UiA University of Agder

Master

Paramedic Training with Virtual Reality: An Approach to Immersive Learning in Procedural Training

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Abstract

This thesis delves into the transformative potential of Virtual Reality (VR) technology in pre-hospital paramedic training, specifically focusing on the ABCDE procedural framework. Current training methods, though effective, are resource-intensive and lack the flexibility and accessibility that VR can provide. The primary objective of this research is to utilize the power of VR to develop a scalable and immersive environment that can facilitate on-demand, realistic training scenarios for paramedics. The study is grounded in human-centered design principles and utilizes the Unity game engine for VR development.

The research addresses development strategies and methodologies to enhance immersion in educational VR applications and examines how dynamic environmental disruptors and feedback systems affect user engagement and immersion. The study incorporates gamification principles, experiential learning, and the Mechanics-Dynamics-Aesthetics (MDA) framework to create engaging and immersive VR training environments.

The methodology involved a user-centric approach, utilizing mixed methods, including qualitative and quantitative user testing with paramedics and students. Based on their invaluable feedback, iterative development processes were implemented to refine the VR application.

The results of this research are promising, indicating that VR has the potential to enhance training outcomes. By providing a flexible, scalable alternative to traditional methods, VR can improve engagement, immersion, and learning effectiveness. While there are limitations, such as the need for gradually increasing task complexity and more proficiency in VR, the findings suggest that VR can enhance pre-hospital paramedic training, making it more diverse and accessible. This display of VR's potential in pedagogy should make developers and educators hopeful about their field.

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Glossary

VR Virtual Reality

AR Augmented Reality

MR Mixed Reality

XR Extended Reality

ABCDE Airway, Breathing, Circulation, Disability, Exposure

HCD Human-Centered Design

MDA Mechanics, Dynamics, Aesthetics

AMLS Advanced Medical Life Support

PHTLS Pre-Hospital Trauma Life Support

HMD Head-Mounted Display

SME Subject Matter Expert

UI User Interface

LC Low Competence

HC High Competence

NLA Norsk Luftambulanse

CE Concrete Experience

RO Reflective Observation

AC Abstract Conceptualization

AE Active Experimentation

Chapter 1

Introduction

In pre-hospital services, the practical training of paramedics within the ABCDE framework is of significant importance. However, the current internal training programs are resource-intensive regarding hours and logistics, leading to significant costs. Additionally, digital training resources are unavailable, limiting the flexibility and accessibility of training opportunities. This thesis proposes a novel solution leveraging Virtual Reality (VR) technology to address these challenges. Integrating a VR solution can complement the existing training landscape, allowing paramedics to engage in training scenarios without real-world consequences. The proposed VR environment allows for immersive, forgiving scenarios where errors incur no repercussions for the patient or the paramedic. The continuous evolution of VR software and hardware enhances the possibilities for realistic and impactful training experiences. Implementing scenario simulations for healthcare training is gaining ubiquity and aligning with technological advancements. This study introduces an immersive VR environment aided by a virtual assistant that facilitates the systematic execution of the ABCDE procedure. The simulation is available on demand, providing a flexible and accessible training solution for paramedics and aspiring apprentices. As the healthcare training landscape embraces technological progress, this research aims to contribute to the evolution of effective and efficient pre-hospital training.

1.1 Target Group

The target group for data collection comprises paramedics with varying levels of expertise and students with minimal prior knowledge of procedural training. Members of this target group require no pre-existing familiarity with immersive technologies or procedural training to participate effectively in the study.

1.2 Research questions

RQ 1: What development strategies and methodologies can enhance immersion in educational VR applications, ensuring users' engaging and immersive learning experience?

RQ 1.1: - How does incorporating dynamic environmental disruptors influence the engagement levels of users in virtual reality environments?

RQ 2: How does the presence of a feedback and knowledge system affect engagement and immersion in virtual reality training?

RQ 2.1 - What is the optimal balance between providing necessary information and maintaining engagement?

1.3 Scope

The scope of this thesis contains the development of a VR application named MediVR within the framework of Human-Centered Design (HCD) [31]. Built using the Unity game engine [83], MediVR immerses users in virtual scenarios where they engage in procedural training of the ABCDE procedure [76]. Users interact with various tools and techniques to assess the patient's condition throughout these scenarios. An instructor accompanies the user, offering guidance and assistance as needed. To progress through the procedure, users utilize tools such as a thermometer, stethoscope, and oximeter, with data displayed on a multi-monitor for monitoring the patient's vital signs. Upon completion, users must determine the patient's condition, after which they receive a final score and a summary of their performance.

By utilizing the HCD framework as the development core, the researchers focus on creating an immersive experience for the end user. This involves examining various development strategies and methodologies to enhance immersion in educational VR applications, ensuring users have an engaging and immersive learning experience.

Furthermore, the research analyzes the role of an instructor within the course. It aims to determine the optimal balance between providing necessary information and maintaining user engagement. This includes studying how the presence of a feedback and knowledge system affects engagement and immersion in virtual reality training and how to find the most effective approach for supporting learners in a VR environment.

User tests were conducted to gather the necessary data to answer the research questions and measure data on immersion and engagement. Using a mixed-methods approach that included both qualitative and quantitative means of conducting user testing, the researchers observed 9 participants. Following the HCD framework, iterations were made throughout the development to refine the application based on user feedback and performance.

1.4 Limitations and constraints

The development process encountered significant limitations and constraints, primarily concerning technology support and resource availability. As the VR landscape rapidly evolves, staying up-to-date with relevant research materials challenged the researchers.

Also, the initial lack of proficiency in VR necessitated a significant time investment to become trained enough to develop a prototype and to facilitate user testing with VR equipment. Compounding this barrier was the research group's reliance on a single Meta Quest 3 headset, which could lead to potential setbacks if the equipment malfunctioned. Older headsets like the Meta Quest 2 were utilized for testing to mitigate risks, albeit with limitations due to battery constraints during prolonged sessions.

Furthermore, the availability of high-competence test users, predominantly engaged in full-time jobs and part-time studies, posed a noteworthy limitation. This limited access to a crucial subset of the target audience, resulting in a lower testing frequency with high-competence members than desired.

1.5 Outlining of the thesis

The thesis follows a structured outline, with each chapter serving a specific purpose to contribute to understanding the research topic. After the introductory chapter, the second chapter delves into the state of the art, providing an overview of various relevant topics. This includes exploring the current landscape of procedural training and simulations in Norwegian

pre-hospital care education. Additionally, it presents a taxonomy of Virtual Reality and its relevance to education.

The subsequent chapter, Methodology, clarifies the research approach adopted and the methods employed to gather data. This chapter offers insights into the strategies utilized to conduct the study, providing transparency and clarity regarding the research process. The methodology chapter also sheds light on the participants and bias relevant to the participants recruited. The Development chapter follows, offering a detailed account of how the researchers developed the application. Grounded in the principles of HCD, this chapter outlines the design decisions and development processes that culminated in the creation of the application.

The fifth chapter presents the study's findings and results, offering insights into the data gathered and a thematic analysis. This chapter synthesizes and analyzes the data collected concerning the research questions posed earlier in chapter 1.2. The sixth chapter, Future Development, presents findings from the last test round that the researchers needed more time to iterate upon. However, this chapter provides potential solutions to the problems.

Furthermore, chapter seven discusses the thematic analysis and findings made through the analysis, centered around the research questions to reach an answer. Lastly, the eighth chapter serves as the thesis's conclusion.

1.6 Intended learning outcomes

- **Usage of VR Technology**
  - Familiarize with VR environment and navigation.
  - Operate VR controllers effectively.
  - Adapt to new learning tools and technologies.
  - Interpret and analyze within the VR environment.
- **ABCDE Procedure**
  - **Airways (A)**
    Perform airway assessment techniques and manage airway obstructions.
  - **Breathing (B)**
    Assess and support patient breathing, and recognize respiratory distress and how to apply interventions.
  - **Circulation (C)**
    Assess circulatory status (pulse and capillary refill), and how to use multi-monitor as a monitoring device.
  - **Disability (D)**
    Assess patient consciousness and train on recognizing and responding to neurological impairments.
  - **Exposure/Environment (E)**
    Perform total patient exposure to identify hidden injuries and learn how to manage the environment to maintain patient warmth.
  - **Patient Assessment**
    Integrate ABCDE steps for a comprehensive assessment and learn how to prioritize interventions based on patient condition.
  - **Decision Making and Critical Thinking**
    Develop decision-making skills under emergency scenarios and learn how to adapt the approach based on the patient's dynamic condition.

Chapter 2

State of the art

2.1 Current procedural training and simulation in Norwegian pre-hospital education

In today's pre-hospital care services in Norway, paramedic training is meticulously structured through the courses Advanced Life Support (AMLS) and Pre-hospital Trauma Life Support (PHTLS). These courses ensure a standardized, systematic approach to examining and treating acutely ill or injured patients nationwide.

All personnel in prehospital services in Norway have individual competence plans, often unique to each ambulance station. These plans follow national guidelines and standards, with the AMLS and PHTLS courses integral to this competence building. A distinctive feature of the ambulance service at Sørlandet Sykehus is the integration of these courses into each employee's competence plan, conducted as part of a two-year apprenticeship program.

AMLS and PHTLS courses are offered broadly to all pre-hospital healthcare personnel in Norway, primarily targeting ambulance personnel. The objective is to provide participants with a systematic introduction to the examination and treatment of acutely ill or injured patients. However, there is an increasing demand for these courses from emergency departments, emergency medical call centers, the military, paramedicine bachelor degree programs, and fixed-wing operators[2], all seeking to ensure a uniform systematic approach to patient management. Norsk Luftambulanse (NLA) coordinates and facilitates these courses nationally. The course concept is owned and delivered by NLA, which collaborates closely with the country's health enterprises to ensure high-quality and relevant academic content. AMLS and PTHLS have been integral to Norwegian pre-hospital training for over 20 years. Both courses combine theory and practice, with an online theoretical component providing a thorough overview of acute medical conditions.

All pre-hospital care personnel in Agder will, in level 1, enroll in e-learning that presents a thorough review of acute illnesses. The main goal is to educate the learners on performing a primary and secondary examination of the patient according to the principles within the ABCDE protocol. Before being admitted to the secondary level of the course, the apprentices must pass a multiple-choice exam. Having passed the first level, the apprentices will, at this stage, participate in practical training. This course level targets the main objective, which is to expand the participant's competence to make the learners more capable of making professionally justified decisions using systematic patient examination. All practical examinations with the PHTLS are conducted on live markers, meaning that the apprentices perform the tests on each other rather than using dolls. The last stage of the second level is a practical examination, which must be passed to complete the apprenticeship.

2.2 ABCDE procedure

Being acutely and critically ill necessitates relying on care and treatment centered on identifying and diagnosing current and potential issues, followed by targeted interventions. The ABCDE protocol undergoes a systematic review with the goal of ensuring that patients emerge from the current situation or illness with no subsequent complications[81]. An acutely ill individual may face a life-threatening situation, with symptoms and conditions changing rapidly. Hence, rapid and systematic problem identification and mapping of the causes and possibilities for intervention are crucial for the patient's future[81]. Full-size pictures of evaluation forms can be seen in Appendix K.

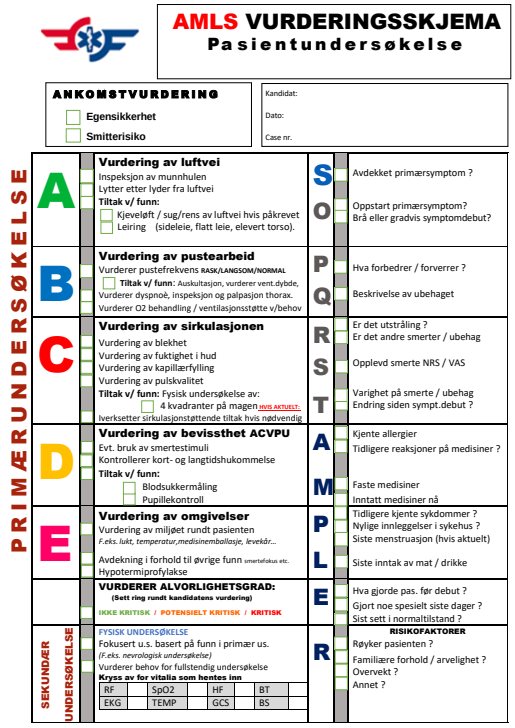

Figure 2.1: Advanced Medical Life Support - Evaluation form

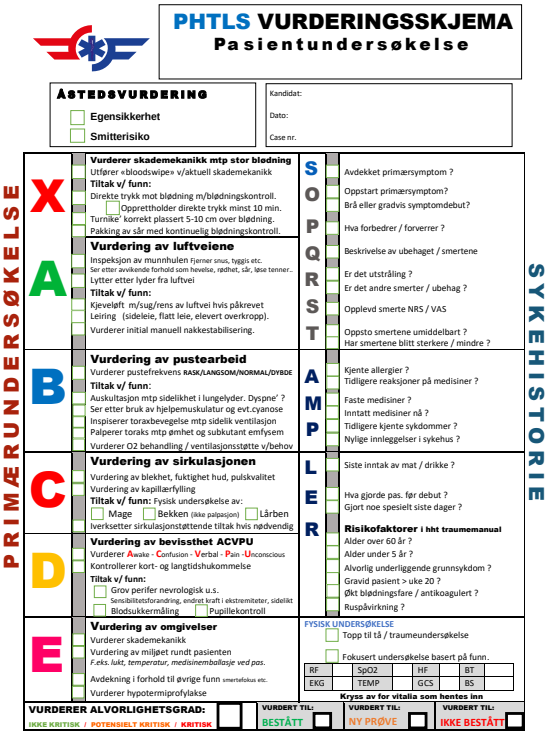

Figure 2.2: Prehospital Trauma Life Support - Evaluation form

The ABCDE protocol represents a systematic and widely recognized method used to assess vital parameters of patients and intervene, if necessary, with the goal of tissue oxygenation. The ABCDE system prioritizes the critical values of the human body in a sequence[81]. This systematic procedure involves a sequential series of steps, with each component building upon the prerequisite of the preceding one. The arrangement first prioritizes the most critical aspects and progresses to the least critical, establishing a systematic assessment and intervention approach. Working according to the ABCDE method involves identifying the problem and intervening rapidly, decisively, and with a clear prioritization of factors most life-threatening to the patient[81].

This systematic framework, considered obligatory in pre-hospital care services, assumes a foundational role for healthcare practitioners. The ABCDEs function as a systematic approach, guiding responders and, through a systematic evaluation, informing crucial emergency medical response decisions.

2.2.1 Components

A - Airways:

Unobstructed airways allow air to flow through the nose, mouth, throat, larynx, and trachea. Evaluating the presence of open airways is of utmost importance, as the brain begins to incur damage within minutes of oxygen deprivation. Blocked airways will ultimately result in cardiac arrest. Personnel also inspect the oral cavity for foreign objects and check for signs of swelling, loose teeth, wounds, and redness[38][81].

