Co-Designing and Learning in Virtual Reality: Development of Tool for Alcohol Resistance Training

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Abstract: This paper presents the design process of a Danish educational virtual reality (VR) application for alcohol prevention. Denmark is one on the countries in Europe with the highest alcohol consumption among adolescents. Alcohol abuse is a risk factor for a variety of diseases and contributes as a significant factor to motor vehicle accidents. The application offers first-hand experiences with alcohol in a safe environment. This is done by simulating a party situation using 125 different 360-degree movie sequences and displaying it in a virtual reality headset. The users create their own experience through a choose your own adventure game experience. The experience is designed to acquire skills for recognizing and handling peer pressure, which has been found to be one of the main reasons for drinking initiation. These skills are acquired though experimental learning. The application is a product of a co-design process involving 10 students (aged 18-28) studying film making and game design at Askov Folk High School (a special kind of Danish boarding school without exams for young adults), Denmark, their teachers, alcohol experts from social services and researchers with expertise within health promotion, social marketing, VR, interaction design and game development. Additionally, 35 students from Askov Boarding School (aged 15-17) participated as actors and extras. This article contributes to research within development of 360-degree video applications for experimental learning with a practical example. The iterative design process of the application, containing exploration of key concepts, concept design, prototype design, pre-usability testing, innovation design and usability test is described, as well as our reflections on virtual experimental learning in the application.

Keywords: Virtual reality, 360-degree video, co-design, alcohol prevention, learning, interaction

1. Introduction

This article is a revised and updated version of *Co-designing an Immersive and Interactive Alcohol Resistance Training Tool Using 360-Degree video* (Lyk et al., 2019). Additional sections on innovation design, usability test and thoughts on virtual experimental learning are added.

Denmark has one of the highest rates of substance misuse among adolescents (European Monitoring Center on Alcohol and Drugs, 2016) and lately an increase in harmful alcohol use have been reported (Tolstrup et al., 2019). Risky drinking may have many negative consequences, for example higher risk of a wide variety of diseases (Barbor et al., 2010), negative impact on school and education (Wechsler et al., 1994) and plays a significant role in suicides and motor vehicle accidents (Barbor et al. 2010). The earlier adolescents start drinking alcohol, the more likely it is that they will abuse alcohol and other drugs later in life (Jenningson, 2004).

This article describes the development of the educational tool *VR FestLab* (ed. In English PartyLab). VR FestLab is a Virtual Reality (VR) application, where adolescents aged 15 to 17 can experiment with intake of alcohol without the physical risks this behaviour could lead to in real life. Users are invited to a virtual party, where they

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are continuously exposed to decision-making scenarios. These choices shape the plot and thus each user creates their own unique experience.
By using 360-degree video, the user gets surrounded by the constructed world and can get an immersive (VR), hands-on experience, which is central in a learning process (Kolb, 1984; Piaget, 2001). Through a gamified user interface, the user can keep track of their current blood alcohol concentration, giving them the opportunity to reflect on their behaviour and change approach if necessary. Moreover, users will experience peer pressure to varying degrees. The goal is that users learn to recognize these situations and develop skills for handling them, so that they are able to make a more educated choice, when they experience similar situations in real life settings.

The application uses the Google Cardboard platform (Google VR, 2019). Google Cardboard is an inexpensive VR headset made of cardboard, in which the user places her phone and together the phone and cardboard headset make up a simple VR headset. Once the application is finalised, it will be available free of charge on both Google Play (for android users) and App Store (for iOs devices). The application is targeted for school use, but with this solution the users can continue their exploration beyond the classroom. For testing the Oculus Quest (Oculus, 2019) was used.

The project was co-created with adolescents and other stakeholders with an empowerment-based living lab approach (Stock et al., 2019; Vallentin-Holbech et al. 2020). The adolescents involved in this project contributed with their experience showing how young people behave and communicate in social contexts and how young people party in Denmark today. This contrasts with most alcohol prevention programs. Often the target group – the adolescents – plays no or a very limited role in the development of teaching material for alcohol prevention. Instead, experts and researchers take the control in the development (Dietrich et al., 2016, 2017; Hurley et al., 2019; McKay et al., 2012a, 2012b; Vogl et al., 2009).

The project consists of seven phases: Exploration of key concepts, concept design, prototype design, pre-usability test, innovation design, usability test and final testing. This article describes phase one to six, focusing on the technical development and the design choices related to this.

2. Background

In a constructivist view, learning happens most effectively when the learner is active and gets first-hand experience with the concept that is to be learned (Piaget, 2001; Papert, 1993; Kolb, 1984). In cases such as adolescent drinking firsthand experience is not desirable as a learning environment, and alternate settings are needed. New technologies like VR and 360-degree video can be helpful. 360-degree videos can immerse users and it can enable them to take charge. As noted by Papert (1993), best learning takes place exactly when the learner takes charge.

2.1 360-degree video and VR

360-degree videos are recorded in all directions simultaneously. In this project, GoPro Fusion is used (Gopro.com, 2019). When the video clip is played later, the user takes the position of the camera and has full control of the viewing direction. The video can be played in a head mounted display (HMD).

