structured with open-ended questions, designed to gather qualitative data on the current experience of online education and its future applicability. Due to the current pandemic restrictions, the interviews were conducted online.

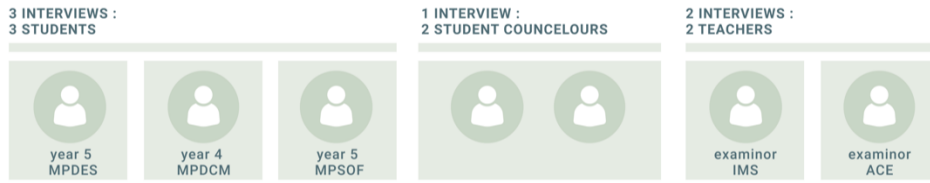


Figure 2: Interviews conducted during project

To further understand the current context of virtual reality in education, a literature study was performed using search words such as, virtual reality and education.

Lastly, the interviews were analyzed and findings from interviews and literature study was gathered into a list of requirements addressing needs and requirements on both the space, the environment and the technical features needed for successful information flow.

4.3 Phase 3: Concept Generation

Aiming at creating a concept of a virtual educational space, brainstorming was the main ideation method used. To visualize the concept, the user journey of both teachers and students were mapped.

5 Literature Study

In order to understand the current context of virtual reality in education space, several literary articles were reviewed. The result of the literature review is presented below.

A comparative study conducted by Hussein & Nätterdal (2015) identifies the advantages of VR applications in education versus its mobile counterparts. They cite an example of an application to learn astronomy called Xolius. Their study realized that VR applications are suitable for 'subjects where an interactive environment is needed' (Hussein & Nätterdal 2015).

Software presented in the paper by Piovesan et al. (2012) enables students to 'manipulate virtually the target that must be explored, analyzed and studied.' By using this tool, student can learn about automata and regular expressions. The software identifies the use of virtual reality to make learning more fun and easier for students.

For deployment of VR, classrooms provide 'unique and credible insights' (Southgate et al. 2018). The study explores, among other things, the ethics and safety concerns of using VR in classroom environment. Southgate et al. (2018) studied the usage of VR for IT and science courses in low-income households.

An example of deployment of VR apps in education outside of research is the use of VR at the University of Toronto - Ontario Institute for Studies in Education (Education n.d.). They use nearly a dozen VR applications in their classrooms. For example, they use a tool called Nearpod that embeds VR into traditional lesson plans, CBC VR for documentaries produced by CBC in VR form, and Sesqui VR for 360-degree experience of Canada's arts and innovation.

As the usage of virtual reality is increasing in education space, it is also relevant to study the use of virtual reality in the contexts of university education, pandemics, and different types of education. The group tries to leverage the knowledge received in the literature study in the development of the solution concept in this report.

6 User Research

6.1 Students

All the students we interviewed used to have physical on-campus classes before the Covid-19 pandemic. They used to visit lecture halls for classwork

and group rooms for group works. They could physically meet their lecturers and teaching assistants for counsel. They could also physically meet their classmates and friends and have lively discussions with them. For the interviewed students, the benefits of on-campus education include being able to have in-person interaction with teachers and friends and being able to have informal conversations with other students. However, the travel to and from the campus took a significant amount of time for them.

On the other hand, since the beginning of the pandemic in early January 2020, Chalmers administration mandated classes to be held online. Group meetings has been converted into virtual ones as well using tools such as Zoom. Sometimes lectures are prerecorded and uploaded to the student portal. The interviewed students regarded the recorded lectures as one of the upsides of virtual education. They also regard the no need of commute to campus as saving of time. Likewise, they cite the ability to share screens via Zoom as a benefit since they can point to objects on screen to clarify their opinion. Furthermore, virtual class provides flexibility to the students as they can watch the lecture at their own time and place.

However, the students feel as if online discussions are not as productive as they could be. They think virtual workshops and seminars are not of any use. Their fellow classmates who they don't know personally can also ghost them in virtual workshops. Similarly, asking a direct question online is difficult as it breaks the flow of lecture. They state that it is harder to understand facial expression of others since many people cannot be viewed at once during online lectures. They can only talk to one person at a time. Furthermore, there could be technical issues such as faulty laptops and dropping Wi-Fi connection.

For a successful education, the interviewed students believe that it is necessary for them to see how others react. This will help them understand if someone is interested in what you are saying or what is being taught. Seeing many people studying at once together in-person can also increase their confidence.

Almost all interviewed students selected pre-pandemic situation as the better of the two situations. They prefer going back to campus for education than studying online. The primary reason they attribute for this is the ability of having physical social contacts. However, they would not want to lose the upsides of having online classes as well. For instance, they would prefer

to have the digital lectures and in-person seminars and workshops. When presented with our proposed solution, they were excited for the potential of such solution. However, they cautioned regarding the technical, financial, and logistic constraints of implementation of such systems at Chalmers.