B - Breathing:

Once unobstructed airways are ensured, the focus shifts to evaluating the patient's respiratory functions and the adequacy of oxygen intake. An abnormal breathing pattern indicates the possibility of either respiratory failure or cardiac arrest. Employing a "see, listen, and feel" methodology, healthcare personnel observe and assess breathing using auditory and visual cues without intruding on the patient. The focus is on understanding the efficiency of pulmonary functions and detecting any potential complications related to oxygen intake and assimilation[38][81].

C - Circulation:

This phase centers on assessing the patient's circulatory system and monitoring vital signs like heart rate, blood pressure, and pulse points. Healthcare professionals use medical equipment to track and precisely detect fluctuations in this data and perform capillary refill tests. The goal is to maintain optimal blood circulation, ensuring the effective delivery of oxygen and nutrients to vital organs and tissues[38][81].

D - Disability:

In this stage, the examination delves into assessing the patient's neurological status and functional capabilities. The term "disability" in this context encompasses a broad evaluation of the patient's level of consciousness, responsiveness, and neurological function. Healthcare professionals may use standardized scoring systems such as the Glasgow Coma Scale (GCS)[56] or simpler assessments like AVPU[57] (Alert, Verbal, Pain, Unresponsive) to measure patient responsiveness[38][81].

E - Exposure:

Ensure personal safety is paramount for emergency personnel. Securing perimeters is essential to minimize dangers before investigating potential damage to the patient. Exposure to dynamic elements such as wind and rain increases the risk of hypothermia for the patient, leading to deteriorating health[38][81].

Additionally, assessing the surroundings in incidents like traffic accidents is vital. Ambulance personnel need to consider factors such as seat belt usage, signs of speed limits, skid marks, and the energy imparted on the patient during impact. This information aids in understanding the nature of the incident and guides the safe and effective management of the patient's care[38][81].

2.3 Extended reality

Extended Reality (XR) refers to all real-and-virtual combined environments and human-machine interactions generated by computer technology and Head-Mounted Displays (HMDs)[69].

XR contains a spectrum of experiences that blur the line between the natural and digital worlds and sometimes combine them.

It can create immersive experiences, from entirely virtual environments to overlays of digital content in the real world. This integration harnesses the power of hardware, software, and sensory technology to revolutionize user experience and interaction, further explained later in this chapter.

Under the XR umbrella, we have three primary technologies: Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR)[69]. Each of these technologies offers unique levels of immersion and interaction, and their distinct characteristics make them particularly suitable for specific tasks. Understanding these differences is key to harnessing the full potential of XR, and detailing why each technology is suitable for different tasks.

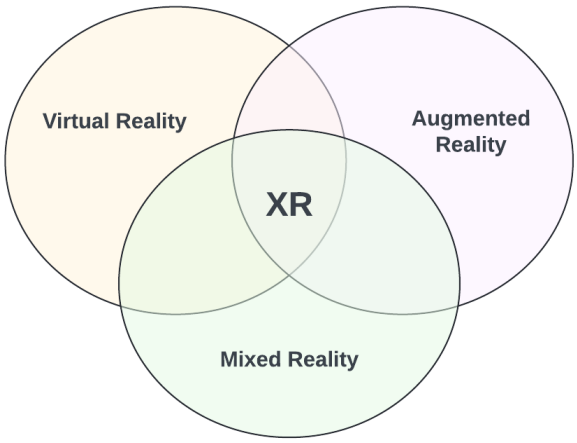

Figure 2.3: Extended Reality, an umbrella term.

2.3.1 Virtual Reality

Virtual Reality (VR) technology creates an entirely immersive digital environment[95]. It transports users into a virtual world where they can interact with 3D objects and scenarios as if they were physically present. VR leverages head-mounted displays (HMDs), motion tracking, and spatial audio to offer a highly interactive experience that engages multiple senses, providing a sense of presence and immersion. The transformative potential of VR, AR, and MR is vast, encompassing various fields and applications[69]. The essential elements of these technologies, such as interactivity, immersion, and presence, enable users to feel genuinely part of the virtual environment.

2.3.2 Augmented Reality

Augmented Reality (AR) overlays digital information onto the real world, enhancing the perception of their surroundings. Unlike VR, which immerses users in a completely virtual environment, AR keeps users grounded in their physical environment while adding layers of digital content through devices like smartphones, tablets, or AR glasses[69]. AR is particularly effective for use cases that benefit from visual enhancement of the real world. For example, AR can bring textbooks to life in education by displaying 3D models of historical artifacts or biological organisms. AR's strength lies in its ability to provide context-specific information and interactive experiences that enhance the real world rather than replace it.

2.3.3 Mixed Reality

Mixed Reality (MR) combines elements of both VR and AR, creating a hybrid environment where physical and digital objects coexist and interact in real time[69]. MR allows users to see and immerse themselves in the world around them, even as they interact with a virtual environment using their own hands and movements. Examples of this could be dynamic applications that switch from an AR environment to a VR environment within the application, either gradually or instantly. This technology is made possible through sensors and HMDs, like the Microsoft HoloLens[49], which can map the physical environment and overlay interactive 3D holograms. MR is suitable for use cases where combining real and virtual elements can significantly enhance the experience. For instance, in interior design, users can now populate rooms with furniture through IKEA's new Kreativ app and, through mixed reality, explore the rooms they have designed[12].

2.4 Immersion Extended Realities

Immersion is a fundamental state in VR, and developers strive to enable this state of consciousness for their users. From a developer's viewpoint, achieving immersion involves creating an environment where users can engage deeply and naturally. For users, this state is a subconscious experience in which they are immersed and present in the VR environment without actively thinking about it[30].

Immersion is the extent to which the VR environment can envelop a user, making them feel part of the virtual world[30]. It involves the sensory input the VR system provides, as explained in Chapter 2.7. In a heightened sense of immersion, users are so absorbed in the virtual environment that the real world disappears. Immersion is crucial for engagement and motivation because it captures users' full attention, allowing them to focus entirely on the VR experience.

This is a critical state for educational VR applications because it influences how users interact with and learn from the virtual environment. A high degree of immersion can lead to more effective learning outcomes as users are more engaged and motivated to participate in the VR experience. This deep engagement is beneficial for educational purposes because it allows users to see multiple perspectives, interact in situated learning, and transfer[20].

2.5 Pedagogical aspects of VR

The landscape of medical practice is undergoing continuous and transformative changes, with the integration of VR offering flexibility in education. VR is emerging as a revolutionary tool in medicine, providing a versatile platform for training that transcends traditional constraints[66]. This technology allows learners to engage in immersive, on-demand training scenarios, providing a unique opportunity to practice and learn in novel ways[66].

According to Leica Geosystems [44], virtual training offers significant advantages due to flexibility and location independence. In various fields of application, a tailored digital reality can be swiftly designed and implemented. Virtual learning content can be delivered securely, as it exists in a virtual environment. Furthermore, virtual training offers additional benefits, such as enhanced patient safety, as complex processes and procedures can be repeatedly practiced. This repetition increases learning effectiveness, as users can thoroughly understand and practice intricate procedures, thereby minimizing errors during routine interventions[44].

One remarkable benefit of VR in medical education is its capacity to familiarize learners with equipment and procedures before they are carried out physically. Learners can gain

a comprehensive understanding of when and how to use medical equipment, mitigating the challenges associated with the initial encounters in real-life situations. The immersive nature of VR enables learners to visualize, practice, and comprehend medical procedures, contributing to a more profound understanding when added to traditional education[66].

The implementation of VR in education extends beyond entertainment, finding applications in healthcare and training future firefighters[24], pilots[63], surgeons[64], military personnel[43], and astronauts[64]. VR facilitates realistic and safe simulations of dangerous and complex situations that are challenging and costly to replicate with traditional educational tools. Its usage has particularly benefited medical training, enabling students to experience and practice procedures in a virtual environment before applying them in real-life scenarios[66]. Additionally, in cases where individuals are more prone to learning by doing rather than reading, VR enables them to learn through a medium that better fits their preferences.

Despite the historical challenges of VR technology's high cost[3] and limited quality, recent advancements have reduced these barriers. The lowering cost and improved design have positioned VR as a practical and promising tool for education. The Norwegian government's decision to integrate simulation tools, including VR, into the national health and hospital plan underscores the growing recognition of VR's potential to enhance learning outcomes[85][5].

2.6 The trajectory of Virtual Reality

VR traces its roots back to the original imaginations of pioneering technologists and visionaries. In the 1960s, computer scientist Ivan Sutherland laid the groundwork for VR by inventing the "Sword of Damocles," a head-mounted display (HMD) that gave users a primitive but compelling glimpse into virtual environments[86]. Despite its cumbersome nature in contrast to today's standards, the Sword of Damocles planted the seeds for what would eventually evolve into the immersive VR experiences of today.

Throughout the ensuing decades, VR underwent incremental development and experimentation as researchers and innovators sought to push the boundaries of technological advancement. In the 1980s and 1990s, arcade-style VR experiences emerged, offering glimpses of the potential for immersive virtual environments[89]. However, these early stages of VR needed to be improved by limitations in computing power, display technology, and user interface design[89].

The actual turning point for VR came in the 2010s with the advent of consumer-grade VR hardware[25]. In 2012, Oculus VR, founded by Palmer Luckey, unveiled the Oculus Rift, a groundbreaking HMD explicitly designed for immersive gaming experiences[25]. The Rift captured the imagination of developers and enthusiasts alike, igniting a renewed interest in VR technology.

Following Oculus's footsteps, other significant players entered the market, including HTC with its Vive headset and Sony with the PlayStation VR. These devices offered varying degrees of immersion and interactivity, but collectively, they signaled a shift in the VR landscape, paving the way for a new era of virtual experiences[25]. In recent years, VR technology has continued to evolve rapidly, fueled by advancements in display technology, motion tracking, and computing power. Standalone VR headsets, such as the Oculus Quest and the HTC Vive Focus, have liberated users from the constraints of wires and external sensors, offering untethered experiences that blur the line between the real and the virtual world[25].

2.7 A taxonomy of the current state of Virtual Reality

2.7.1 Head Mounted Displays

A Head-Mounted Display (HMD) is a wearable device that delivers VR and Augmented Reality (AR) experiences directly to the user's eyes[21]. The device contains a display or screens, optics, and often additional components such as speakers, sensors, and tracking systems. The essence of an HMD lies in its ability to immerse users in virtual environments by presenting visuals and audio directly to the user. Within the scope of VR, one also refers to the HMDs as output devices because of their ability to deliver these experiences.

Types of HMDs:

Figure 2.4: Monocular HMD - Vuzix M300

Figure 2.5: Binocular HMD - Meta Quest 3

Figure 2.6: Optical See-Through HMD - Microsoft Hololens 2

- **Monocular HMDs:** Monocular HMDs utilize a single display screen to deliver visuals to one eye, offering a more straightforward and lightweight design. These systems offer only partially immersive experiences, which are more considered Augmented Reality systems. [53]
- **Binocular HMDs:** Binocular HMDs feature two display screens, one for each eye, providing stereoscopic vision and a more immersive viewing experience. By presenting slightly different images to each eye, binocular HMDs create the illusion of depth and dimensionality, enhancing the sense of presence in virtual environments[53].
- **Optical See-Through HMDs:** Optical see-through HMDs overlay digital content onto the user's view of the natural world, seamlessly blending virtual and physical elements. These devices are commonly used in AR applications, where users must simultaneously interact with virtual and real-world objects[28].

Tethered HMDs

Tethered HMDs are VR headsets that connect wired to a high-powered computer or gaming console. They offer high-fidelity visuals and immersive experiences but require external hardware for processing and rendering. Tethered HMDs provide many features and capabilities, making them ideal for demanding VR applications such as gaming and simulation[23].

These HMDs typically feature advanced display technologies, high-resolution screens, precise tracking systems, and integrated audio, contributing to immersive virtual experiences with exceptional clarity and realism[23]. The tethered nature of these devices allows for more demanding applications to execute, as they are connected to high-powered computers or gaming consoles capable of handling complex computations and rendering tasks[23].

This setup often results in higher frame rates and smoother experiences with applications that require substantial computational resources. Nevertheless, the tethered connection restricts mobility and may introduce a degree of inconvenience, detracting from the seamless immersion that standalone HMDs offer.

Standalone HMDs

Standalone or integrated HMDs are VR headsets with built-in processors, sensors, and displays. They offer greater mobility and convenience than tethered HMDs. These devices do not rely on external hardware for operation, allowing users to enjoy immersive VR experiences without being tethered to a computer or gaming console[36].

Standalone HMDs are designed for portability and ease of use, making them ideal for casual users, enterprise applications, and VR experiences. They offer a wide range of features, including inside-out tracking, integrated audio, and wireless connectivity, providing users with a seamless and immersive VR experience without additional equipment[36]. However, with standalone HMDs, developers must optimize applications to run smoothly, as the HMDs have all the required components to run the applications within the HMD itself. This untethered solution allows for more seamless integration. However, demanding applications that exceed the computing power of the HMD may result in lower frame rates.

2.7.2 Input devices

In the immersive realm of VR, input devices play a pivotal role in bridging the gap between the physical and digital realms. They empower users to engage with virtual environments by converting real-world motions into virtual actions. Input devices encompass equipment that supplies data and control signals to information processing systems, including computers, consoles, or HMDs[35]. Input devices tailored explicitly for VR transmit information to applications and facilitate interaction within virtual spaces, akin to conventional input devices like mice and keyboards. Yet, their distinct design caters specifically to the demands of virtual environments.

Tracked handheld controllers with buttons, triggers, and motion sensors are among VR's most common input devices. They allow users to manipulate objects and navigate virtual spaces precisely, making them versatile and widely used for gaming, simulations, and interactive experiences requiring precise manipulation and navigation. Additionally, these controllers feature six degrees of freedom (6DoF) tracking [92], enabling users to move freely in 3D space. Moreover, handheld controllers often incorporate haptic feedback features to provide users with tactile sensations, strengthening the overall immersive experience and informing users about potential actions that could be taken by using the buttons on the controller[73].

Motion trackers are components within virtual reality systems, as they accurately replicate users' real-world movements. Whether mounted on the body or handheld objects, these devices capture movements with high fidelity, making them indispensable for applications requiring full-body interactions[87]. From virtual training simulations and physical therapy exercises to motion capture for animation, motion trackers play a crucial role in various VR experiences. They enable users to perform actions with lifelike precision and contribute to the creation of realistic character animations. Overall, motion trackers provide users with seamless and immersive interactions within virtual environments. Examples of such tracking equipment will be explained further in Outside-In tracking.