When talking about VR and 360-degree video, *immersion* is very central. Murray (1997) compares immersion to being enclosed in water and therefore surrounded by another reality. Elmezeny, Edenhofer and Wimmer (2018) have investigated immersion in relation to 360-degree video, comparing 360-degree video with traditional video formats and VR. They describe two main categories of immersion, *narrative immersion,* which is *"… influenced by the setting, as well as by interplay of story, characters, and viewer integration"* and *technical immersion*, which *"… manifests through cues to direct the viewer's attention and cues to acknowledge the viewer as a part of the virtual environment."*

2.2 Experience based learning

According to constructivism learning theory, learning is an active construction of knowledge rather than a transfer of knowledge (Papert, 1993; Piaget, 1947; Kolb, 1984). Learning is constructed though interaction with the world and though this interaction mental schemas are constructed, from which we relate to the world.
Papert (1993) mentions computers as a key tool, when trying to make (new) learning more accessible. It is not always possible to let the learner interact with the concept that needs to be learned in a real-world setting.

However, by making a simulated world, where the learner can experiment, set up hypothesis and test them, the learner can still get a first-hand experience when using technologies.

3. Situating the Design Case

Previously, anti-alcohol campaigns have mainly been based on moral encouragement, fear campaigns, or presenting factual knowledge to adolescents. While some programs have delivered positive outcomes (see Hurley et al., 2019) others have failed to deliver the desired outcome (Faggiano et al., 2017).

Recently, it has been found that one of the main reasons why young people start drinking is peer pressure (Hendricks, Saval and Florence, 2015; Flay, 2000). This knowledge has led to better and more effective anti-alcohol campaigns.

Blurred Minds (Dietrich et al., 2019) is an Australian alcohol prevention program. The program includes the world's first VR simulation, which aims to train adolescents' ability to withstand peer pressure. The application is made as a gamified party, where the user makes various choices along the way, and depending on the choices they experience different consequences (Dietrich et al., 2019).

In the current project, a similar application was developed for the Danish context. This project drew on the experience gained by Blurred Minds developers and the feedback they got from their users (Durl, Trischler and Dietrich, 2017). The development took place in a co-design process, where one of the developers behind Blurred Minds was a part of the development group. The group included a diverse range of stakeholders including the Askov Folk High School's film teacher, film students, a game design teacher, game design students, alcohol experts from social services and health promotion, game design, VR and interaction design experts. 35 students, aged 14-18 years, from Askov Boarding School participated in the production as actors and extras. The Folk High School was selected because it has students from all regions of Denmark, and therefore represents the diversity of potential user groups.

4. Related work

The combination of letting users create their own experience while being immersed in a 360-degree simulation is quite unique. During our literature search we did not come across any similar projects.

However, the idea of letting the users create their own story, by making a number of choices, is not new. In the book series 'Choose your Own Adventure' published by Bantam Books the reader is the central character. The reader faces two or three options for every few pages and depending of the reader's choices the story unfolds in different ways (Kraft, 1981). The Netflix film Black Mirror: Bandersnatch (IMDb, 2019) is inspired from 'Choose your Own Adventure'. The film consists of several movie sequences, which are put together based on the viewer's choices, as also seen in the FestLab application.

FestLab builds on experience-based learning. Therefore, we want the user to get experiences as realistic as possible in the application, which is why 360-degree video is used.

360-degree video's ability to immerse users is utilized in many different contexts, for example it has been proven to be effective for exposure therapy. VR has also previously been used for treatment of alcohol and nicotine addiction (Trahan et al., 2019). Users were exposed to environments activating their cravings, but contrary to the real world, these environments were carefully controlled and customized by a therapist. The same approach has been used for treatment of posttraumatic stress disorder (PTSD), where patients were exposed to trauma relevant environments (Rizzo et. al, 2015) and for treatment of anxiety (Carl et. al. 2019). These projects are good examples of virtual reality being able to foster presence and trigger emotions in users.

In an educational context VR can be used to give students a first-hand experience. In an earlier project VR and augmented reality (AR) teaching material about the solar system was co-designed with 5th grade students and their teacher. The material consisted of a traditional compendium with text and pictures and a mobile application. Most pages had additional simulations (in AR or VR), which could be accessed through the application. As an example, the students were able to take a walk by the Barringer crater or study the planets orbits around the sun in a 3D simulation (Majgaard et al., 2017).

360-degree video has also earlier been used to educate adolescents about binge drinking. In the videos 'Decisions: Party's Over', users can follow a party from four different persons' perspective and experience the dangers of binge drinking (DRINKiQ, 2018). Contrary to FestLab the videos are not interactive, and the users are locked to a fixed timeline.

5. Methodology

The project is an iterative design process which used the Living Lab approach *"co-creat[e] innovation through the involvement of aware users in a real-life setting"* (Dell'Era and Landoni, 2014). This means that the users are co-creators though the whole process, from the first conceptual development phase through prototyping to launch of the finished product.

The project will go through seven phases, see figure 1 below: Exploration of key concepts, concept design, prototype design, pre-usability testing, innovation design, usability test and finally testing to find the effect on alcohol consumption among adolescents in Denmark. Currently, we are preparing for the last test.