6.2 Student Counselors

In this study, we have interviewed two student counselors at Chalmers in order to understand what factors and parameters which can lead into bad student health. We asked the student counselors about the most common issues regarding student health, the potential mixing of online and traditional education post Covid-19 to enhance student health.

Most common issues regarding student health according to student counselors pre- and during Covid-19

Both student counselors agreed with each other that the most common issue regarding student health is stress and can be divided into two categories, stress related to studying and stress considering circumstances outside school. Furthermore, the student counselors say that there are also different issues depending on how far the student have come into their education i.e., first year in the bachelor, master thesis or in between.

First year / newly arrived students have more issues regarding that they feel alone and missing belonging in their class. Especially students that are new to the city as exchange students can feel very much alone and miss belonging. First year students can also experience high level of stress and workload due to lack of study technique.

The student counselors say that the issues concerning student health haven't changed so much during Covid-19 but increased in numbers. The students struggling more in finding a social context and motivation. Social context and being seen are both very important in the beginning of one's education and informal meetings are almost gone due to the social distancing that came with Covid-19. Though the student counselors say that it is easier for students who has studied for a couple of years since they probably already have friends in their classes and knowledge about study technique that's fit them.

Nevertheless, both categories of students (first year and seniors) may not have the optimal space nor furniture at home to create a decent study environment, apartments are either small or that you have a crowded home with parents, siblings or partner etc. This could according to the student counselors create a chain reaction that decrease the student's motivation and further leads to failing class which can cause stress. Furthermore, the student counselors say that most of the students already know how to build a functional study environment and that's important to have a study technique that's fitting the student, nevertheless the guidance is more about talking and to help the students feel seen and not alone, to help the students put words of what they feel. Some students are having a more difficult time where they need the right physical environments and tools to have laboratory work and workshops. There's also a general concern about the society regarding the pandemic which affect the students negatively.

Potential mixing of online and on-site education post Covid-19 to enhance student health

Even though this pandemic of Covid-19 has brought more negativity to student health, the student counselors says that there's a lot to learn from this distance education, all parts are not bad. They say that we will learn a lot about psycho-social health and stress that are connected to deadlines, different approaches for different type of courses. Some students like to have online lectures due to its flexibility even though some students struggle. They also mention that we have noticed how important the physical meeting and interaction between humans are, to have a social context. As they mentioned above, even though there's positive outcomes e.g., flexibility, there will probably be a rush to get back into traditional education as fast as possible.

6.3 Teachers

Through interviewing two teachers a lot of understanding was gained on their experience of changes in education from a teacher's point of view, benefits and downsides with the shift of educational space and the potential of online education post Covid-19.

Changes in education from a teacher's point of view

As well the teachers are affected by the current pandemic situations and the shift from onsite to online education that has followed. During this shift of educational space, elements such as lectures, workshops, tutoring, practice sessions, presentations and exams needs to be adapted to an online teaching context which in turn affects the teachers and their way of educating to a high extent.

A factor of change highlighted by both teachers is the interaction between students and teachers. Teaching online, the interaction is described to be less open and more as a monologue. Using zoom as the platform of interaction, both auditory and visual input can be given. Though, as the students often turn their video of, teaching is instead described by one teacher to be like talking to a wall. As visual input is important, for example, as feedback on the understanding and involvement of the students, the lack thereof can be problematic.

Benefits and downsides with the shift of educational space

The shift in educational space has also impacted from where the education can be performed. Benefits and downsides described by the teachers thus does not only address the topic of educational space, but also the topic of working remotely, as visualized in Fig. 3.

Teaching online, negative aspects mentioned are the lack of visual feedback, lack of direct interaction and the technical challenges sometimes appearing within zoom. Positive aspects are that it is less tiring to teach online but also that more students can attend the classes, for example, even though the student is slightly sick.

Working remotely, a negative aspect mentioned is bad internet connection. Positive aspects mentioned are, for example, the time saved not commuting, the good environment at home and the potential of enjoyable breaks spending time in nature or having a coffee.

The teachers as well have a lot of insight in how the students are affected by online teaching. For example, the student's well-being is described as problematic, as students to a higher extent are feeling depressed according to course evaluations. As well the final ratings of courses during Covid are described to be lower, which may indicate that as well the student's learning is affected.

Potential of online education post Covid-19

Having compared the educational context pre- and during Covid-19 it is as well of interest understanding how the education post Covid-19 can be influenced by current online and remote education. As the interviewed teachers as well are examiners, responsible for designing the courses, they are an important part of deciding whether to continuously include online elements in the classes or not.