2.7.3 Sensors and tracking systems

Inside-Out Tracking

Inside-out tracking defines how users interact with VR environments using the VR headset's built-in cameras to monitor head, hand, and finger movements[18]. This technology eliminates external sensors or controllers, providing users with a ready-to-go system straight out of the box. Using hand gestures or input devices, users can manipulate objects, navigate menus, and perform various actions within the virtual space[18]. Controllers still function alongside the Inside-Out Tracking method, allowing users to choose their preferred mode of interaction. However, by opting for hand gestures alone, users may miss out on tactile feedback typically provided by physical controllers. Nevertheless, accessories such as gloves with haptic feedback components can supplement this experience, enabling users to utilize haptic feedback still while relying solely on hand gestures.

An inherent advantage of Inside-Out Tracking is its convenience and freedom of movement. Unlike traditional VR setups requiring external hardware, this technology enables users to move freely without the constraints of additional equipment[18]. This enhances user comfort and streamlines the setup process, promoting VR experiences for a wider audience. Using controllers alongside Inside-Out Tracking further enhances the user's ability to interact with the virtual environment, providing precise inputs and tactile feedback when necessary. However, users opting for hand gestures alone may need more support regarding feedback and precision[18].

However, while Inside-Out Tracking offers flexibility, it also entails certain limitations. The accuracy of hand tracking may fluctuate based on factors such as lighting conditions, gesture complexity, and if the tracked hands are occluded[18]. Inside-out tracking is being leveraged in the most sought-after HMDs and is quickly becoming the norm[11]

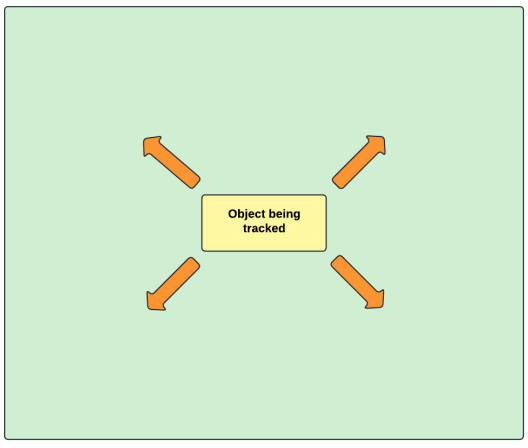

Figure 2.7: Inside-out tracking

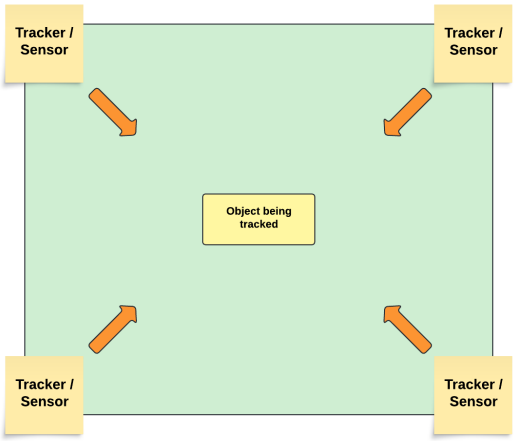

Figure 2.8: Outside-In tracking

Outside-In Tracking

In outside-in tracking, the VR system utilizes external sensors, like cameras or infrared sensors, strategically positioned throughout the environment[18]. These sensors act as reference points, capturing the movements and positions of markers or sensors affixed to the user or their VR devices. The external sensors identify and track markers or sensors attached to the user's body or VR equipment. These markers may consist of reflective markers, LED markers, or other distinctive features recognizable by the sensors[60].

The tracking data collected by the external sensors is transmitted to a computer or dedicated tracking hardware for processing. Advanced algorithms and triangulation techniques are employed to analyze the data, determining the precise position and orientation of the tracked markers in three-dimensional space. Leveraging the tracked markers' positions and the VR setup's known geometry, the system computes the user's position and movement relative to the reference points provided by the external sensors[18]. This information facilitates the adjustment of the virtual camera's position and orientation. Outside-in tracking captures the user and mimics the movements. This makes the technology widely used in the movie industry.[60]

2.8 Motivational theories / pedagogical theories

2.8.1 Intrinsic motivation

In this work, applying intrinsic motivation can be understood as a motivator for engaging with the application's inherent value[70]. Individuals genuinely interested in the themes addressed in this research, such as integrating immersive technology in educational settings, are more likely to find personal fulfillment by engaging with its content[70].

Interests vary significantly among individuals, but accurately incorporating topics relevant to the target audience makes it easier to supplement the research with meaningful content. Addressing relevant and meaningful topics also increases the likelihood of audience engagement on a deeper level. With a defined target audience and meaningful content, participants are motivated to enhance their knowledge. Intrinsic motivation may stem from a desire to improve understanding. Culminating this application as a means of scaffolding would be highly relevant for potential users from the medicinal field. By successfully implementing this work as a scaffold, participants are presented with challenges they can overcome by engaging with the content. By exploring and applying new knowledge, they can overcome previous challenges, leading to mastery and triggering intrinsic motivation[26]. This process deepens their understanding and encourages personal growth and achievement. Making meaningful decisions, exploring various paths, and incorporating newly acquired knowledge within a purposeful framework provides significant intrinsic motivation and instill a sense of mastery in the participants, reflecting the principles of experiential learning[52].

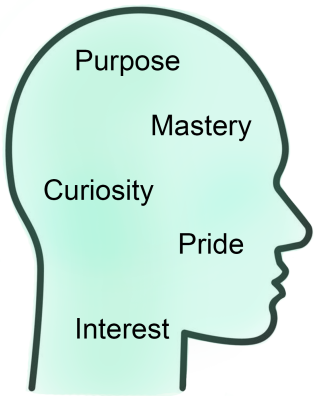

Figure 2.9: Intrinsic motivation

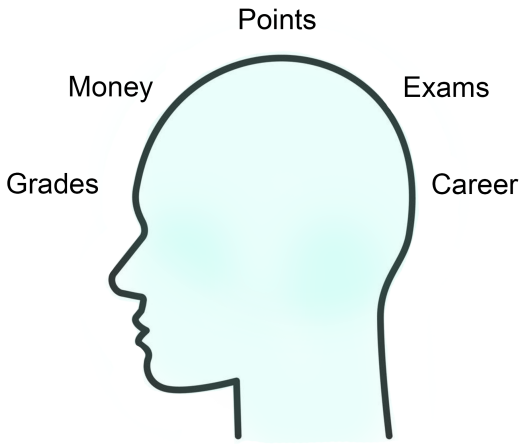

Figure 2.10: Extrinsic motivation

2.8.2 Extrinsic motivation

Contrary to intrinsic motivation, which originates from internal desires and interests, extrinsic motivation is driven by external influences shaping people's behaviors. As Richard and Deci highlighted[70], these external factors drive individuals to participate in activities to achieve separable outcomes. In the context of this research, extrinsic motivators take the form of tangible rewards or incentives that encourage participants to sustain their involvement. For instance, participants may be incentivized to engage or receive recognition for their participation.

Furthermore, extrinsic motivators in the application can be seen as scores, points, or positive audio feedback the instructor provides. While these motivators often initially draw individuals to engage with the application intrinsically, they require careful adjustment to ensure enduring engagement. However, extrinsic motivators remain essential to the VR experience, shaping the dynamics of the application. They serve as rewards and punishments, motivating players to reflect on past experiences and use newfound knowledge to evade failure or setbacks[90]. Conversely, rewards offer a sense of achievement and progression, reinforcing player commitment and advancement, as Vriend[90] discussed.

2.8.3 Experiential learning theory

Learning is the cornerstone of our understanding and actions in personal development. It is a dynamic process triggered by experiences that guide individuals towards a heightened understanding. At its core, learning revolves around a transformative journey resulting in a profound change in knowledge or behavior[6]. Experiential learning transcends the accumulation of information, instead involving a continual quest for understanding and refining existing knowledge. Genuine learning experiences balance the unknown and the known, leaving and enduring impact on the learner.

In contrast, traditional classroom settings often rely on lectures and information delivery, where learners absorb knowledge from a more knowledgeable teacher. In this scenario, learning unfolds through hearing, reading, talking, or writing about subjects without direct contact with the subject's core [41]. On the other hand, experiential learning urges direct experiences as the primary source of knowledge. Whether through internships or projects, it adds a hands-on dimension to academic studies, allowing the learners to experience a confrontation with the subject matter.

Experiential learning offers a myriad of benefits compared to traditional classroom learning. By engaging in real-world experiences, learners develop critical thinking skills, problem-solving abilities, creativity, and adaptability. Moreover, experiential learning focuses on more profound engagement with the subject, enhancing knowledge retention[13]. Applying experiences to the absorption of knowledge adds a new layer to learning, working in synergy with retention to deepen understanding[13]. Through reflection and feedback, learners are encouraged to identify strengths and areas for improvement, thus facilitating continuous growth and development. One of the core advantages of experiential learning is its focus on transferable skills. These skills, such as communication, teamwork, leadership, and time management, are invaluable in academic and professional settings. Experiential learning experiences allow learners to practice and refine these skills in authentic contexts, preparing them for success in their future careers.

The experiential learning theory, attributed to David A. Kolb [40], can be separated into different stages of the experiential learning cycle. This cycle consists of four key components: concrete experience, reflective observation, abstract conceptualization, and active experimentation[52].

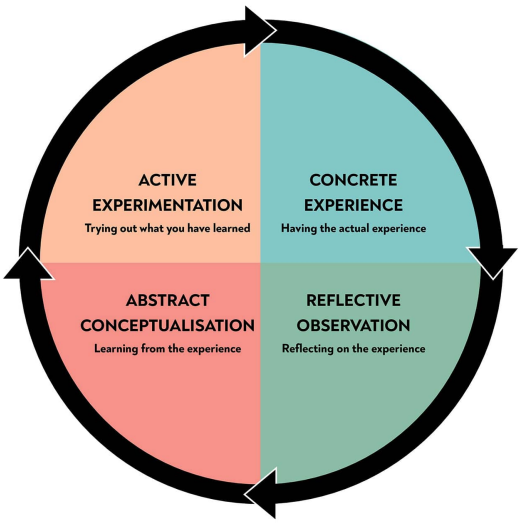

Figure 2.11: Four stages of the learning cycle

- Firstly, the cycle begins with a concrete experience (CE), where learners engage in hands-on experiences or encounter real-life situations relevant to the subject matter. This is the foundation for learning, providing a tangible context for understanding[40].
- Following the CE, learners move into the reflective observation(RO) stage. Here, they reflect on and analyze their experiences, considering what happened, why, and what they learned from the experience. This phase encourages introspection and critical thinking, allowing learners to gain insights and perspectives[40].
- Next, learners use abstract conceptualization(AC) to connect their experiences and existing knowledge frameworks. They conceptualize and theorize about the observed patterns and phenomena, seeking to understand underlying principles and theories[40].
- Finally, learners enter the active experimentation(AE) stage, where they apply their newfound understanding and insights to real-world situations. This may involve testing hypotheses, implementing solutions, or engaging in hands-on experiences to refine their understanding[40].

2.9 MDA Framework

The MDA framework, developed by Robin Hunicke, Marc LeBlanc, and Robert Zubec[34], is a formal method for understanding games and game development. Integrating this framework into game analysis aims to bridge the gap between game design and development, game criticism, and technical game research. Utilizing the framework as a methodology will enhance clarity in the iterative processes inherent in game development. The framework categorizes games into interconnected components: mechanics, dynamics, and aesthetics, each viewed differently by players and designers[34]. Where the developers of the application see the mechanics as defining the dynamics, which in turn defines the game's aesthetics. In contrast, the players perceive aesthetics as setting the tone directly related to dynamics and mechanics[34].

Mechanics sketch the systems that outline gameplay, encompassing behaviors, actions, and other interactive systems provided to players within the game context[34]. These mechanics, coupled with the game's content, define gameplay dynamics. Within MedivR, interacting

Figure 2.12: Different perceptions of the components

with the patient and using equipment to analyze the patient's condition illustrates the interplay between the mechanics and dynamics, where interpreting the situation and choosing the right action influence the dynamics. As seen in this example, the mechanics would then be the action the user needs to take to move forward, whereas subsequently, the dynamics would be the individual's interpretation of the situation and how to move forward.

Dynamics represent the real-time behavior of how mechanics influence player actions and interactions during gameplay. They dictate how players respond to inputs and engage with each other's outputs, generating diverse outcomes[34]. In the context of the MediVR prototype, dynamics refer to how users' outcomes from interacting with the VR application's mechanics vary, leading to diverse experiences and responses. For instance, the dynamics in MediVR encourage users to engage with the procedural training tasks differently based on their unique approaches and interactions with the tools and instructor.

Examples of dynamics within the MediVR prototype include:

- **Collaboration and Guidance:** The interaction between the user and the virtual instructor creates a dynamic where the user must respond to the instructor's guidance and feedback. This can lead to a sense of mentorship and support. However, interpretation of the guidance may lead to diverse outcomes.
- **Urgency and Realism:** Environmental audio cues, such as car honking and patient breathing, create a dynamic sense of urgency. Users must manage their stress and stay focused under pressure. However, audio cues affect the participants differently.

Aesthetics envelop the subjective emotions experienced by individuals during game engagement[34]. In applications that contain scoring systems or are competitive in other ways, players derive satisfaction from the emotional investment required to emerge victorious. The aesthetics within MediVR refer to the emotional responses and experiences that the users have while engaging with the VR application[34]. These aesthetics result from the interplay between the mechanics and dynamics, ultimately shaping how users perceive and interact with the VR environment. A complete list of the components within the prototype can be seen in Appendix F.

Examples of aesthetics within the MediVR prototype include:

- **Sense of Accomplishment:** MediVR's dynamic progression of task complexity is designed to allow users to build their skills gradually. Users who complete increasingly challenging tasks experience a profound sense of accomplishment and mastery. This feeling is further reinforced by the immediate feedback and scoring system, which

highlights their achievements and provides clear areas for improvement, fostering a continuous learning process.

- **Fellowship and Support:** The interaction with the virtual instructor provides a dynamic of guidance and support. This dynamic encourages a sense of fellowship, as users feel accompanied and assisted throughout their training. The instructor's presence helps users stay engaged and motivated, creating a supportive learning environment that enhances the aesthetic experience.
- **Challenge and Urgency:** The dynamics of realistic scenarios and high-pressure situations, such as dealing with patient emergencies, are meticulously crafted to create an aesthetic of urgency and challenge. Users must stay focused and manage their stress levels, which mirrors the intensity of real-life medical situations. This dynamic engagement keeps users on their toes and deeply involved in the training.

2.10 Applied educational gamification

Gamification is the practice of including game-like elements in non-game contexts to enhance engagement and motivation. It involves applying aspects of game design, such as rewards, challenges, and progression systems, to encourage participation and achievement. In educational settings like this research, gamification can evolve the learning experience by making it more interactive, enjoyable, and effective. By integrating points, levels, and time restrictions, educators can actively motivate students to engage with course material and complete learning objectives.