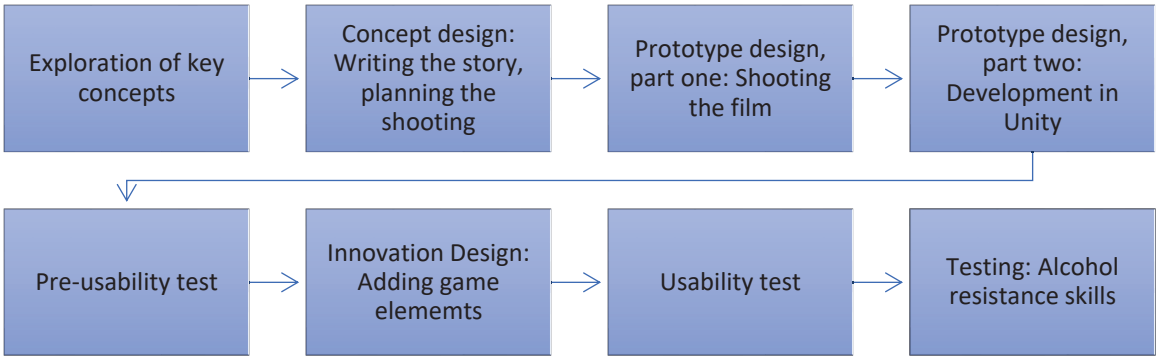

Figure 1:. The seven phases of development.

In the following we describe the design process for the first six phases.
All quotes from interviews were translated from Danish to English by the author.

6. Exploration of key concepts

The first iteration consisted of an exploration of the key concepts and testing the 360-degree camera.

To explore the key concepts, the participants from the development group were invited to test the Australian VR House Party application and were later asked to share and discuss their experiences. The project leader of the VR House Party shared his experiences from developing the application, summarized challenges that they experienced, shared feedback from their users and provided recommendations on how the application could be improved.

Subsequently, the students and stakeholders together made a list of features, which the Danish application should contain. For example, the team wanted a more realistic calculation of the blood alcohol concentration (BAC), which in the Blurred Mind's VR House Party was deemed to be unrealistic. For example, the user could pass out after as little as three drinks and it did not seem to matter whether you drank 3 drinks in a row or spread them over a longer period.

The new application should also be more consistent in giving instant feedback to the user. Several of the students from the development group had been confused when they suddenly experienced a sudden end to the game. Additionally, an ending scene, which evaluated the evening, was deemed to be a valuable addition.
It was also decided that the experience should contain more elements of gamification to further boost engagement. Therefore, mini games based on popular drinking games (e.g. 'Never I have Never' and 'Beer Pong') were included.

Among the feedback that the developer of VR House Party had received from users was to gain more control over their along the opportunity to make more choices. According to Papert (1993) the best learning takes place when the user controls choices and it was decided that the user should be placed in the middle of the party and be in charge of who to talk to and where to go.

The students in the development team also commented on the distance from the user to other people in the Blurred Mind application, which in some scenes was deemed to be too far, resulting in the user feeling distanced and that they were observing instead of being part of the action. According to Sheik et al. (2016), the right distance between characters and the camera can increase emotional immersion.

7. Prototype design: Writing the story/planning the shooting

After the first session and brainstorming with the development team, the students from the film and game design course and their teachers started working on the manuscript. First, they decided on different types of personalities, made their personas and then flowcharts for each person. The students' work was accepted by the rest of the development team with minor changes. This made the students feel heard and included in the process. Students reported they felt even more motivated to continue to contribute to the project (Vallentin-Holbech et al., 2020).

Figure 2 shows the scene with one of the main characters. Each oval represents a film sequence and the rhombus the choices the users get. In this scene, the story varies based on the gender selected on entry to the simulation (red and blue).