Discussing the ideal way of teaching post pandemic, the opinions differ between the interviewed teachers. While one teacher expresses a will to fully go back to on-site education, the other teacher describes a mixture between online and on-site education as the ideal. Elements such as presentations and tutoring are both highlighted to benefit from onsite meetings as they are described to be dependent on elements such as eye contact, body language and feedback. Lectures on the other hand are described as the educational activity that has been working out the best in an online format and a possible continuation thereof is highlighted by both teachers.

Apart from being dependent upon teaching activity, there are as well other factors described to affect the success of online education. Similarly, as well the size of the class, what grade the class is targeting, but also the type of the course can be important factors to consider. For example, a teacher described that you cannot teach a math course in the same way you teach an architect course.

7 Proposed Solution

7.1 Limitations of the Solution

This study focused on the main users (stakeholders), teachers and students. Even though other stakeholders could be of interest, e.g., university board or property owners, this was firstly a study regarding environment, space and information more than financial nor organizational study.

Virtual reality in education is more useful and will contribute more to workshops than in lectures. Even though that the user research shows that different users favor different types of lectures, e.g., traditional or digital

(Zoom) lectures, there was no need to add, implement or construct new different types of lectures (see Figure 3). Further conclusions from the user research states that there was a problematic and negatively effect on psycho-social health to have collaboration activities within the present digital tool (Zoom), therefore we will limit this concept proposal to workshops.

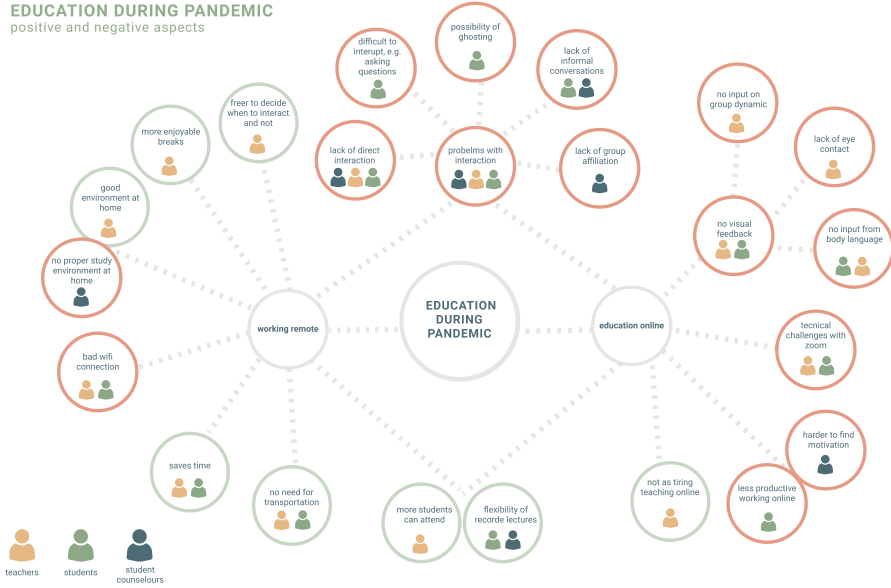


Figure 3: Positive and negative aspects of the online and remote education during the pandemic, mentioned in interviewees by teachers, students and student counsellors.

7.2 User Requirements for the Solution

One tree diagram was identified and summarized for each one of the three main thematic blocks (see Figure 4). The elements and parameters which are summarized helps to identify what is necessary for a successful education. Those elements are latter on taken in concern for the solution design. The tree diagram for environment was summarized from the user research, space was mapped from the course workshops plus previous experience attending workshops from the team, information was conducted from the brief literature study and the team.

The environmental tree diagram is connected to social sustainability and important to support mental health. The main different between traditional education and education through Zoom is the lack of visual feedback. The teachers and student feel like their alone and there is tough to feel and be presence without eye contact, facial expressions and body language. It's hard to find users and to know if they are participating the workshop or if they simply just have joined the meeting.

The tree diagram of space covers what features that is necessary in the virtual space for communication and learning when participating in a workshop e.g., writing, drawing, sharing screen. The prerequisites of the home office (physical space) are also included where e.g., the auditory environment and ergonomics are considered.

Finally, the tree diagram of information, where some crucial requirements are summarized. There are special requirements as VR googles, camera to capture expressions and movements, stable internet connection and a computer which has enough capacity to handle the virtual space.