Drawing inspiration from Wendy Hsin-Yuan Huang and Dilip Soman's A Practitioner's Guide To Gamification Of Education[33], the gamification process within education involves several key steps. Firstly, understanding the target audience and the context in which the education program will be delivered is essential. This includes identifying students' characteristics and preferences and considering factors such as the timeframe and learning environment.

Next, defining clear learning outcomes is crucial for guiding the gamification process. Objectives may range from general instructional goals, such as completing assignments or projects, to specific learning goals to understand concepts or acquire skills[33]. A full list of the intended learning outcomes within the context of this application, can be found in Chapter 1.6.

By breaking down the curriculum into manageable stages or milestones, each with its own goals and potential pain points, educators can effectively identify areas where gamification can be applied to enhance engagement and motivation. This control over the learning process empowers educators and instills confidence in creating engaging and compelling learning experiences[33].

Like the MDA framework, one can manage the components within an application by breaking them into categories. Identifying resources involves determining the tools and mechanisms needed to implement gamification elements successfully. This may include tracking mechanisms, feedback systems, and incentives to encourage progress and participation. Using the MDA framework to identify stages within MediVR that can be gamified, the researchers concentrated on tracking mechanisms, rules, and feedback delivery to the user. Concerning tracking mechanisms, the mechanics of MediVR manifest in the form of an accumulated score, which is eventually revealed to the user upon course completion. In addition to the final score, the instructor provides feedback to the user throughout the course, constituting a form of gamification[33].

Chapter 3

Methodology

3.1 Division of participants

The researchers categorized the test participants into two groups based on their expertise in the paramedical field: high competence (HC) and low competence (LC). The HC group included four individuals recruited from Sørlandet Sykehus: two paramedics, one paramedic apprentice, and one medicinal innovation consultant. Each member possessed varying degrees of paramedical knowledge. In contrast, the LC group consisted of five students from the University of Agder with little to no prior knowledge of the ABCDE procedure.

To address the issue of potential knowledge retention among participants across sequential tests, researchers recruited different students in each testing session within the LC group. By incorporating new students for each test, the study aimed to gather fresh and unbiased data, free from the influence of retained knowledge gained in previous tests. This approach ensures diverse perspectives and minimizes the risk of bias in the evaluation process.

The two groups served distinct purposes in the study. The HC group identified shortcomings within the course's curriculum and explored possibilities and opportunities for future iterations. On the other hand, the LC group, comprised of students, was tested to observe their interaction with the course content and to assess their ability to retain information and complete the course without prior knowledge of the ABCDE procedure.

	Initial design	1'st iteration	1'st iteration
Week	10	15	16
Participants	4 HC	4 HC, 3 LC	2 LC
Methods	User test, observation	User test, observation	User test, observation
Methods	Pre interviews	Pre/post interviews	Pre/post interviews

Table 3.1: Overview of research advancement

3.2 Bias in research

Bias in research refers to systematic errors or distortions in the collection, analysis, interpretation, and presentation of data[72]. During usability testing, researchers must be aware of biases and actively work to minimize them to ensure the data collected is valid and reliable. This can be done using standardized protocols, ensuring a diverse and representative sample, and maintaining a neutral and non-judgmental stance during data collection[78].

One example of bias is the Hawthorne effect, a phenomenon where participants modify their behavior or performance simply because they are aware of being observed[71]. In the context of usability testing, this can be a significant challenge. Participants may alter their

interaction with the VR application to impress the researchers or to conform to perceived expectations, rather than providing genuine feedback.

Another common bias is social desirability bias, where participants tend to respond in a manner they believe is socially acceptable or favorable rather than expressing their accurate opinions or experiences[29]. For instance, participants may exaggerate their good experiences with the VR application to align with the research project's goals or avoid appearing critical.

This research considers biases related to the collaboration with Sørlandet Sykehus and the participants' association with the university and project. Participants in the HC group, consisting of practitioners of pre-hospital care and innovation consultants, may exhibit positive biases due to their familiarity with the project's goals and enthusiasm for implementing new technologies in healthcare settings. Additionally, the novelty and potential benefits of the VR application may further amplify positive biases among participants in the HC group, as they may be inclined to endorse the technology's adoption within the hospital. Adhering to the principles of extrinsic motivators, as mentioned in Chapter 2.8.2. To address these biases, it's crucial to maintain transparency, encourage open communication, and actively seek diverse perspectives.

Another bias to be mindful of exists within the LC group, composed of students with varying degrees of familiarity with the researchers on different personal levels. Participants in this group may exhibit biases stemming from their relationships with the researchers, potentially influencing their responses during usability testing. Researchers need to recognize and address these biases to ensure the integrity of the data collected from both the HC and LC groups.

3.3 Guiding Principles for Educational VR Development

The principles proposed by Johnson-Glenberg[39] are theoretical concepts and practical tools relevant to educational VR development. They offer a broad list of principles that guide developers in creating effective and engaging VR learning experiences. As VR continues to emerge as a powerful tool in education, the need for well-defined design guidelines becomes increasingly crucial. Johnson-Glenberg's principles provide just that, serving as a cornerstone for informed development decisions.

In the context of this research, several of Johnson-Glenberg's principles have been selected and adopted into the development process through a series of iterative design cycles, where they were tested and refined. Furthermore, the principles serve as a benchmark against which the application's success can be evaluated. Chosen design principles are listed here, and their relevance is explained. After that, the application's performance and effectiveness will be evaluated based on the standards established by these principles in the findings and results chapter.

1. **Make it Beginner-Friendly:** Ensure accessibility by assuming users are novices, simplifying interactions, and providing intuitive and consistent controls. This is done by commencing with the premise that all learners are new to VR, which underlines the importance of easing the user into the virtual space. [39].

   Relevance: Ensuring beginner-friendliness is vital because users vary widely in age, competence, and learning styles. Intuitive controls help novices adapt quickly to VR, improving their learning experience by focusing on content rather than technology. This approach promotes inclusivity and accessibility across diverse user groups.

2. **Minimalistic UI Design:** Avoid cluttering the screen with unnecessary UI elements that can disrupt immersion. By minimizing static UI elements and reducing information to single windows, the user experience remains focused and immersive. [39].

   Relevance: A minimalistic UI design is essential for maintaining immersion during training sessions. By removing clutter and unnecessary elements, users can focus on the learning content, maximizing their engagement and retention of information. Ensure that users remain focused on the instructor's guidance, tasks, and the patient's health, enhancing the overall learning experience.

3. **Gradual Complexity Scaffold:** Introduce cognitive steps incrementally, starting with more straightforward tasks and gradually progressing to more complex ones. This scaffolding approach applies to the physical interactions and movements within the VR environment and the subject matter, ensuring a step-by-step progression in learning.[39].

   Relevance: For pre-hospital care procedures, which can be complex, this scaffolded approach ensures that users can understand and master each concept before moving on to more advanced topics, resulting in a more effective learning process.

4. **Collaborative Design with Subject Matter Experts (SMEs):** Engage teachers, SMEs, and clients in co-designing the educational content. Incorporate ongoing feedback to ensure contextual relevance and alignment with real-world standards.[39].

   Relevance: Collaborating With SMEs to ensure the application aligns with the curriculum and educational objectives. By incorporating feedback from SMEs, the training content becomes more relevant and meaningful to users, ultimately enhancing their learning outcomes. Involving subject matter experts also allows developers to consider long-term possibilities for implementing relevant additions.

5. **Structured Exploration:** Encourage guided exploration to maintain focus and engagement. Employ pacing and constrained choices to direct learners' attention effectively.[39].

   Relevance: Guided exploration maintains user engagement by directing their attention to relevant content, scenarios, and locations during the immersive experience. Users can explore the virtual space effectively by providing a structured learning environment.

6. **Minimize Text Dependence:** Utilize visual aids, animations, and audio to convey information whenever possible. Reduce reliance on lengthy text to alleviate eye strain and cognitive fatigue associated with prolonged reading in VR.[39].

   Relevance: Minimizing reliance on text is crucial, especially in a VR environment where users may experience cognitive fatigue from prolonged reading. By utilizing visual aids, animations, and audio cues, users can absorb information more efficiently and without depleting their cognitive resources.

7. **Facilitate Error-based Learning:** Embrace errors as opportunities for experiential learning. Provide low-stakes scenarios where errors contribute to understanding. Gradually increase the consequences of errors as users progress.[39].

   Relevance: Embracing errors as learning opportunities encourage users to experiment and learn from their mistakes. In a safe virtual environment, users can make errors without fear of real-world consequences, allowing them to learn from their experiences and consider newfound knowledge in future actions.

8. **Iterative Playtesting with Diverse Users:** Conduct frequent testing with diverse user groups to gather feedback and identify areas for improvement. Differentiate from developer testing to ensure insights accurately reflect end-user experiences.[39].

   Relevance: Conducting frequent playtesting with diverse user groups allows for identifying broad usability issues and areas for improvement. By gathering feedback from different perspectives, the application can be refined to better meet the needs and preferences of its target audience.

9. **Timely and Non-intrusive Feedback:** Deliver feedback promptly and subtly to support ongoing learning. Pace feedback to allow for cognitive integration while avoiding overwhelming the learner.[39].

   Relevance: Providing feedback promptly and subtly supports ongoing learning without disrupting the user experience. Users can adjust their actions by delivering them feedback at the right moments.

10. **Design for Reflection:** Incorporate opportunities for reflection to solidify learning. Balance action-oriented tasks with moments for contemplation and self-assessment. [39].

    Relevance: Incorporating opportunities for reflection allows users to solidify their learning and assess their progress. By balancing action-oriented tasks with moments for contemplation, users can reinforce their understanding of the ABCDE procedure and identify areas for improvement, akin to the cyclical stages of experiential learning.

11. **Active Engagement through Hand Controls:** Promote active learning through physical interaction with hand controls. Incorporate gestures and kinesthetic actions to manipulate content and reinforce learning.[39].

    Relevance: Promoting active learning through VR's possibilities, such as physical interaction with input devices, enhances user engagement. By incorporating input devices and kinesthetic actions, users can interact with the virtual environment more naturally, resulting in a more immersive and practical training experience.

12. **Aspirational Adaptivity:** Strive for personalized and adaptive learning experiences tailored to users' needs and comprehension levels. Leverage dynamic branching to enhance learning outcomes, even though it may require additional resources.[39].

    Relevance: By aiming for personalized and adaptive learning experiences, the application can effectively meet the needs and preferences of its users. MediVR can tailor the learning experience based on knowledge level by leveraging dynamic branching.

3.4 Data gathering

Data gathering is essential as it is the cornerstone for well-informed decision-making and strategic planning. Furthermore, it validates the feasibility of research and lays the groundwork for any project. Sufficient data collection in broader contexts, such as technology, ensures that the information acquired allows developers to develop without unnecessary resource expenditure. Moreover, it plays a crucial role in real-time monitoring and problem-solving, ensuring stability and reliability.

3.4.1 Preliminary data gathering

The preliminary data-gathering process served a dual purpose, as it introduced the collaboration between the researchers and the SMEs from Sørlandet Sykehus and connected the researchers to the curriculum. This initial phase was crucial for grounding the curriculum and identifying which parts of the ABCDE procedure should be visualized and how to do so. By collecting preliminary data, the researchers could categorize information effectively and develop an initial design, which was subsequently presented to the HC group. This approach ensured a solid start for the project, providing a more focused and informed development process and allowing the development of a draft for a storyboard, as seen in Appendix C.

3.4.2 Test Environment

The testing occurred at the Usability Laboratory, facilitated by I4Helse and the University of Agder[42]. The test participants were engaged in evaluating two different versions of the prototype. The first test round of the prototype took place during the first week of March, while the second test round occurred during the second and third weeks of April.

The first test of the application was to test the prototype's initial design and curriculum for the HC group of four participants. During the test sequence, the researchers experienced major technical complications, which resulted in the test only functioning as preliminary data gathering and minimal observation of the progress through the ABCDE procedure. More information regarding limitations and constraints is mentioned in Chapter 1.4.

The second test accommodated 9 participants, was conducted with two individuals at a time, and lasted 40 to 60 minutes. The testing procedure commenced with a brief pre-test interview lasting 5 minutes, followed by instructions on operating the input devices and HMD. The core segment of the test involved a 25-minute period for participants to interact with and explore the prototype, during which researchers observed their actions and progress. Additionally, the application was streamed onto external devices to facilitate observation and recording of participant interactions. After the observation phase, researchers exited the room, allowing participants to complete a digital questionnaire lasting about 15 minutes. Finally, a 15-minute post-interview session delved deeper into participants' experiences and feedback regarding the prototype.

During the testing sessions, the researchers utilized two rooms, each with two chairs, a desk, and a computer, to stream the application for observation. The application's streaming allowed the researchers to monitor the participants' experiences in the live feed, the order in which they completed the tasks, and to get an indication of where in the timeline problems occurred. Additionally, the test environment allowed the participants to move freely without the possibility of bumping into objects. It was also well-lit, providing the HMD with a platform to generate precise tracking data of the participant's movements.

3.4.3 Human Centered Design approach

Human-centered design (HCD) is an approach to innovation and problem-solving that places the needs, preferences, and behaviors of end-users at the forefront throughout the design process[94]. It entails comprehending users' perspectives, gathering insights into design criteria that enhance usability, and ensuring that the final product meets their requirements. By engaging users from the outset and throughout development, developers can proactively identify and address potential issues before they escalate[94]. HCD is characterized by its iterative nature, involving prototyping, testing, and refinement cycles. Each iteration builds upon insights from previous ones, gradually improving the prototype[31]. Moreover, HCD follows a cumulative hierarchy, where each stage serves as a prerequisite for the next level of

development. This means that insights from earlier stages inform subsequent ones, leading to a cumulative improvement in design. MediVR's prototype adheres to this framework, enabling the initial design concepts to be prototyped and tested effectively with users.

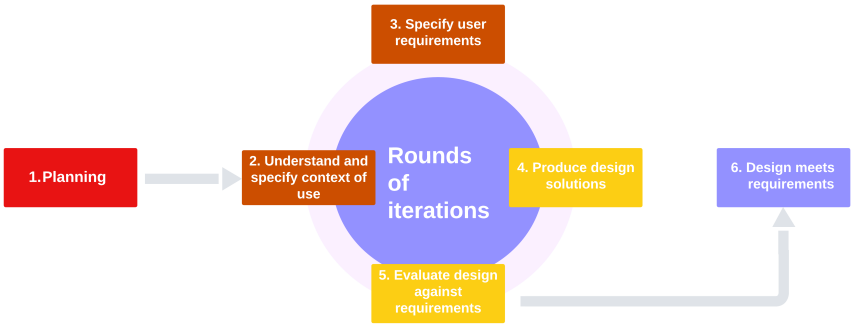

Figure 3.1: Human-centered design framework, adapted from [7]

3.4.4 Qualitative interviews

Qualitative research interviews encompass various approaches, including structured, semi-structured, and unstructured methods. Structured methods follow predetermined questions in a specific order, ensuring participant consistency. In contrast, semi-structured interviews blend planned questions with opportunities for respondents to provide elaborative responses, offering flexibility within a structured framework[62]. Unstructured approaches involve open-ended discussions without predefined questions, allowing for spontaneous exploration of topics based on participants' responses.