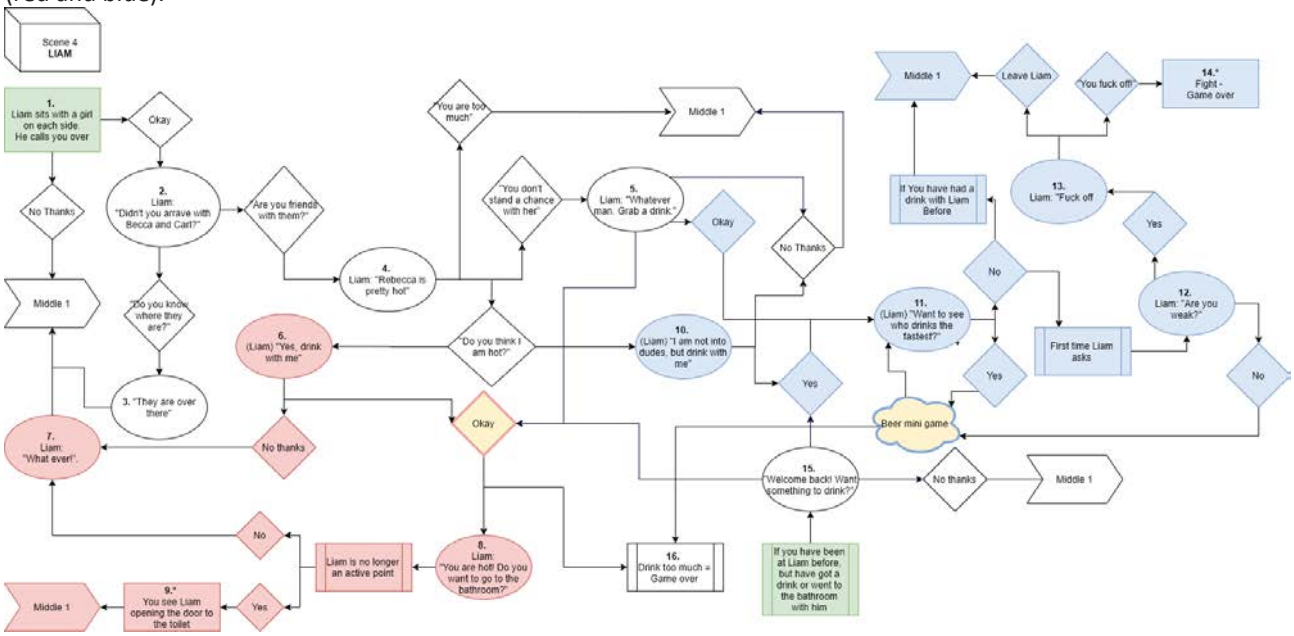

Figure 2: Flowchart of scene 4.

The finished manuscript ended up with eleven scenes consisting of 125 different film sequences. The students from the film course then casted actors and extras from the boarding school.

8. Prototype design part one: Shooting the film

The recording of the 360-film was completed with a team of film school students. Different roles were assigned including sound technician, line-producer, stage designer and instructor (see figure 3). One of the researchers with VR experience was responsible for the operation of the camera.

One of the challenges of filming 360-degree video is that the film team cannot be present in the room, where the recording takes place – otherwise they are visible in the clips. Therefore, the camera was controlled through the GoPro application on a tablet (Gopro.com, 2019).

Figure 3: Students from Askov Folk School's Film course getting ready to film.

In some scenes the team took advantage of the fact that the camera filmed two times 180-degree footage, which is not stitched together until afterwards. It made it possible to record background and foreground in two different recordings, so no actors and extras needed to be on the set all the time.

Figure 4. GoPro Fusion setup

Figure 4 shows the setup of the camera. The recordings were made over three days, of which 9 hours were filmed almost without interruptions on the last two days. The camera only holds battery for a couple of hours, so a power bank was connected and placed in a bag, since a wire to a power outlet would have been visible in the recordings.

An external microphone was attached in the middle of the tripod. GoPro Fusion does record audio, but the quality is not good enough for the purpose of this project.

9. Prototype design part two: Development in Unity

The recordings were stitched together afterwards and edited. Sound and movie were combined and then clips were implemented in Unity.

For each scene in the manuscript, a scene in Unity was made. In figure 5, scene 4 the character Liam is seen. At the bottom the flowchart is placed to maintain the overview. Each of the black circles is a sphere with a movie clip.

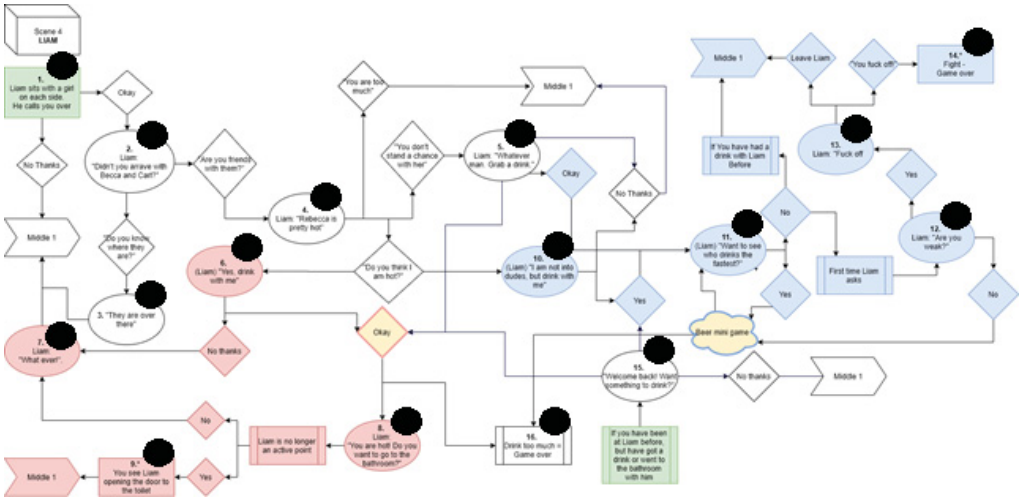

Figure 5: Scene 4 with Liam in Unity.

The spheres have a specific material, which makes the video play on the inside of it, see figure 6. By placing the camera and thus the users in the middle of the sphere, they are surrounded by the video and get an immersive experience.

Figure 6: Video playing on the inside of a sphere.

The spheres have a canvas and on this the buttons that make up the interaction and links between the clips are placed. They are not visible from the start, but when the video clip is almost finished, the different options for the user are shown. The user now chooses from a list of two to six options. She does this by staring at the button for about 1 second. First a small animation appears to indicate that the button is clickable and then – if she keeps staring – the button will be clicked. The click calls the function SphereChanger if the option leads to a new clip within the same scene and otherwise the script SceneChanger if the clip leads to a new clip in another scene.