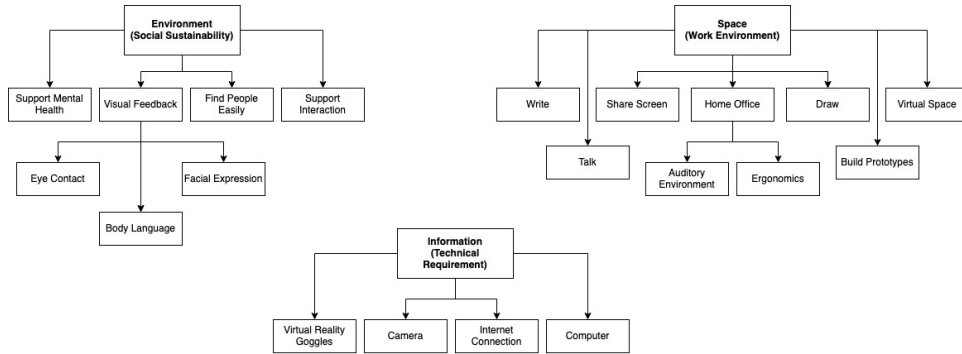


Figure 4: Tree diagrams of user requirements

7.3 Solution Design

With a starting point in the limitations decided upon and the user requirements found a concept of a solution was developed. The solution sets out to provide a virtual space that addresses the needs of students and teachers participating in a workshop and provide them with the space needed to perform the activity, with the right information at hand and with an envi-

ronment supporting a good mental health. Further, a concept covering the three main activities performed during a workshop as well as the technical implementation details of the activities performed is proposed.

7.4 Main Activities Performed in a Virtual Workshop

Setting out to design a space that fulfills the requirements of a workshop, three main activities and corresponding solutions was identified: informal interaction, presentation and collaboration. In this proposed concept the main activities are all taking place in the same virtual space, like when performing workshops in a physical environment, though the features present within each activity may change.

7.4.1 Informal Interaction

During physical workshops, informal interaction often takes place between students and teachers before and after the workshop, but also during breaks. This activity is often characterized by informal communication and free movement among participants. As informal communication is an activity highlighted by, for example, the student counselors as an important part of forming a student's social context, making informal interaction available during online virtual workshops is believed to be an important part of the solution (see Figure 5).

This solution concept proposes a virtual space enhancing informal interaction before the workshop, during the breaks but also after the workshop, as visualized in Figure 9 and 10. Similar to a physical workshop, this virtual space is designed to allow free movement within the space and auditory input and output (i.e., communication) made possible with the persons in the closest virtual surrounding.

7.4.2 Presentation

During both physical workshops but also during online workshop (i.e., utilizing zoom), elements of presentation often occurs when the teacher facilitating the workshop introduces the workshop, but also when the participating



Figure 5: Inspiration for how the activity of informal interaction might look Graham (2020)

students shares their work among each other, as visualized in Figures ??, 9, and 10. This activity is often characterized by one or a few individuals presenting and the others listening, followed by a short dialogue with questions and feedback.

To design a virtual space suitable to perform this activity this concept proposes a space where the auditory input and output but as well visual input and output (e.g., the speaker, the presentation and the audience) also are available to all participants. Further, it is proposed that the audience should be facing the person presenting, like physical lectures, to secure proper visual feedback (e.g., body language and facial expressions).

7.4.3 Collaboration

During both physical workshops and online workshops (i.e utilizing zoom) elements of collaboration often occurs as the main activity. It is characterized by group work around a certain theme, with communication and movement mainly occurring within the group. Further, a common media is often used to interact and collaborate around (e.g., a whiteboard, a paper, a digital board).



Figure 6: Inspiration for how the activity of presentations might look Graham (2020)

To design a virtual space suitable for collaboration, this concept proposes a space where collaborative medias is provided to the group, for example, through interactive tables or screens (see Figure 12). Further, auditory input and output as well as the visual output created is shared only among the group members.

7.5 Implementation Details

There are several sub-activities that users of the VR system must perform while traversing through the user journey. Being able to talk to other participants of the workshop is a key activity. The VR system requires a microphone to capture the audio from the speaker and transmit it through the internet to the listener. Listeners need earphones or headphone to hear the audio. The VR system listens to the audio and interprets the words. The system displays avatars that move their mouth accordingly in the sync with words.

Secondly, being able to see is crucial for any VR system. Participants utilize VR goggles to achieve this. In order to fulfill the user requirements