Qualitative interviews delve into critical topics aligned with specific research questions, ensuring comprehensive, relevant data collection[22]. Researchers typically conduct these interviews in controlled environments such as usability laboratories or during fieldwork in ethnographic research settings. By exploring participants' perspectives, behaviors, and experiences, qualitative methods enable a profound understanding of human nuances, enriching the research process and producing insights into complex issues[22]. Through participants' articulation of their experiences, qualitative research reveals issues that standardized scales may overlook, contributing to developing more valid measurement tools. Additionally, qualitative research can unveil previously unrecognized research areas, as issues initially deemed insignificant may gain relevance during the data collection phase.

3.4.5 Mixed Methods

As the name might suggest, mixed methods incorporate qualitative and quantitative elements to varying degrees, often complementing each other through triangulation. Triangulation in mixed methods research involves using multiple sources, methods, or data types to corroborate findings, enhance validity, and provide a more comprehensive understanding of the research phenomenon[61]. Mixed methods allow researchers to leverage the strengths of both qualitative and quantitative methods in a single study, providing a more comprehensive understanding of the research topic. Researchers can gain deeper insights into complex phenomena while quantifying relationships and patterns by combining qualitative techniques, such as interviews or observations, with quantitative methods like surveys or experiments.

However, it is essential to acknowledge that qualitative and quantitative methods have weaknesses. The strengths of the counterpart compensate for these weaknesses [10]. For example, qualitative methods capture rich, detailed insights into participants' experiences and perspectives, while quantitative methods produce reliable, generalizable outcome data. By

integrating both approaches within a mixed methods framework and triangulating findings, researchers can mitigate the limitations of each method and capitalize on their respective strengths, leading to a more robust and complete understanding of the research topic.

3.4.6 Usability testing

Usability testing is essential in evaluating a design's effectiveness and user-friendliness. It aims to identify usability issues, gather user feedback, and refine the design iteratively. Typically conducted with actual users within the target group performing specific tasks, usability testing provides valuable insights into user behavior, preferences, and limitations.

As previously mentioned in 3.2.1 Test Environment, the researchers conducted usability testing at the premises of i4Helse at the University of Agder. Recognizing that conducting usability testing only at the end of the development process can lead to missed opportunities for improvement and time-consuming rework, the researchers conducted usability testing throughout the process to ensure that the design effectively meets the user requirements. By integrating usability testing early and continuously throughout the project, the researchers could address issues proactively, uncover possibilities, and ultimately deliver a better user experience.

As a part of the iterative process, the researchers conducted user testing with nine participants across three testing sessions. The testing commenced with a usability test involving four participants from the HC group. With experience within the curriculum, this group served as screeners for the curriculum and valuable contributors to identifying possibilities and shortcomings. Subsequently, 3 new participants from the LC group, with little to no prior experience with the curriculum, underwent testing. The week after, two additional participants were included in the LC group and admitted to the research.

With feedback from both groups, the researchers refined and iterated the prototype, enabling subsequent testing on new and prior participants. This approach ensured that the test participants represented individuals with various degrees of familiarity with the technology, genders, ages, and familiarity with the curriculum.

Pre-test interview

At the outset of the usability testing, pre-test interviews consisting of 9 questions marked the starting point. These interviews included questions about the participants' age, familiarity with the curriculum, preferences in learning, and familiarity with the technology. Pre-test interviews serve the dual purpose of collecting data about the participants' expectations and previous experience while allowing the participants to settle down in the test environment, easing their minds and making them more comfortable. The full pre-test interview can be seen in Appendix I.

Observation

To start the observation, the participants were given the Oculus Quest 2 or 3 HMD and the needed input devices. Observation within usability testing involves closely watching participants interact with a product or system to understand their behaviors, actions, and reactions[96]. It aims to gather insights into how users engage with the design, identify usability issues, and validate user feedback. Furthermore, observations allow researchers to collect significant data to determine whether the application meets the set goals.

In the researchers' approach, observation during usability testing was conducted by closely monitoring participants within the test environment as they performed tasks and progressed

through the course. Interviews supplemented this observation to confirm whether the participants' verbal feedback aligned with their activities. By integrating qualitative data from the interviews with the observation data, researchers could determine if the verbal feedback corresponded to their actions. The researchers took detailed notes during these observations, documenting participant behavior and any encountered issues.

During the testing sessions, participants were encouraged to think aloud, articulating their thoughts and feelings as they interacted with the application. This allowed the researchers to understand the participants' experiences and uncover challenges. Instead of assigning tasks, the instructor, within the immersive experience, guided the participants on what actions to take. The researchers noted any difficulties following the instructor's instructions, providing valuable insights into potential usability issues.

Quantitative questionnaire

Upon completing the course within the application, the participants were handed a questionnaire, which they would answer according to the Likert scale[68]. The Likert scale is a rating scale that allows participants to indicate their level of agreement or disagreement with a series of statements[68]. Likert scales typically range from strongly disagree to strongly agree, providing a standardized measure of attitudes, opinions, or perceptions on a given topic[68]. This is relevant to quantitative methods as it enables researchers to quantify and analyze participants' responses statistically, allowing for comparisons and generalizations across a larger population.

Quantitative research involves collecting and analyzing numerical data to understand and describe phenomena[32]. Structured questions intended to elicit close-ended responses are used, and participants typically choose between quantifiable answers or a set of provided options[32]. These methods measure variables and relationships between them, allowing researchers to quantify trends, patterns, and correlations systematically. Unlike qualitative methods, which focus on exploring the depth and context of human experiences, quantitative methods emphasize numerical precision of findings [32].

The quantitative questionnaire utilized in this research project is grounded in the User Engagement Scale (UES)[58], incorporating items specifically relevant to the study's focus. These items contain enjoyment, interest, usefulness, and ease of use derived from the UES framework. By integrating these elements into the questionnaire, findings can effectively measure and quantify user engagement levels with the immersive experience under investigation. The complete list of UES can be seen in Appendix I.

Post-test interviews

The post-test interview served as the final stage of the usability testing process. It allowed the researchers to delve deeper into participants' experiences and gather valuable insights to complement the quantitative data collected through the UES. Through semi-structured interviews, participants could elaborate on their actions, providing valuable context and reasoning behind their decisions. Additionally, the interview allowed participants to raise any unexplored areas or concerns. By clarifying responses and capturing user perspectives, the researchers gained an understanding of user needs and preferences, which informed further iterations of the prototype. The full post-test interview can be seen in Appendix I.

Chapter 4

Development

Development became a central part of the master's thesis, and the results reflect a multimedia VR prototype that includes substantial work with 3D models, animations, audio, scripts, and UI. This chapter will explain how the researchers developed the different aspects of the prototype and why specific development methods were chosen.

4.1 Inspiration

The researchers' inspiration for developing and researching this application derives from their desire to contribute to the healthcare sector and leverage the capabilities of the new Meta Quest 3 headset. Driven by their passion for working with Unity and exploring the potential of VR technology, they were excited to collaborate with Sørlandet Sykehus. This project aligns perfectly with their interests and provides an opportunity to impact people's lives meaningfully. Additionally, the researchers required the project to contain coding and 3D design with a significant purpose, making this endeavor even more exciting. The prospect of working on something intrinsically motivating, combining their inherent interests with the chance to create positive change, fuels their enthusiasm for the project.

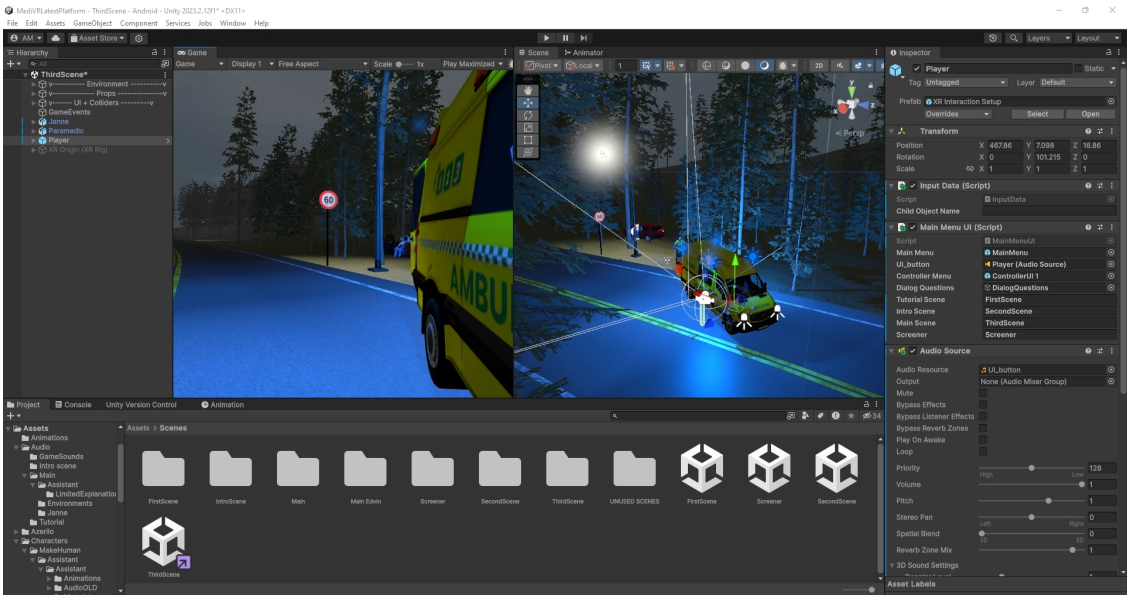

Figure 4.1: MediVR Unity

4.2 Unity

Unity Technologies is a versatile game engine that enables the development of diverse gaming experiences and applications. It caters to a broad spectrum of developers, from seasoned professionals to novices, all under a free-to-use model. It supports seamless downloading of 3d models from the Unity Asset Store, pre-programmed assets from third-party providers, and extensive documentation and online support. Unity was the recommended development tool in our previous courses, so due to our experience with the program, we chose to use it to develop the prototype.

Initially, the prototype was developed using the Unity 2022.3.8f1 editor version, but it was later discovered that this version was not compatible to build the application for both Meta Quest 2 and Quest 3. A decision was made to upgrade to the latest version, version 2023.2.12f1, which fixed this problem.

4.2.1 Unity VR Tools

OpenXR is an open standard developed by the Khronos Group[59], aimed at unifying the development of XR applications across various hardware platforms. It provides a standard API (Application Programming Interface)[93] that allows XR applications to run seamlessly on different devices, regardless of the underlying hardware or software platform. OpenXR focuses on working with different XR hardware and platforms, enabling developers to write code that is easily ported across a wide range of devices. In other words, it helps ensure compatibility between different XR hardware and software.

The XR Interaction Toolkit is a package Unity provides for developing interactive experiences in XR (Extended Reality) within the Unity game engine[98]. It simplifies implementing everyday interactions such as grabbing objects, movement, and UI interaction in XR environments. The toolkit is designed to work across various VR and AR platforms supported by Unity, including Oculus Rift, HTC Vive, Windows Mixed Reality, and others. It allows developers to modify how the interactions behave through scripts or the inspector tab in the Unity editor.

XR Origin (XR Rig)[99] is a component from this package that controls the player's movement and interaction in the prototype. This preset includes a hierarchy of game objects and, subsequently, script components that translate the movement of the VR headset and controllers in the physical world into the player's actions in the VR digital world.

4.2.2 Scenes

The prototype is divided into multiple scenes to differentiate four scenarios. A scene is equivalent to an instance of an environment and whenever the player transitions between scenes, all the assets are loaded in. Separating the scenarios helps increase performance.

Figure 4.2: Screener overview

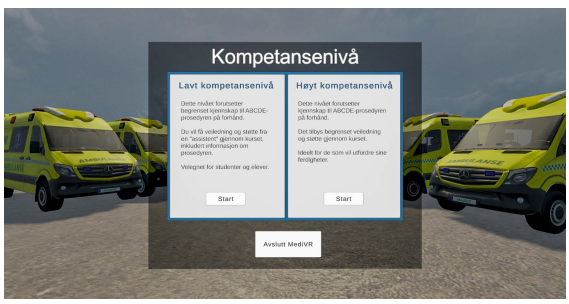

Figure 4.3: Options for difficulty

The first scene is a screening, during which the player has the option to choose between two variants of the course. The difference between the two variants is the player's medical competence. The player can choose "High Competence," which results in less information given by an instructor, or "Low Competence," which means the instructor will explain every step of the procedure in greater detail throughout the course.

Figure 4.4: Tutorial overview

The second scene provides the necessary tutorial on using the VR headset and touch controllers. To complete the course, the player needs to know how the headset and controllers react in the VR environment compared to their movements in the physical world and how the controller buttons interact with the game objects. This scene introduces movement, interaction with 3d models, and interaction with UI through audio from the instructor, UI panels, and other graphical elements.

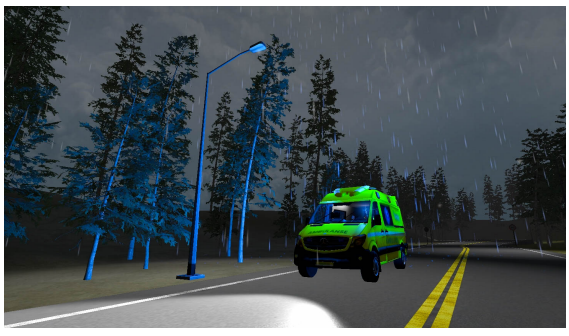

Figure 4.5: Ambulance driving to the crash site

Figure 4.6: Driving to the crash site

The third scene serves as an establishing shot and introduces the player to the environment of the central part of the simulation. Additionally, as an establishing shot, the scene also designed to allow the user to reflect and solidify newfound knowledge absorbed during the tutorial. The player is sitting in the passenger seat of the ambulance while driving to the accident site. When arriving at the accident site, the instructor will describe a "window

message"[37], a short and concise description of the accident that is mandatory to report to the AMK (Emergency Medical Communication Centre)[4].

Figure 4.7: Main scene overview

Figure 4.8: Arriving at the crash site

The fourth and final scene focuses on arriving at the emergency location, bringing the necessary equipment, and examining the patient. When the player approaches the patient, the instructor will provide instructions on what actions are required, and then the player will perform the necessary actions. This loop will continue until the ABCDE procedure is completed. After completion, the player will be presented with a scoreboard summarizing their actions through the fourth scene in the course. This scoreboard tells the player how many points and errors they got and how many times they asked for help from the instructor.