To calculate the BAC, the chosen gender and average weight for a 16-year-old female or male and game time were used. One minute in real time corresponds to 30 minutes in the simulation. This was chosen to keep the play time per usage down to 10-12 minutes and thereby preventing users from experiencing too much of the application at first try, which could limit replayability and subsequent class discussions. The time is shown at the top of the screen and is always visible. The BAC is also shown here. It looks like a classic game health bar and shows the BAC in percent, see figure 7. 100% green is sober, and the BAC bar then gets more and more red as the user gets drunk. 100% red corresponds to a BAC at 2, which is very high and results in blackout. When the user chooses to take an alcoholic drink the script BACCalculation is called. This script calculates the current BAC and updates the user interface (UI). It uses the correct algorithm for BAC calculation (Becker & Nielsen, 2019).

BAC calculation algorithm:

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Female: Alcohol consumed in grams / (body Weight in kg x 60 %) - (0,15 x hours from drinking start) =
BAC
Male: Alcohol consumed in grams / (body Weight in kg x 70 %) - (0,15 x hours from drinking start) = BAC
```

The BAC bar is updated continuously, so it is visible to the user that the BAC changes over time.

Figure 7: UI: Digital clock and BAC bar.

10. Pre-usability test

When the basic functionality was done, a (pre)usability test was made. The goal of this test was primarily to find bugs, evaluate the interaction and UI and get ideas for gamification of the app.

Four students from a new Askov Game design course volunteered to participate. They were aged 21-24 and therefore they were older than our target group, but for the purpose of a usability test of game elements and potential improvements as well as obtaining ideas for additional gamification elements, they were deemed suitable.

Each of them first tried the application for about ten minutes under passive observation of members of the research team. The researchers made notes of their observations along the way. Afterwards semi-structured interviews of the students took place. The students were interviewed in pairs to make them feel more confident and feel that they could talk more openly. Additionally, it could come in handy when talking about future gamification of the application because the students are used to brainstorming together and often pairs seem to get better ideas than individuals (Fullerton, 2014). The downside of making interviews in pairs is of course dominant respondents, which can influence the other. Sound recording of the interviews were made.

Thereafter, quotes from the interviews and notes from the observations were compared and divided into themes.

10.1 Results and discussion of results

10.1.1 BAC bar – clarification of purpose, virtual position and introducing animations

It was found that none of the students knew the purpose of the BAC bar before they had their first alcoholic drink and one of them did not understand the connection between drinking alcohol and the bar decreasing until he was almost finished playing. It was suggested that the bar should have a caption for example “Per Mille Meter” or the symbol for per thousand. The green/red colors of the bar made two of the participants think of a classic health bar and as a consequence of that, they did not really want to drink alcohol since it would decrease their “health”/”life”. This might limit student’s experimentation in the app, which is the opposite of what we want – the students should experiment as much as possible in this safe environment. This involves both “good” and “bad” experiences with alcohol as our hypothesis is that experiences in the app will give students knowledge and tools they can later apply in these situations in real life. According to Papert (1993) the natural learning path

contains false theories; which students learn as much from as they do from the true ones. Therefore, it is important that they feel that they can experiment freely and do not feel that drinking alcohol in the application is a (completely) unwanted act.

As a solution to this issue one of the participants suggested making the bar all white, because this would be more neutral and most likely not directly make the users think of "loosing life" like in a game. Furthermore, they suggested to make the decrease of BAC over time more visible. For example, only show the decrease on the bar when a scene ended so that the decrease would be bigger. He also mentioned that adding an animation could make it even more visible and more fun to look at.

The association between the BAC bar and a health bar made one of the participants search for a clear goal *"… like in a game".* He was uncertain of what to do in the simulation. He and the other participant with whom he was interviewed with, discussed this issue. They knew the simulation was not a game, but the BAC bar made them feel like they needed to "stay alive" to a certain point to face an upcoming challenge. One of them suggested that the goal of the application should be clearer, for example a short explanation in the start menu. The main use of the application will at a later point be in schools, where it will be placed in a didactic context, so in that situation it might not be a problem. But the application will also be available on Google Play (for Android users) and App Store (for iOS users) and in that context the purpose must be clear.

It was also suggested to change the position of the BAC bar and the digital clock. One of the participants felt that the digital clock (at the top of the screen right in the middle, above the BAC bar) amounted to a pressure. He instead suggested to place the clock at the bottom of the screen in the right side, where clocks normally – according to him – are placed in games.