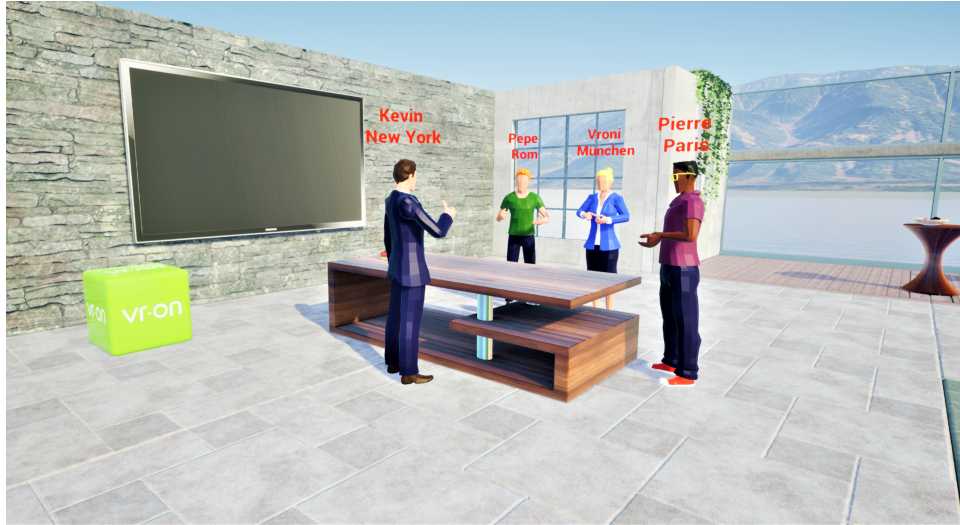


Figure 7: Inspiration for how the activity of collaboration might look VR-ON (n.d.)

of seeing facial expressions and body language of other participants, the system must capture the upper body movements of them in physical space. A camera must be placed in front of the participants. The camera captures the upper body movements, including facial expressions, and display those movements in the virtual space.

Participants should also be able present their work in the virtual space. There should also be a way to display as many screens as necessary in the virtual space. These screens can be editable by the participants i.e., the screens can be used as whiteboards or blackboards and be written over. Similarly, the screens can also view videos, data, or any other information.

In workshops participants also need to write and draw (see Figure 8. An accessory that can be used is a VR pencil (see Figure 11). It is like an ordinary pencil, however, with VR control capabilities. The VR pencil can be used to write or draw on a board or independently on empty space. The VR pencil interprets the text written or drawings into virtual space.

Typing can be achieved via two methods. One of them is to display a virtual keyboard when users move their heads. Second way of achieving this is via development of a new type of goggle. The new goggle can have the

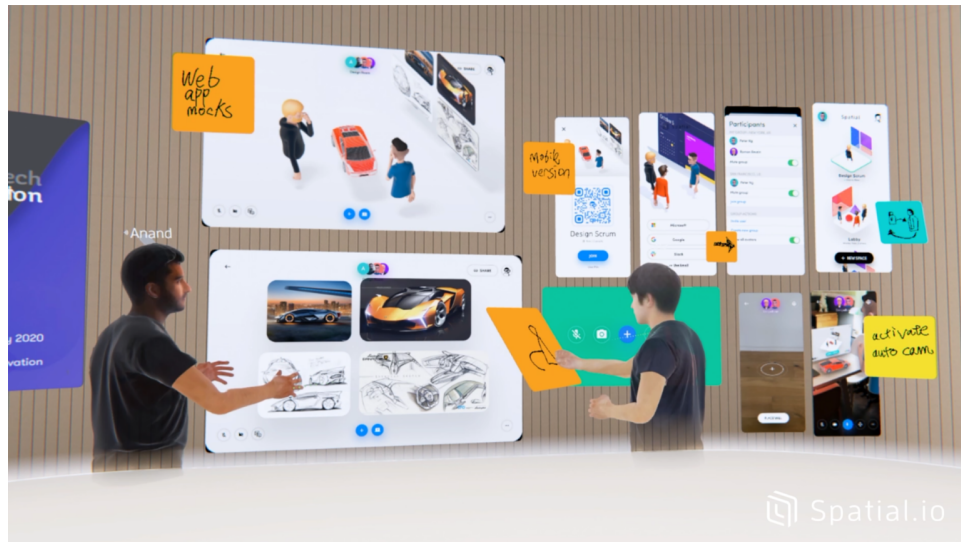


Figure 8: Inspiration for how the activity of collaboration might look Sprigg (n.d.)

functionality of being opaque and transparent view as per the need. The opaqueness of the goggle will enable VR and the transparency of it will enable AR. In order to type, users can switch to AR mode to see an actual keyboard in physical space.

In order to “go” from one point to another in a virtual space, a VR remote can be used. The VR remote can be used to point to a point in virtual space. Then the avatar will move to that point.

Finally, to find people in the virtual space, participants can move there head around and look for the person. Once the person is found, the participant can “go” towards the person. Similarly, the name of the person to find can be typed. The avatar can then be “teleported” to the place where the searched person is located.



Figure 9: The user journey of a student attending a VR workshop and the main and sub-activities being performed doing so.

8 Discussion

8.1 Group Work

The group formed for this study composed of students from three different programs. The students brought in different perspectives and life experiences to this study. Collaboration between them has been reflective, productive, and effective. Shameer, being a student of information technology devised the technicalities of the virtual reality system of this thesis. Frida, being a student of industrial design engineering, contributed with knowledge and experience in user research and the design process. Björn, being a student of Design and Construction Management, contributed with comprehensive knowledge about the field of civil engineering.