4.2.3 Version Control

Plastic SCM is a version control system that integrates with Unity to manage source code, assets, and other project files[65]. It provides a collaborative environment to track changes, manage push and pull requests, and coordinate work effectively. Plastic SCM is a built-in feature in Unity and a desktop application for managing development between multiple participants.

The built-in feature in Unity made it very easy to push and pull changes, but merge conflicts could happen. A merge conflict happens when someone works on the same scene, script, or game object. This problem was solved by carefully planning who was working on what part of the project at any given time.

4.3 3D Models

Because of the limited time allocated to development, almost all the assets used in the prototype were downloaded for free online. Unity asset store[84], sketchfab[74], and turbosquid[1], amongst other websites, provide a large collection of free downloadable assets. Blender was used to fix edges on some of the 3d models[27].

4.3.1 Human 3D Characters

The prototype required two human-looking 3D models, one for the patient and the other for the instructor. Several options were explored to find the most versatile, customizable, and free downloadable 3D models. MetaHuman is a complete framework that allows anyone to create, animate, and use highly realistic digital human characters in game development[47]. Still, it is developed for Unreal Engine, which results in compatibility issues with Unity.

Adobe Fuse CC is similar to MetaHuman. It's a standalone 3D character creator that can be downloaded for free on the Steam platform[77] and supports a variety of body parts, clothing, and dynamic texturing substances[14]. However, Fuse has been discontinued and is no longer supported for animations and rigging.

Figure 4.9: Instructor made in MakeHuman

Figure 4.10: Fbx file imported to MediVR

After further research, MakeHuman was discovered. This character creator focuses less on realism than the other examples but still provides an extensive application with fully rigged and customizable characters that can be downloaded for free[97]. Compared to Fuse, this character creator is supported by Adobe Mixamo, which allows for fully rigged characters and various free downloadable animations.

Figure 4.11: Original outfit texture

Figure 4.12: Improved outfit texture

The paramedics clothes had to be changed to resemble a visually realistic paramedic wearing a Norwegian uniform[50]. This was achieved by importing the MakeHuman png texture file into Photoshop and painting different colours on the outfit. The hex codes red - f60e0e and neon yellow - b6f437 was used on the pants and jacket, dark red – 590101 for the shirt, and a pattern of alternating squares of dark green - 2a6656 and grey - 9b9eab was used to paint

the reflector parts of the outfit. Finally, an emblem[54] and a badge was added to the upper arm and chest.

4.3.2 Adobe Mixamo

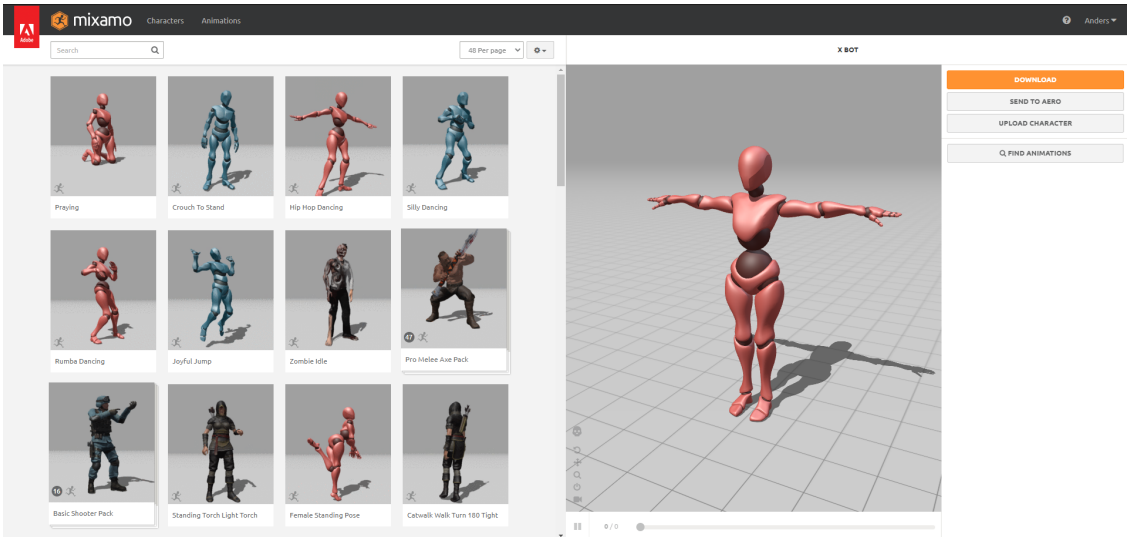

Figure 4.13: Free downloadable animations from Mixamo

Adobe Mixamo is a website that provides hundreds of free downloadable animations[51]. The MakeHuman character was uploaded to Mixamo to preview the various animations available. Because the prototype focuses on realism, the character models needed animations for walking, talking, and idleness. These animations were exported from Mixamo and imported into Unity[46].

However, for the animations to be effectively applied to the MakeHuman models, you have to create an avatar and a rig from the model inside Unity [9].

Because of the differences between the rig from the Mixamo animations and the rig from the MakeHuman models, parts of the animations looked unnatural and disfigured. This especially applies to the hands, fingers, and legs. The animations from Mixamo are "read-only," meaning you can not directly edit the animation keyframes inside Unity. To circumvent this, the animation file can be duplicated as a separate file outside the character model prefab. The keyframes were then edited to prevent body parts from being disfigured. To make the texture on the instructor's uniform like the Norwegian standard, the texture files were edited within Photoshop and applied to the instructor as the uniform was finished.

4.3.3 Third Party Downloadable Content

Most of the 3d objects that was used in the prototype was downloaded from the Unity asset store, Sketchfab, and Turbosquid. Some prerequisites were made regarding the downloaded objects that were used in the project. The main condition was that the 3d object was free to download. Furthermore, a focus on the balance between realistic looking objects compared to their file size and triangle count was carefully considered, while also being compatible with the built-in render pipeline. A complete list of 3d objects and plugins can be found in Appendix G.

4.3.4 Environment

The action's environment has been iterated upon numerous times and crafted within the Unity platform, utilizing assets sourced from various repositories. To create a lifelike setting,

the surroundings of the crash site are decorated with animated trees, employing Unity's Wind Zone and bend factor features to simulate natural swaying movements. This was made by using the built in tool Terrian Tools in Unity[79]. The design features a curved road leading to the crash site, bent in both directions to prevent users from encountering an endless horizon. This curvature effectively encloses the region, enhancing the illusion of a larger scene. Complemented by immersive audio elements, the environment synergizes to provide users with an enriched and immersive experience within the application. Two main plugins have been used to create the environment in the scene. The roads are made with the RoadArchitect plugin[48], and nature is created using the Terrain tool. Both of these plugins have intuitive and extensive user interfaces, and they include a variety of related 3d models. However, they are outdated, which results in various yellow and red error messages in the unity console. This caused some issues because any minor adjustments, to the road system in particular, could break the whole scene and subsequently require a rollback to a previous version because the error messages could not be resolved.

4.4 Interactions

The condition for how the course progresses is through the player's interaction with the environment. In the tutorial, the player must move simple objects and interact with UI elements. Similarly, in the main part of the course, the player needs to perform various tests on the patient using equipment that the user interacts with.

4.4.1 Interactable 3D objects

All of the 3d models that the player can interact with have scripts attached to them from the XRI Interaction Toolkit package. Either "XR Simple Grab Interactable" or "XR Grab Interactable" are used on the objects, depending on how advanced the interaction is. These scripts allow the player to select, grab, move, and release objects with the triggers on the Oculus Touch controller. These scripts also contain events that can send information to other game objects or scripts based on the interaction type used.

4.4.2 UI

User interface panels will periodically give information on what the player needs to do to progress in the course. These panels contain textboxes and buttons. A lot of information needs to be given to the player throughout the course, and these UI panels will complement the instructor's monologue to diversify the information flow.

Most UI panels will only provide specific information. Still, the main menu UI allows the player to change camera height, view the controller key bindings, or change between the different scenes.

4.4.3 Oculus Touch Buttons

The XRI default input actions are set to default maps, but are customizable. Through Unity, the researchers mapped desired buttons to scripts, allowing them to assign the main menu and other functions to different buttons.

4.5 Scripts

Custom scripts must be written to change the behavior of game objects and player interactions. In Unity, these scripts are written in the "C Sharp" coding language[16] and can be created with an Integrated Development Environment (IDE)[17].

Figure 4.14: Main Menu

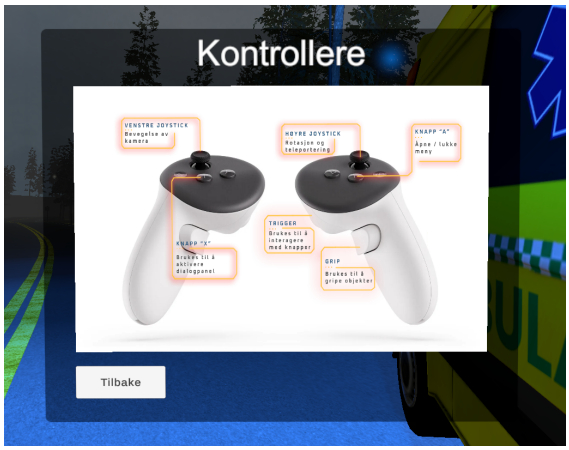

Figure 4.15: Overview of controller keybinds

As previously mentioned, all the interactable objects have scripts attached to them. However, the prototype also has scripts that control the traffic system, conditions for progressing in the course, and a scoring system based on the player's correct or incorrect actions. Most of the smaller scripts are connected to the main script, called "GameEvents," which controls which stage the player is currently at, when the instructor can progress, and if the player gains or loses points.

4.6 Audio

To increase realism and immersion, the prototype includes multiple audio sources. The researchers downloaded free audio for wind, rain, car sounds, honking, and patient breathing. They implemented audio to supplement the visuals and enhance realism further. The application presents the user with different scenes featuring various visual elements. The researchers intentionally added high intensity, frequency, and volume to the complementary audio to explore whether the different audio sources would function as disruptors. This approach allowed the researchers to investigate Research Question 1.2, as mentioned in Chapter 1.2.

4.6.1 Voiceover

During the initial development stages, computer-generated audio based on text was utilized to voiceover human actors. This approach facilitated planning for future curriculum implementations and enabled developers to accurately time animation lengths. As the project progressed, the audio was completely redesigned in collaboration with a paramedic and a student. The paramedic was invited to the university studio to record the voiceovers for the instructor, and the student was involved in recording the audio for the patient. The recording sessions used a Zoom H4nPro audio recorder [100], and the audio was post-processed using Adobe Premiere Pro CC for refinement[15].

4.7 Optimization

Optimizing the VR application is paramount to ensure a seamless and immersive user experience. This optimization entails catering to the specific hardware on which the application will run, mainly since the aim is for it to operate untethered from a computer. It necessitates building the application and installing it directly on the VR headsets. By optimizing for the target hardware, the application can leverage its capabilities efficiently, and the researchers

will have information on what thresholds are before the application becomes too heavy for the HMD to run.

As the research focuses on identifying strategies and methodologies to enhance immersion, ensuring the virtual experience runs smoothly on standalone devices without compromising framerate becomes crucial. Maintaining an optimal framerate is essential to prevent user experience disruptions and uphold the sense of immersion. Therefore, enabling users to remain untethered while experiencing optimal framerate became a critical consideration for the researchers. This section details the choices and solutions implemented by the researchers to optimize the application.

4.7.1 Lighting

In the different scenes, baked lighting was predominantly used to illuminate the environment. Baked lighting is a technique in Unity that involves precomputation, where lighting information is calculated and stored in textures. These textures are then applied to static objects in the scene. Each scene typically has one lightmap, a texture containing all precomputed lighting information for static objects. Static objects like buildings and terrain remain stationary throughout gameplay and benefit from this precomputed lighting method. It enhances realism and visual consistency while minimizing the computational requirements during runtime.

On the other hand, non-static objects, such as vehicles, require the dynamic illumination provided by real-time lighting to accurately depict their movements and interactions within the scene. Enabling or disabling baked lighting does not affect static objects' illumination in real time since baked lighting cannot be modified dynamically. While resource-intensive, this crucial role of real-time lighting is essential for bringing these dynamic elements to life in complex scenes (Fix the ambulance problem and show screenshots before and after tris).

Figure 4.16: Baked lights on static streetlights

Figure 4.17: Realtime lights on non-static car

By balancing the use of baked and real-time lighting, the researchers ensured that the VR experience maintained visual fidelity and realism. Directional lights and streetlights were baked into the environment to provide consistent illumination, while dynamic elements like moving vehicles and emergency lights on the ambulance utilized real-time lights.

4.7.2 Triangle Count

Vi kan forsøke å ta ambulansen inn i blender og decimate modellen for å så ta den tilbake inn i main scene.

4.7.3 Terrain

This subsection will focus on what actions were taken to optimize the terrain within the application. The terrain includes the ground and its textures, as well as trees and it's settings.

- **Terrain heightmap resolution Reason:** The resolution was reduced to optimize performance and reduce memory usage while still maintaining acceptable visual quality. Resolution was reduced from 4097 x 4097 to 513 x 513.
- **Increased Pixel Error Reason:** Increasing the pixel error threshold allowed for faster rendering by reducing the level of detail in distant objects. Pixel error count was increased from 5 to 40.
- **Decrease Base Map Distance Reason:** Decreasing the base map distance improved rendering performance by loading and unloading terrain textures more efficiently based on the player's proximity. Base map distance was decreased from 1000 to 200.
- **Billboarding Reason:** Starting billboarding at a closer distance improved performance by reducing the number of detailed objects rendered in the distance. The billboarding is set to start at 50.
- **Detail Distance Reason:** Adjusting the detail distance optimized performance by controlling the rendering of detailed textures and objects based on the player's distance from them. The detail distance is set to 80.
- **Tree Distance Reason:** Reducing the tree distance minimized rendering overhead by limiting the number of trees rendered at a distance, thereby improving performance. The tree distance is reduced from 5000 to 500.
- **Max Mesh Trees Reason:** Limiting the maximum number of mesh trees optimized performance by reducing the complexity of the scene while maintaining visual fidelity. The Max mesh trees is set to 50.

4.7.4 Fog to Conceal Terrain Changes

Fog in scene: The changes made on the terrain, lead to transition effects on the horizon. To address this, fog is implemented. It gradually obscures distant objects, such as trees affected by billboarding and texture changes on the terrain, thereby minimizing the abruptness of transitions. This gradual blending is important to maintaining a seamless and immersive experience for users, reducing the likelihood of crude visual artifacts. By adjusting the fog parameters, the reseachers can fine-tune the level of obscuration, ensuring that transitions remain subtle while effectively concealing any noticeable changes on the horizon.

4.8 Human-centered design in development

In the context of the research project, the researchers developed a prototype that would function as a proof of concept to gather data and shed light on the research questions. As depicted in Figure 3.1, the researchers followed the four critical components within the HCD framework: understanding and specifying the context of use, specifying user requirements, producing design solutions, and evaluating design solutions against prior set requirements.