The participants expressed a desire for an opportunity to lower the BAC by other causes than time, for example drinking water or going to the bathroom to pee. But in real life drinking water or going to the bathroom will not reduce BAC (Healthline, 2020) and therefore this feedback could not be implemented.

10.1.2 Interaction and feedback

The gaze interaction worked well according to the participants. They understood how to make choices and praised the interaction. They, of course, have more experience with games (and VR) than the average adolescent.

It was also suggested to add an animation or sound effects when the user drinks and throws up. This could give the user a clear feedback and let them know what is happening, which according to the students was not always obvious. They also mentioned giving the user warnings when they are close to passing out. It could be done with a blurry effect or an animation of blinking slowly.

10.1.3 Immersion

The participants all got caught up in the story and they reported they wanted to experience more. Two students described a feeling of "being there" at the party. One of them said that it was especially in the center point, where the user stands in the middle of the party and can choose whom to go talk to. This is interesting because at this point, the user is standing by himself or herself and they are only observing. It is not an ideal situation for immersion since the users presence in the scene is not acknowledged by the others guests and the narrative is paused (Elmezeny, Edenhofer and Wimmer, 2018). The explanation for this could be that it is at those points in the story that they feel most in control. It was more expected to see immersion in the scenes containing more interaction. The users' presence is to a greater extent acknowledged there, which is one of the characteristics of technical immersion (Elmezeny, Edenhofer and Wimmer, 2018).

Minor bugs were also found, for example wrong placement of buttons and a line though the picture sometimes.

11. Innovation Design

11.1.1 BAC bar – clarification of purpose, virtual position and introducing animations

Based on the test, the BAC bar got a new look, see figure 8. The colors were changed, so instead of the red and green the bar now has a grey and half opaque background. The time is placed in the same frame as the BAC bar to indicate that they are connected.

Figure 8: The BAC bar was redesigned, and a bubble animation was added each time the user drinks alcohol

11.1.2 Interaction and feedback

To make it clearer to the user that something actually happens when they choose to drink alcohol, more feedback was added; a bubble animation, a drinking sound and an animation of the BAC bar, which makes a shaking movement to attract user attention. A sound effect for when the user throws up was also added

Furthermore, an increasing "dizzy effect" was added. This effect should simulate the user getting drunk by moving the user (the camera) slowly from side to side for a few seconds. The speed and amplitude of the effect increase as the BAC gets higher. This was discussed early in the design process but given the risk of cybersickness (Rebenitsch and Owen, 2016), when moving the user in the simulation, while being stationary in the real world, the idea was dropped. Repeated requests from users made us rethink this and we decided to test if it could work without too many students getting sick.

11.1.3 Ending scene

An ending scene was also added. This scene aims to summarize the evening and provide feedback to the users on her actions during the party. The scene takes place the morning after, where she wakes up in her bed and has a look at her smartphone. Here she will receive different text messages from other participants at the party. The messages received depends on her actions, e.g. if she chooses not to help the very drunk guy, she will get a message from a friend asking if she has seen him (see figure 9). The user navigates through the messages using the gaze interaction which they are already familiar with at this point. They will first see a list with names of the senders. Here they choose which conversation to read and can return to the list by clicking the back arrow. The buttons are placed as on a real mobile phone to make the interaction as smooth and realistic as possible.

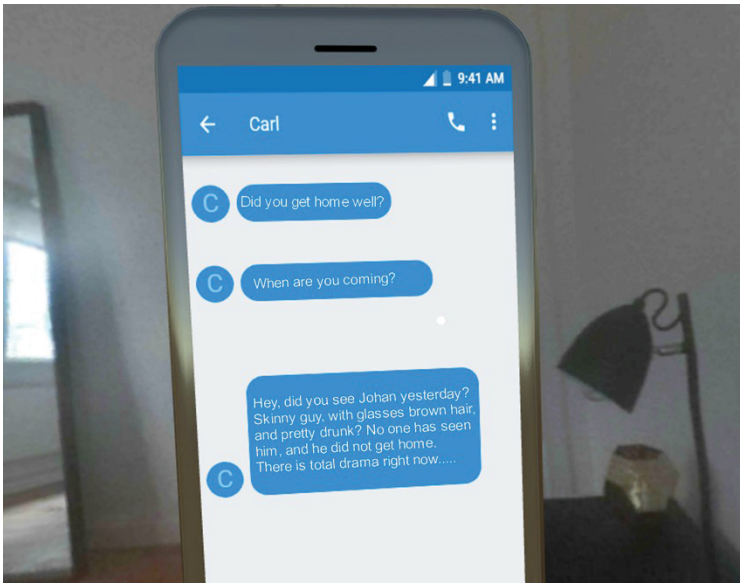

Figure 9: If the user chooses not to help the drunk guy, Johan, they will receive this message [translated by author]

The messages and the actions that trigger them were designed by the students (again to make simulation as realistic as possible). Some of the messages contained swearwords, which we chose to remove or censor since the app is to be used in schools. For example, "fuck" was written "F#@&".

12. Usability and immersion test

After the adjustments from the pre-usability testing, another usability test was conducted. The goal this time was to evaluate the additions and corrections to the app and see if the users got cyber sick with newly added drunk animation.

The test took place in the same way as the last test - each user tried the application for about 10 minutes under passive observation and afterwards they were interviewed. This time the headset was casting to a television through a Chromecast, allowing the observer to see (real-time) what the user was seeing in the headset.

Six students from the next student cohort enrolled in Askov Game design course volunteered for this phase of the study.

Five of the students immediately saw the BAC bar and understood that it illustrated their alcohol intake. The last user said that he did not pay much attention to it to begin with, because he thought that the bar showed the headset's battery life. In the interview they were asked what happened when they drank alcohol. They did all notice the bubble and drunk animation as well as the BAC bar getting fuller.