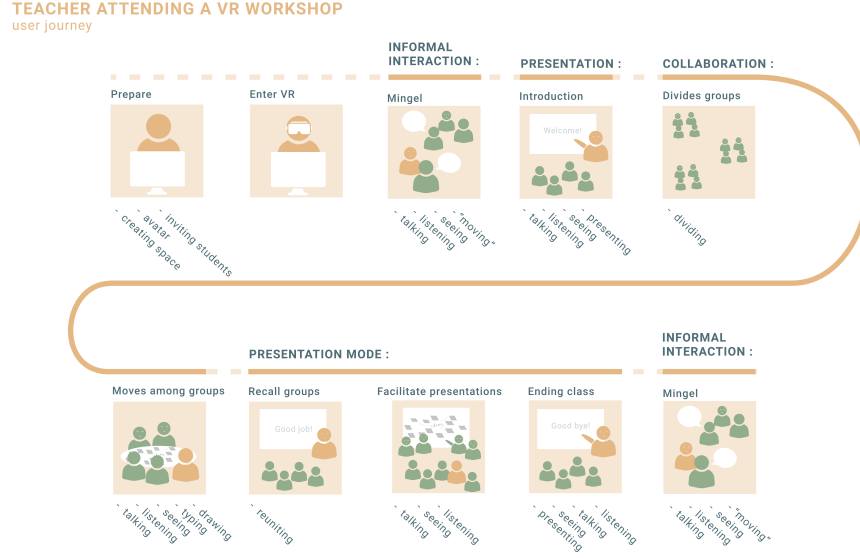


Figure 10: The user journey of a teacher attending a VR workshop and the main and sub-activities being performed doing so.

8.2 Impact on the Thematic Blocks

8.2.1 Space

The proposed concept of a virtual workshop space addresses three different kind of spaces; the physical workshop spaces, the online workshop spaces (i.e., zoom) and the proposed virtual workshop space. Implementing our proposed virtual solution might have an impact on both physical and online spaces, as it provides an alternative to both these currently used spaces. Firstly, as the virtual space is argued to have the potential of fulfilling the user requirements to a larger extent than currently used online spaces, the need of these might decline. Similarly, through providing a good option to physical spaces, it might reduce the physical spaces needed for workshops at campus Johanneberg.

Thus, it is interesting to reflect upon whether a virtual space can provide a good option to a physical space. Comparing the usage of virtual and physical spaces it can be argued that utilizing virtual spaces may have benefits

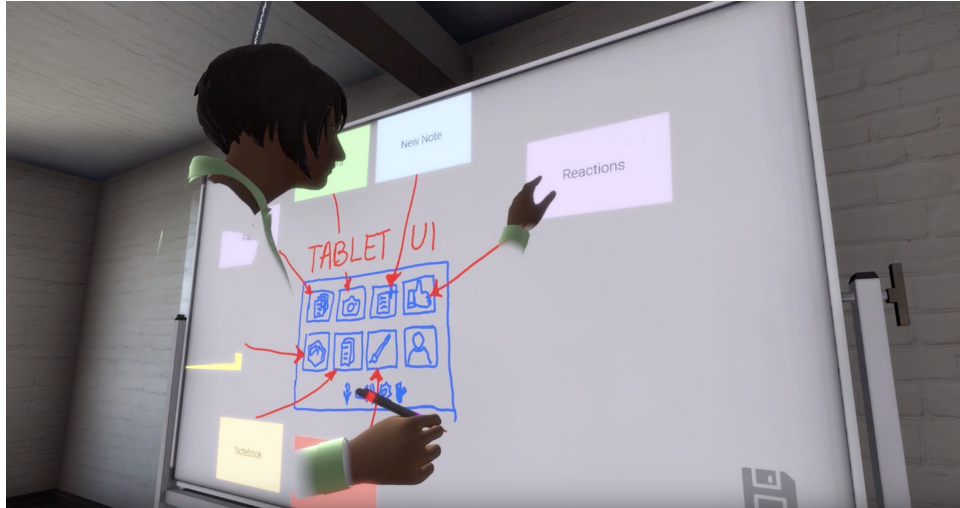


Figure 11: Inspiration for VR pencil XR World Academy (n.d.)

as, firstly, they provide an opportunity to connect the space of Johanneberg with that of other universities, and secondly, as it provides a space that is easier and more cost efficient to adapt to a certain workshop (e.g., number of screens, number of participants, medias utilized).

8.2.2 Environment

The environment may be the most important block in this project. In order to create an environment that supports mental health among students, providing a space supporting dialogues and interactions, by following the user requirements it hopefully will have a positive impact and decrease psychosocial health issues among students. Even though that this project mainly focuses on the virtual space and environment, one must not forget the home office that is needed to implement this concept (see Figure 12. Possible factors that could be a challenge when having a home office is that there could also be noise at home, while facilities built for education are mostly built with good acoustics and noise reduction.