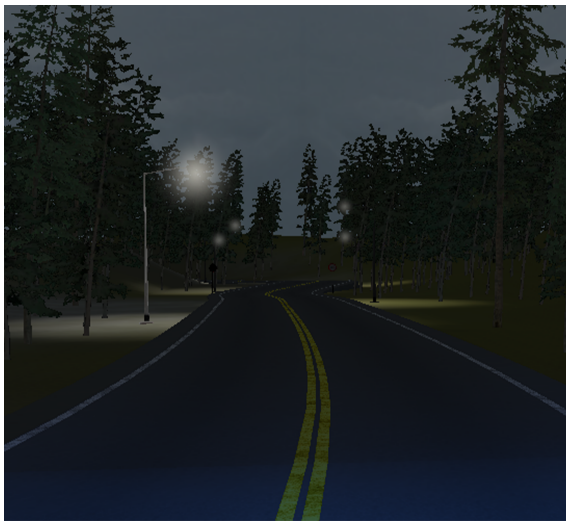

Figure 4.18: Road and environment not affected by fog

Figure 4.19: Road and environment affected by fog

This iterative approach allowed the researchers to incorporate user feedback and insights at each stage of the design process, resulting in a definitive prototype tailored to user needs and preferences.

Due to the researchers' limited knowledge of Unity, procedural medical training, and VR's capabilities, they worked alongside the HCD framework, deviating from the traditional standard of focusing on its components before development. Developing alongside HCD enabled the researchers to gain insight into what was achievable with the available technologies. During the initial phase, the researchers dedicated much time to engaging high-competence stakeholders, shedding light on considerations for curriculum integration within the prototype, and defining the desired learning outcomes.

By embracing a collaborative approach prioritizing stakeholder involvement, the researchers ensured that the final product would effectively meet user needs and provide a meaningful learning experience, in line with Principle 4: Collaborative Design with Educators. This principle emphasizes the importance of engaging with Subject Matter Experts (SMEs) in the design process to ensure the educational content aligns with pedagogical goals and instructional strategies. Recognizing the crucial role of stakeholders in shaping the prototype, the researchers valued their contributions as instrumental to the project's success.

4.8.1 Specifying context of use

Specifying the context of use involves understanding the environment, tasks, and characteristics of the users interacting with the product. This step is crucial in the design process as it provides insights into how the product will be used in real-world scenarios and informs design decisions to ensure that the solution meets user needs effectively. By understanding user characteristics such as their knowledge, skills, and preferences, designers can tailor the product to suit their needs and preferences. Similarly, gaining insights into the tasks users perform and the environment in which they operate helps designers anticipate potential challenges and opportunities for improvement.

Paramedics, apprentices, instructors, and other medical personnel interact with the training environment in various capacities, each with their tasks, skills, and preferences. Understanding the context in which these stakeholders operate is essential for designing a training solution that effectively complements ongoing internal training. The researchers employed the PACT framework for People, Activities, Context, and Technologies to achieve this[55].

This framework helps analyze the current and future use context, considering the needs and preferences of the main stakeholders involved in pre-hospital care training. For instance, The PACT analysis identified users with varying degrees of familiarity with VR technology, suggesting the need for intuitive user interfaces and straightforward interactions. Additionally, clear instructions and guidance within the application are crucial to helping users navigate the training scenarios and procedures effectively. The complete PACT analysis can be seen in Appendix A.

Subsequently, the researchers developed personas to understand the users' needs, goals better, and expected behaviors based on the information gathered from the PACT analysis and principles mentioned in Chapter 3.3. Personas are fictional and specific characters representing the target users[67]. Furthermore, A persona is a collective representation of target users who display shared behavioral characteristics, serving as a hypothetical archetype of real users.[67]. Personas cultivate empathy among developers, enabling a deeper understanding of user perspectives[67]. The developed personas contain essential elements, including technical proficiency, user narratives, descriptions, and backgrounds. These components provide a foundation for understanding user behaviors, preferences, and contexts, guiding the design process. The full list of personas can be seen in Appendix B.

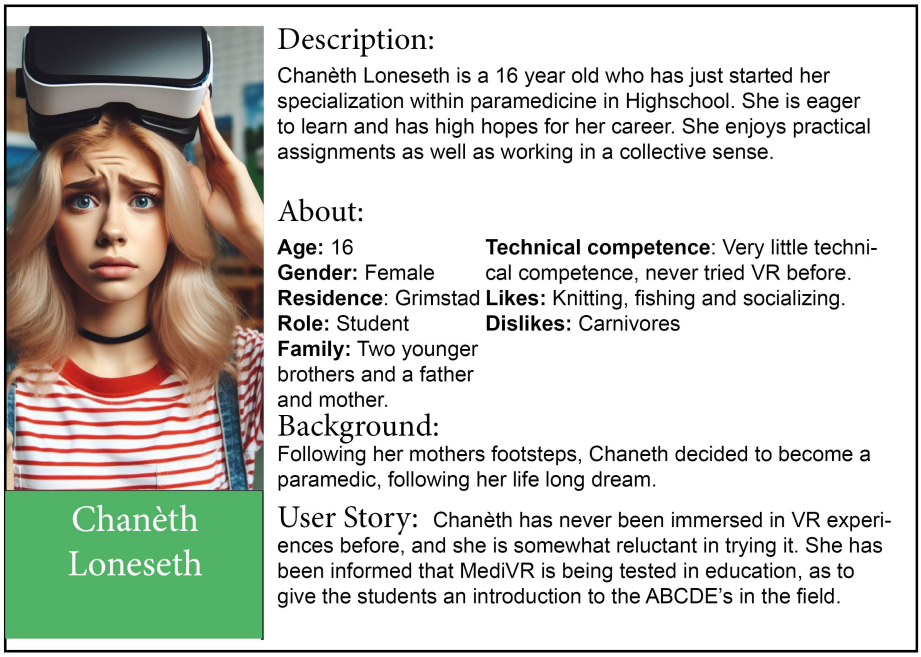

Figure 4.20: Chaneth Loneseth

4.8.2 Specifying the User Requirements

Specifying user requirements is a critical stage in the HCD cycle. During this phase, designers actively gather and document detailed information about users' needs and expectations for the product or system under development. This includes identifying functional requirements, which outline the product's specific features and functionalities, and non-functional requirements, which specify performance, reliability, and usability criteria. A widely utilized method for determining user requirements is the Volere shell template, which offers a

structured framework for capturing and organizing requirements to ensure comprehensive coverage of user needs[88]. In this research, the Volere shells are firmly grounded in the insights gained from the PACT analysis and personas, which serve as a solid foundation for defining user requirements. Additionally, the Volere Shells have been adopted and reworked to better suit the needs of this research. The formulation of the non-functional Volere shells draws inspiration from the chosen guiding principles for education VR, as listed in Chapter 3.3. This allows the researchers to develop Volere Shells that challenge the principles critically and allow benchmarking towards set criteria. A complete list of all the Volere shells can be found in Appendix D and E.

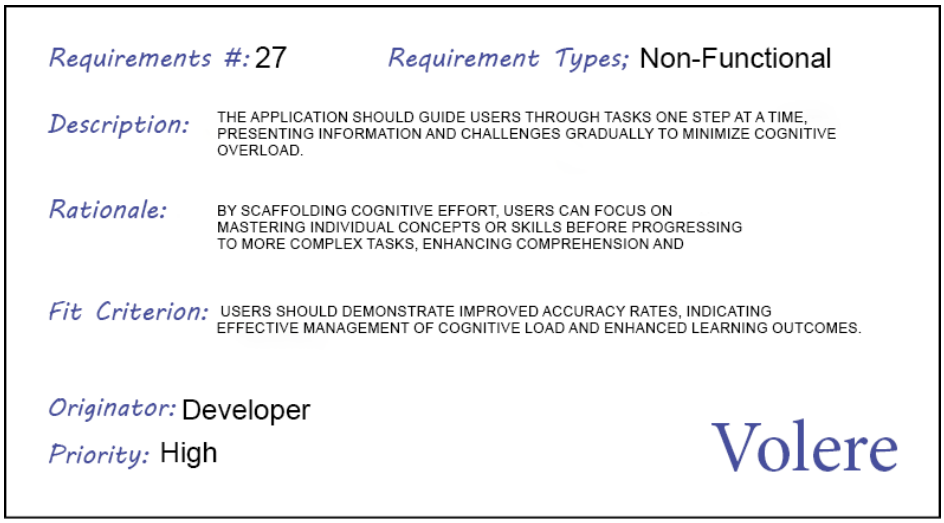

Figure 4.21: Volere Shell - Non-functional requirement number 27, inspired from principle 3 "Gradual Complexity Scaffold"

4.8.3 Producing design solutions

Engaging in discussions and dialogue with Sørlandet Sykehus marked the beginning of the application's design. Initially, the developers constructed essential and simple scenes using the Oculus Integration SDK within Unity, based on simple storyboards, to test VR functionalities[8]. This involved configuring VR components such as interactions, UI elements, Unity settings, scene management, and scripting. Subsequently, the developers created a proof of concept featuring a minimalist design, limited tools, an outdated American ambulance, and a patient. As scene refinement ensued, the environment, including elements like trees, roads, and traffic, underwent continuous improvement to better suit user needs and context.

The first tested iteration of MediVR was designed with three distinct scenes. The first scene was a tutorial for VR functionality training, followed by an introductory scene that guided users to the crash site. The final scene was for procedural training. At this stage, the application actors could have been more detailed and were only minimally animated. The instructor's role was portrayed without voice-over, using instead a robotic synthesized voice generated from text input. This design iteration was not a built application but a running application, requiring the headset to be tethered to a computer with powerful specifications. However, the user could open the mouth of the patient, lean in to hear the patient's breathing, perform a capillary refill test, ask the patient simple questions, and check the patient's temperature.

Design Improvements

In contrast to the earlier proof of concept iterations designed primarily for testing, the latest design iterations have been influenced by data collected during these testing rounds, leading

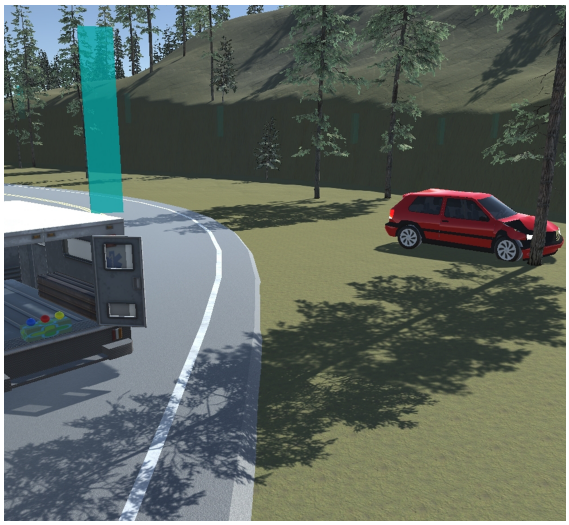

Figure 4.22: Early crash site

Figure 4.23: Final crash site

to a design rework. The most recent iteration introduces a user-centric screening process, empowering users to select a path that aligns with their needs and level of competence. Significant environmental improvements have been made, resulting in a more realistic setting. Figures 4.3 and 4.4 illustrate that the terrain is smoother, the forest is denser, and the ambulance model has been updated to adhere to Norwegian specifications, ensuring relevance to the target audience.

Moreover, the instructor character has undergone a comprehensive redesign, featuring more realistic animations, a uniform adherence to Norwegian standards, and a complete voice-over implementation. Finally, the application has been developed to operate untethered, allowing it to run on standalone devices, thereby enhancing accessibility and usability for users.

Figure 4.24: Instructor early iterations

Figure 4.25: Instructor latest iteration

A conceptual model was developed to visualize the flow between the different components within the application[91]. The conceptual model visualizes the proposed system's structure, functionality, and interactions, aiding in understanding and conceptualizing the final product. It also guides the developers in shaping the system's architecture and features based on the identified user requirements. This initial model provided a foundational blueprint for the physical design, which underwent iterative refinement and enhancement to evolve into a high-fidelity prototype. The conceptual model can be seen in Figure 4.5.

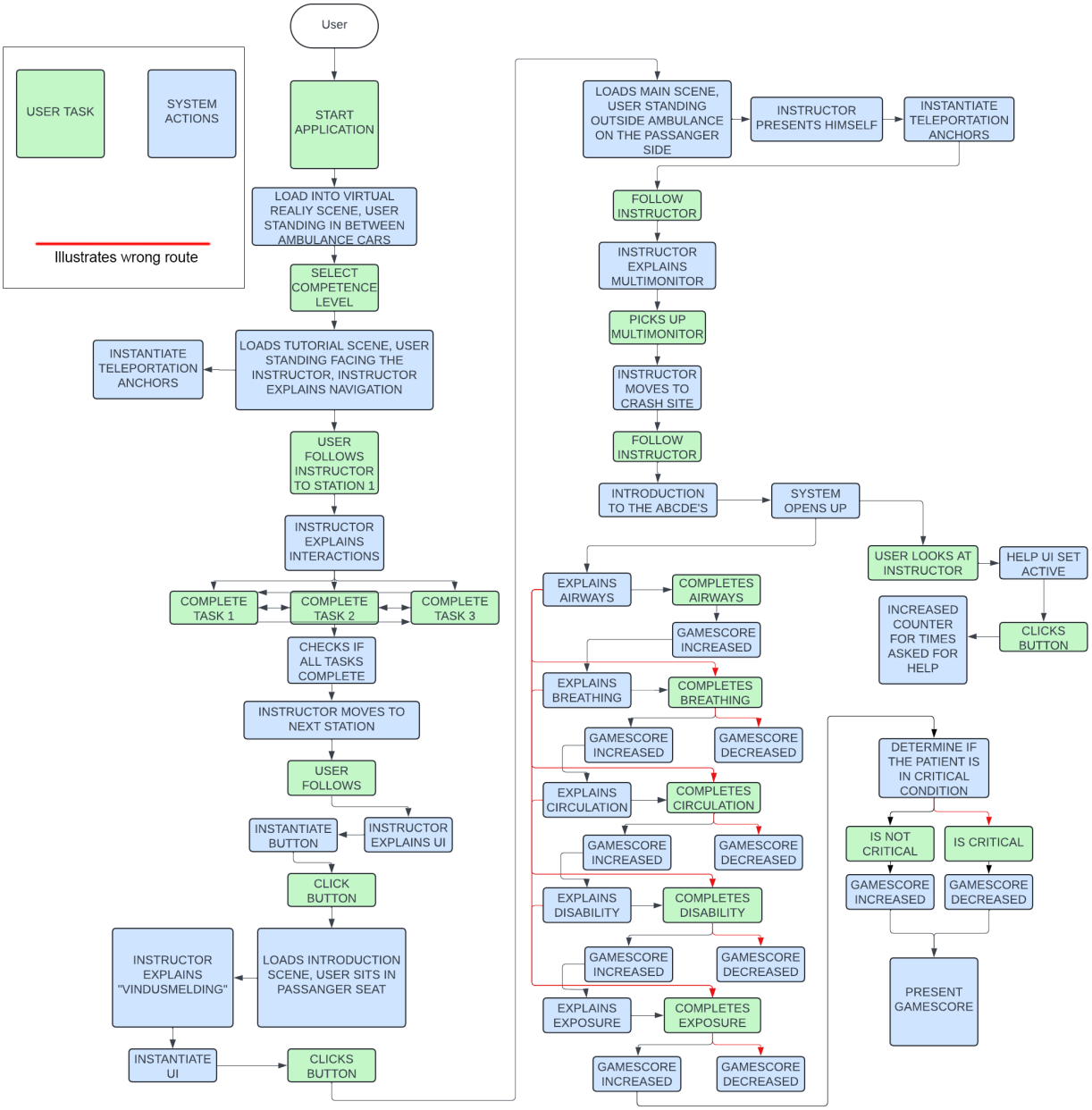

Figure 4.26: Conceptual model

4.9 Iterations

Grounded in the preliminary insights and information SSHF provided, as explained in Chapter 3.4.1, the researchers developed the initial design and tested it on participants from the LC and HC groups. This testing process revealed functional and non-functional bugs, primarily identified through observation. This section details and discusses these bugs, shedding light on the refinement process taken to address these bugs.