12.1 Results and discussion of results

12.1.1 BAC bar

One of the students added that she did not know what would happen when the bar was full, for example if she then would be *"… really drunk but having a good time and partying on or passing out and getting game over*". Another student suggested to make the bar gradient from green to red or adding a *"… normal happy smiley face to one end of the bar and a smiley looking really bad at the other end".*

This time no one seemed to make the connection between the BAC bar and a health bar. They experimented more freely with alcohol than they were prepared to do in the earlier test and they did not seem to be afraid of filling the BAC bar. Two of the users drank enough alcohol too pass out and got game over. When asked about their tactics afterwards, they both expressed that they were aware of the BAC bar getting fuller, meaning they got more and more drunk, but they consciously kept drinking to see what would happen.

The new placement of the clock also seemed to make a difference. Two users commented on the time passing while playing. One user with the BAC bar two-thirds full said, *"I'll better wait until midnight before I have another beer"* and another said "*Oh, it is already past 1 o'clock. I better hurry and play beer pong"*.

12.1.2 Interaction and feedback

They did all notice the drunk animation, where the user is moved from side to side, and knew that it got initiated by drinking alcohol. They generally liked the animation. One of the users, who got so drunk he passed out and therefore also experienced the animation at its highest, expressed that he was feeling a bit dizzy while using the application. In his view this was not negative *"In some way it makes it feel more realistic. When I am drunk in real life, I can also get... Ehhmm… You know this feeling of your head lagging and being mentally behind [lagging: concept used to describe computers responding slower than expected]".* Surprisingly none of the other users felt any cybersickness. This could be due to the BAC bar functioning as a static frame, which reduces the risk of cybersickness (Rebenitsch and Owen, 2016). Further testing will determine if this applies more broadly.

Cybersickness can be a breaker of immersion and the feeling of being present (Weech, Kenny and Barnett-Cowan, 2019). In this application, users could on the other hand expect to feel this discomfort as they get drunk in the simulation, which could – theoretically – increase immersion.

12.1.3 Ending scene

The message system worked as intended. All users knew right away how to choose a message and return to the list. A user expressed *"It was funny to see that it actually meant something what I did in the game. I will have to*

try again and choose something else. And drink way more alcohol." Another user described the last scene as "interesting" and added *"It made me rethink what I answered and made me want to try again".*

One user was a bit baffled by one of the messages he received. He had talked to the very drunk guy, Johan, in the corner, who tells the user that he is feeling very bad and asks the user what he should do. The user chose to help him go to the toilet to throw up. Johan then says that he is feeling better and the user can now choose between calling the guy's parents or returning to the party right away. The user chose the last option, which later results in a message from the friend, who invited the user to the party. The message says "*So we have an agreement in the class that we call the parents if someone throws up. It wasn't ok that you just left Johan"*. The user felt that he had done the right thing by taking the drunk guy to the bathroom, and therefore he felt that the message was unjustified.

12.1.4 Immersion

The test showed a few signs of immersion. While one user was on the dancefloor, he started to move slowly to the music for a second after which he laughed and said, *"I totally forgot that you could see me"* and instantly stopped moving. When asked about this afterwards he reported a feeling of being at the party and for moments forgot where he physically was.

Another user said that she got the feeling of being present in the virtual room, but that she did not feel engaged in the story, which played out around her. This indicates a lack of narrative immersion. It could be caused by her being a few years older than the intended target group.

This feeling of being present at the party is beneficial to the learning process. It enables the user to get a realistic firsthand experience with alcohol. By breaking the immersion, the user gets an opportunity to take a step back and analyze the situation, which is also critical in relation to experiential learning**.** Frasca (2006) argues that destroying immersion can *"…be a positive feature because it can encourage the player's critical thinking" (Frasca, 2006).* He described this as *outmersion*. In VR PartyLab outmersion might happen when the BAC bar draws attention to itself by shaking and enlarging after the user drinks alcohol. This could make the user analyze her own behavior and for example come to the conclusion that she should wait to drink another beer as seen in the test.

13 Thoughts about the learning design inspired by experiential learning

In this section, we introduce ideas for developing didactics/learning design to support the learning goals. The VR Party application should in real life be a part of classroom teaching where the drinking topic and maybe group pressure theory is introduced before students are exposed to the VR Party.

Learning goals: The intended learning goal for the students using this simulation was to recognize and deal with peer pressure in a party situation. Additionally, the students would experience the consequences of saying yes and/or no to alcohol in the simulation. The goal was that the students developed their understanding of blood alcohol concentration (BAC), peer pressure, and competencies regarding choosing only to drink moderately based on their VR experiences.