Figure 12: Inspiration for how VR might be utilized at a home office Stambol (2020)

8.2.3 Information

Body language and facial expressions are two types of information transmitted via the proposed VR system. Unlike in existing tools such as Zoom, usage of the system would make it possible for participants of workshops to project their body language and facial expression in the virtual space.

Similarly, knowledge and information can be exchanged bi-directionally through the VR system. Since, it is a virtual manifestation of a real physical space, participants can gather in the virtual space and conduct discussions and presentations. This facilitates dialogue between teachers and students rather than a monologue from the teacher like that in a traditional online lecture.

Physical world contains more informational noise compared to virtual one. For instance, other participants talking in the background, a running fan, etc. can contribute to the informational noise. The ‘noise’ does not pertain to auditory ones only. There can also be visual noise. In a virtual space, through the proposed system, one can selectively remove informational noise. This makes transfer of information more efficient and effective.

8.2.4 Flow

More distance education from home (Online) may result in less people commuting to campus Johanneberg, which in turn will affect the flow of people in and around campus. Therefore, the needs of transportation and transport pollution will decrease. On the other hand, it could increase “local” movement where students and teacher live. Although local movement which mean shorter distances, may attract more sustainable transportation like bicycles and walking instead of cars and buses.

8.2.5 Resources

Many of the resources in planet Earth are limited. Since agricultural and industrial revolutions, people have consumed a significant number of resources. Because of over extraction, many of the resources are in verge of depletion. Resource depletion would result in additional man-made calamities on top of natural ones. For example, wars could be launched for drinking water. This project aims to reduce the usage of campus facilities so that resources are saved in the campus. However, it would require more technical accessories such as VR goggles, computer/laptop, internet connection, and home office space for each user.

8.3 Sustainable Development Goals

This concept of education in a virtual space could hopefully have a positive impact on three of UN Sustainable Development Goals. Good health and well-being through a better educational Environment and decreased psycho-social health issues. Quality education through better collaboration and discussions in the new Space instead of the present (Zoom). Also, Climate action through Information and Technology which will reduce traffic pollution.

The strengths of this project which hopefully can support the trustworthiness of this concept to be sustainable and functional, is the user research. The users (Students and Teachers) have given their thoughts regarding good quality education and work environment. This has been followed and serves as the backbone of the concept.

8.4 Ethical Aspects

The proposed virtual reality system requires the users to have a camera capture their upper body movements, including their facial expressions. This functionality is required to enable more accurate movements and expressions of the avatars in virtual space. However, it can lead to participants feeling “watched”. Since they would have the camera recording their every move and their background, they are not certain about what is being recorded at times since they would be wearing a VR goggle.

The proposed solution also assumes that the users (both teachers and students) are technically knowledgeable. Although, the solution can be designed and developed to make it as easy to use and intuitive as possible, it is not certain that everybody will be able to use it. Also, a significant ethical question to answer is whether Chalmers can mandate students to use the VR system or not, as it changes the norm of how education is imparted.

8.5 Recommendation for Future Continuation

Continuing this project there is still many aspects that needs to be further studied and iterations that needs to be done to create a solution suitable to utilize within Chalmers University, as visualized in Figure 13.

Firstly, the project focus has the requirements of the main users of a virtual workshop space (I.e. teachers and students), though, there are many other stakeholders and actors that needs to be involved. Thus, it is suggested that further dialogues are initiated to understand, for example, stakeholder requirements.

Secondly, this project has focused on creating a concept regarding space, information and environment within a virtual educational space and have not put any focus on, for example, financial or organizational studies. Thus, it is suggested that more research is done, and the concept is developed to as well include a feasible design of the service of providing virtual education as well as the process of implementing and maintaining it.

Thirdly, even though this project has focused on the users and their requirements, there is still a lot to learn to create a solution that successfully addresses the user needs. Thus, it is suggested that the concept is further

developed in close contact with the user, i.e., through performing continuous user testing and iterations.

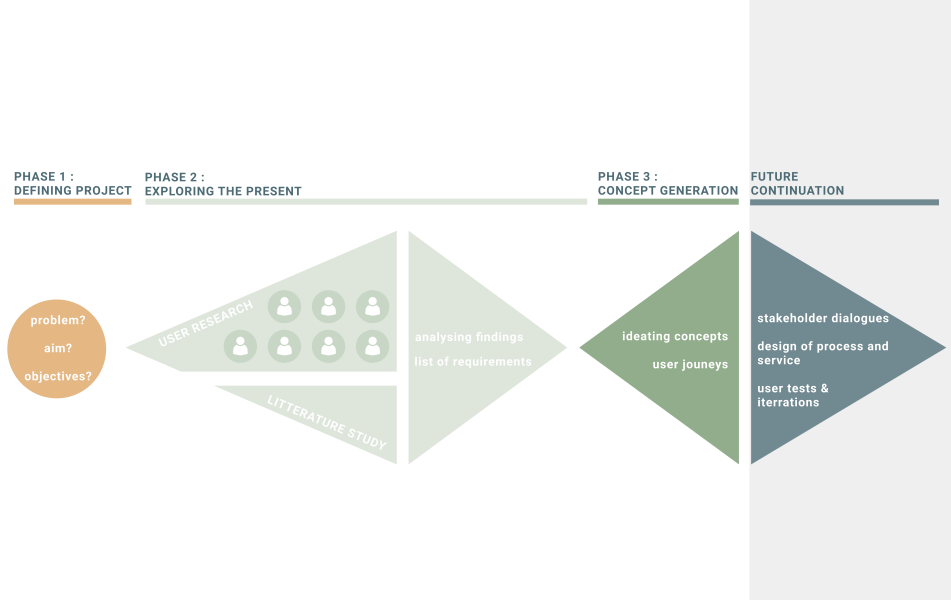


Figure 13: Potential future continuation of the project

9 Conclusion

Since the advent of virtual reality systems their application has grown significantly. However, a promising area of virtual reality is training. VR is used to train professionals working in dangerous areas such as mining. Usage of virtual reality is also growing in school and university education. In this report, the group proposed a virtual reality system tailored for workshops at Chalmers. There are several benefits that the proposed system would provide to teachers and students at Chalmers. Despite of the benefits, there are also some constraints, including constraints on applications of the system at Chalmers. Further improvement on the design and application of the proposed system can make it more suitable for full-scale implementation at Chalmers and other universities.

References

- Chalmers University (2020), ‘Chalmers ställer om till verksamhet på distans’.
URL: <https://www.chalmers.se/sv/nyheter/Sidor/Chalmers-staller-om-till-verksamhet-pa-distans.aspx>
- Design Council (2020), ‘What is the framework for innovation? design council’s evolved double diamond’.
URL: <https://www.designcouncil.org.uk/news-opinion/what-framework-innovation-design-councils-evolved-double-diamond>
- Education, O. I. F. S. I. (n.d.), ‘Virtual field trips and general vr content apps’.
URL: <https://guides.library.utoronto.ca/c.php?g=607624p=4494048>
- Folkhälsomyndigheten (2020), ‘Om viruset och sjukdomen’.
URL: <https://www.folkhalsomyndigheten.se/smittskyddsbereadskap/utbrott/aktuella-utbrott/covid-19/om-sjukdomen-och-smittspridning/om-viruset-och-sjukdomen/>
- Fu, W., Yan, S., Zong, Q., Anderson-Luxford, D., Song, X., Lv, Z. & Lv, C. (2021), ‘Mental health of college students during the covid-19 epidemic in china’, *Journal of Affective Disorders* pp. 7–10. DOI: 10.1016/j.jad.2020.11.032.
- Graham, P. (2020), ‘Spatial opens vr/ar collaboration platform to all, from smartphones to oculus quest’.
URL: <https://www.vrfocus.com/2020/05/spatial-opens-vr-ar-collaboration-platform-to-all-from-smartphones-to-oculus-quest/>
- Hussein, M. & Nätterdal, C. (2015), The benefits of virtual reality in education: A comparison study.
- Piovesan, S. D., Passerino, L. M. & Pereira, A. S. (2012), Virtual reality as a tool in the education, in D. G. Sampson, J. M. Spector, D. Ifenthaler & P. Isaías, eds, ‘Proceedings of the IADIS International Conference on Cognition and Exploratory Learning in the Digital Age 2012’, IADIS.
- Southgate, E., Smith, S. P., Cividino, C., Saxby, S., Kilham, J., Eather, G., Scevak, J., Summerville, D., Buchanan, R. & Bergin, C. (2018), ‘Embedding immersive virtual reality in classrooms: Ethical, organisational

and educational lessons in bridging research and practice’, *International Journal of Child-Computer Interaction* . DOI: 10.1016/j.ijcci.2018.10.002.

Sprigg, S. (n.d.), ‘Vr collaboration platform spatial launches on the oculus quest store with new features’.

URL: <https://www.auganix.org/vr-collaboration-platform-spatial-launches-on-the-oculus-quest-store-with-new-features/>

Stambol (2020), ‘Remote collaboration via vr ar at home’.

URL: <https://www.stambol.com/2020/03/16/remote-collaboration-via-vr-ar-at-home/>

United Nations (n.d.), ‘The 17 goals’.

URL: <https://sdgs.un.org>

VR-ON (n.d.), ‘Vr as a solution to multi-user collaboration’.

URL: <https://blog.vr-on.com/vr-as-a-solution-to-multi-user-collaboration>

World Health Organisation (2020), ‘Who coronavirus disease (covid-19) dashboard’.

URL: <https://covid19.who.int>

XR World Academy (n.d.), ‘Virtual collaboration’.

URL: <https://xrworldacademy.com/virtual-collaboration>