Content and learning activities: In the simulation, the student attended a virtual party and created her own experience through a number of choices. The 360-degree simulation was experienced through VR glasses to provide an immersive and intense experience. One example was that the learner could choose: 1) whether to drink alcohol or not, 2) the type of alcohol and 3) drinking frequency. The user was also faced with non-alcohol related choices such as the opportunity to help an intoxicated man, starting a heated argument or flirting with other guests.

Learning aspects - Experiential Learning: In this experiment we used the Experiential Learning Theory as a basis of how to support students' learning process, as students learn through experience in this VR-simulation. Kolb's (1984) theory of Experiential Learning describes how learning happens as the learner reflects on concrete experiences.

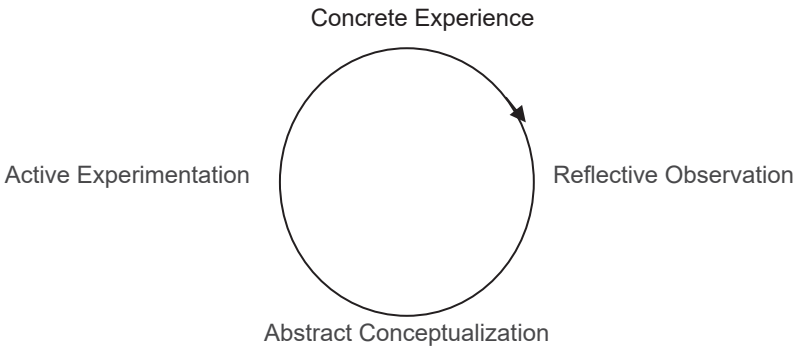

Figure 10: The small learning loop - Experiential Learning Model (Kolb, 1984)

In the first stage - *Concrete Experience*, the learner physically experiences the here-and-now (see figure 10). This experience forms the basis for reflection and the learner has the opportunity to consider what is taking place and decode it (reflective observation). Then they can compare this to their previous knowledge and try to work out and decide how to understand this and decide what worked well and what could be improved (abstract conceptualization). After this he or she can think about how to engage in an experiment based on what they learned to improve what they just experienced (active experimentation). Every new experiment is informed by previous experiences and reflections and forms a cyclical pattern that can be continued, until the learner reaches the goal they aims for in this learning experience.

In the *VR-Party* the learner experienced the here-and-now party situations such as peer pressure in the form of drinks offered by new potential friends (concrete experience). The learner then reflected on the drinking situations (reflective observation) and thought of how to interpret and evaluate what took place (abstract conceptualization). Then she made strategies on how to improve her next decisions and tried this out in the VR-experience (active experimentation), informing new cycles of experiences and reflections (active experimentation).

Learning design reflections: To optimize the students' learning process and harvest the gains from the VR experience, the teacher must plan the learning design carefully 'around' the use of the VR-experience, see the figure below.

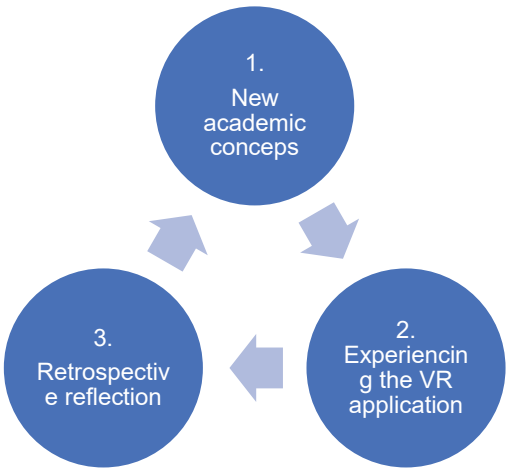

Figure 11: The large learning loop - Learning design around the VR application.

The usage of the VR-Party application in classroom teaching calls for an initial introduction to knowledge about blood alcohol concentration (BAC) levels and peer pressure. Retrospective reflections on the experiences after the VR experiences are also crucial to transform the experience into new knowledge about BAC, peer pressure, typical party situations, and drinking behavior. The concrete learning design will often be repeated if more

theory and new challenges in the VR application needs to be introduced, tested, and evaluated. In this case we have more than one learning loop.

To summarise Virtual Experiential Learning runs in two loops. The small loop is what the students experience and reflect on in the VR simulation. The larger loop focusses on the learning design, academic concepts and retrospective reflections. In the small loop the individual student experiences VR and the experience leads to tacit knowledge. In the larger loop, the teacher's role is to support a process that transforms the tacit experience into explicit knowledge on BAC, group pressure and drinking patterns.

14 Summary and conclusion

The article has presented a practical example of how to co-design an immersive and interactive environment, where adolescents can acquire skills for recognizing and handling peer pressure in relation to alcohol though experience based learning. The design process began with exploration of key concepts and concept design in the development group, followed by design of the prototype involving development of flowcharts, writing of manuscript, filming and development in Unity. The application ended up consisting of 125 movie clips. The clips the user meets and in which order depends on the choices the user makes, but also gender and current BAC.

We learned that flowcharts are a great help, when filming a larger story with multiple paths. Without the flowcharts we would have lost track and we would not have been able to shoot all the clips in just one weekend. The flowcharts were also a big help when the clips were implemented in Unity.

The prototype has been through two usability tests. The tests showed that the application has potential for immersing users. The users felt presence, and some had a feeling of "being there" at the party, which is positive in relation to users getting realistic firsthand experiences with alcohol (concrete experience). Users reflected on their experiences (reflective observation) and interpreted them by analyzing the events and connecting them (abstract conceptualization). From this point new strategies in the VR experience were made and tested (active experimentation). The next step is to test the application on the target group. We will start by doing a pilot test and then the application will be tested in a randomized controlled trial to clarify the effect – will adolescents have more skills to resist peer pressure to drink after having used this application?

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