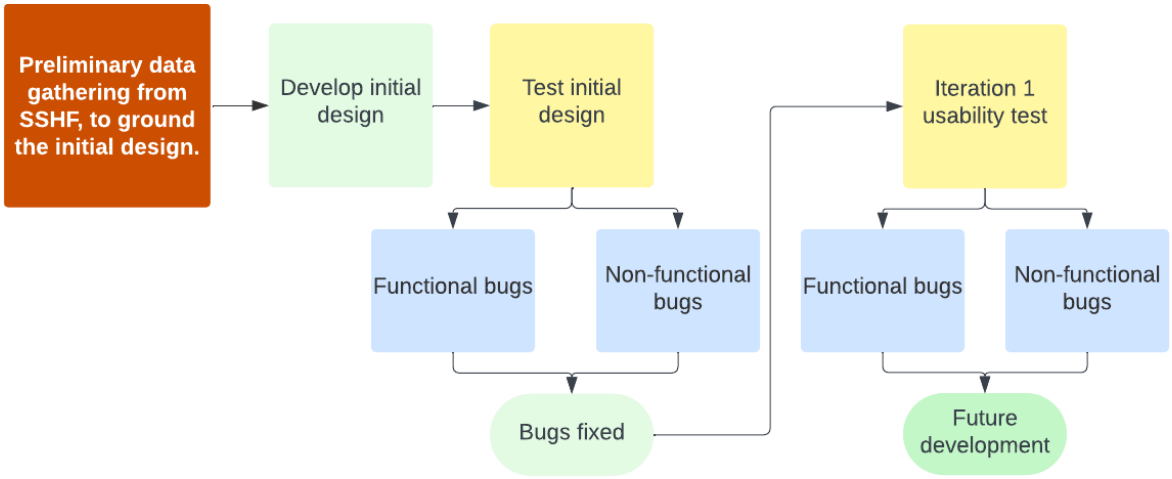

Figure 4.27: Overview of testing and development

4.9.1 First Iteration

Non-functional bugs

- **Objects in tutorial could get lost which inhibited progression**
  A reoccurring issue during the tutorial was that the participants moved the interactable objects without listening to the instructor, nor reading the UI text boxes above the objects, which disabled the ability to progress and required a complete reset of the course. Some participants threw the interactable objects beyond the test area, which inhibited progression. The solution to this problem was to reset the position of the objects unless the participant completed the correct action.
- **Player spawning outside of the ambulance while driving to the crash scene**
  During the intro scene, where the participant is sitting in the passenger seat and being introduced to the crash site, some of the participants camera view was outside of the ambulance vehicle. Several attempts were made to constraint the participant camera view within the ambulance, without any clear solution. It was later discovered that when the researchers created the boundaries for the VR-headsets, then gave the headsets to the participants, the boundaries were calculated based on the researchers' initial position. The final solution was to let the participants create a stationary boundary around their position, which solved the problem.
- **Open mouth and grabbing object could happen simultaneously**
  During the airways step of the procedure, the participants could accidentally open the patient mouth and simultaneously remove any object with one single input on the controller. To fix this problem, a check was made to ensure that the mouth was opened before enabling the option to remove the object from the patient's mouth.

- **Breathing zones did not register nor playing sound correctly.**
  When the participants used the stethoscope, four different zones on the patient's upper body needed to be checked before completing the step. These zones were time based, requiring the participant to hold the stethoscope in place for two seconds at each zone to complete the step. Some of the participants moved the stethoscope too quickly, resulting in incomplete checks of the different zones and subsequently not registering those steps as completed. This was fixed by playing the breathing sound queue and disabling the breathing zone, after two seconds, regardless of whether the participant held the stethoscope directly on the breathing zone.

- **Capillary refill could be activated unintentionally.**
  One of the major issues of completing the ABCDE procedure was how to complete the capillary refill step. Several participants accidentally activated the capillary refill when attempting to open the patients mouth. The researchers explored the possibility to use a button to activate the capillary refill, but this would likely lead to further confusion. The final solution was to move the hitbox of the capillary refill further up on the patient's forehead to reduce the probability of accidentally activating it unintentionally.

- **Objects spawned inside the players hand while grabbing.**
  The attach point of the multimonitor equipment; the thermometer, stethoscope, and oximeter could lead to unintended behaviour if the participant reached to close to the respective equipment while grabbing, resulting in the tool being locked inside their hand and not interacting properly. This was solved by disabling the object on the multimonitor while the participant was grabbing the object, while simultaneously activating the current object in the participant's hand. When the participant released the object, the opposite effect would occur.

- **Player could grab two tools at the same time.**
  Both the left-hand and the right-hand controller were able to pick up equipment at the same time, but this led to unexpected results because several tools could be equipped simultaneously. A decision was made to only allow the right-hand controller to interact with objects and the UI to avoid this problem.

Non-functional

- **Confusing to know what trigger to use for interaction.**
  Although the tutorial covered the use of the different controller key binds, the participants either forgot or did not pay attention to the information regarding how to use the hand controllers effectively. This resulted in confusion as to which buttons to use when interacting with the environment. To mitigate this problem, a graphic of the key binds was added to the main menu, allowing the participants to review the key binds at any given time during the course.

- **It is difficult for players to know how many interactions are needed to progress in each step.**
  Some of the participants were confused by what action to perform at any given time, either because they did not listen carefully to the instructor's guidance or because they did not know about the possibility of asking for help. A third measure was implemented to guide the participants to perform the right action by adding a text box at the top of the dialog options window, which described the necessary actions to complete the current task in the procedure.

- **Make it challenging for those with competence within the procedure**
  In Chapter 3.3, Principle 12 emphasizes Aspirational Adaptivity, presenting the pos-

sibility of striving for personalized and adaptive learning experiences to meet users' needs and preferences. During observation, researchers noted that participants in the HC group tended to be eager to continue without closely listening to the instructor's guidance. To tackle this issue and utilize dynamic branching, a screener scene was implemented by the researchers. This feature enables users to set their preferred knowledge level within the application, which subsequently would alter the amount of presence the instructor would have in the course, leaving the users with either alot or very little instructions and information given.

Chapter 5

Findings and results

This chapter will focus on the findings from user tests of the prototype. By applying the thematic analysis method to the data sets from interviews and questionnaires, several main themes were discovered[82]. These themes were then divided into sub-themes to analyse the data sets more accurately. The thematic analysis of the themes, and sub-themes, will create a better understanding of the benefits and drawbacks of the prototype. The analysis will also make it possible to answer the research questions that were mentioned in Chapter 1.2 In order to address the participants better, participants of the Low Competence will be adressed as LCX (Low Competence Participant number) and HCX (High Competence Participant number).

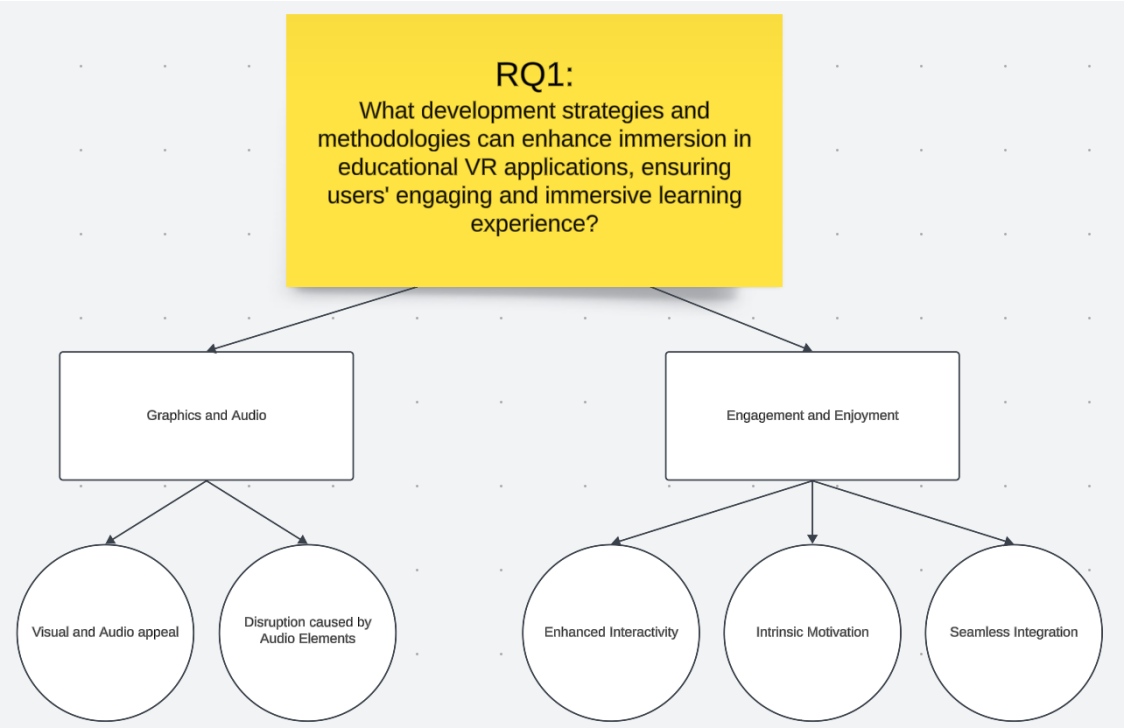

Figure 5.1: ThematicAnalysisRQ1

5.1 Theme 1: Graphics and audio.

One of the prototype's goals was to simulate a realistic environment. This theme deals with how graphics and audio can enhance the immersion of the experience. The participants mainly argued that the 3D models looked realistic and that they did not pay much attention to the ambient audio. They believed that if the sound were missing, it would affect them more negatively than how the current sound in the prototype affected them positively.

5.1.1 Sub theme 1.1: Visual and audio appeal

As discussed in this article [75], the research shows that enhanced graphics with greater visual realism led to participants feeling more immersed in the virtual environment. The environment with more realistic features like shadows and reflections made participants feel a stronger sense of presence and induced higher stress levels than the less realistic environment. This marks a natural starting point in the thematic research, as it is highly relevant to the research question proposed.

There was a joint agreement among the participants that the simulation was visually pleasing and realistic, with some remarks exposing potential improvements. Participant HC4 stated, "Realismen var god, og man føler virkelig at man er på et annet sted. Grafikken i VR er selvfølgelig ikke fotorealistisk, men tror ikke dette vil ha negativ påvirkning på læringsutbyttet".[1] This highlights the immersive quality of the VR simulation and suggests that perfect photorealism is not necessary for effective learning.

Participant LC2 said, "Det synes jeg var noe av det bedre, som gjorde mer komplett, var at ambulansen og helsepersonell fyren så ekte ut. Pasienten og bilen så ganske realistisk ut og det hjalp veldig til at jeg følte at jeg faktisk var i situasjonen og at jeg kunne konsentrere meg på å faktisk hjelpe den pasienten".[2] This underscores the importance of realistic elements in enhancing the overall experience and immersion and potential improvements regarding animations.

Additional participant comments regarding audio appeal:

- Participant HC4 said, "Det var mer virkelighetsnært at instruktøren forklarte med stemmen, kontra om det kun hadde vært tekstlig kommunikasjon."[3] This emphasizes the value of auditory explanations in enhancing realism while adhering to principle 6, " Minimize text Dependence."
- Participant LC1 said, "Jeg tenkte ikke over vind og regn, det passet godt til scenen og økte nivået."[4] This highlights how environmental details like weather can enhance the immersion and realism of the simulation.
- Participant HC2 said, "Jeg tenkte ikke over vind og regn, det var bare tutingen. Men jeg synes vind og regn passet så godt til scenen at jeg tenkte ikke over det en gang, ja, det er sånn det er".[5] This comment highlights the importance of subtle details in creating a cohesive and immersive experience, suggesting that their absence would be noticeable.
- Participant LC5 said, "Jeg likte det veldig godt, det passet atmosfæren, og det var mye stemning på en måte. Var mye effekter som jeg egentlig ikke la merke til der og da, men det var veldig kult atmosfære."[6] Highlighting that the audio fits well with the atmosphere in the scene.

[1] The realism was good, and you really feel like you are in another place. The VR graphics are not photorealistic, but I don't think this will negatively impact the learning outcome.

[2] I think that was one of the best aspects, which made it more complete, was that the ambulance and the paramedic looked real. The patient and the car looked quite realistic, which helped me feel that I was in the situation and could concentrate on helping the patient.

[3] It was more realistic for the instructor to explain with his voice rather than just text communication.

[4] I didn't think about the wind and rain. It fit well with the scene and increased the level.

[5] I didn't think about the wind and rain, it was just the honking. But I think the wind and rain fit so well with the scene that I didn't even think about it, yes, that's how it is.

[6] I liked it very much, it fit the atmosphere, and it was very atmospheric in a way. There were many effects that I didn't notice at the time, but it was a very cool atmosphere.

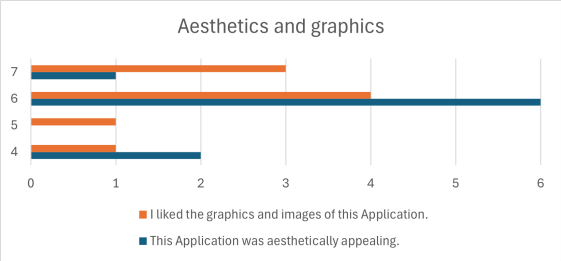

Figure 5.2: Graphics and aesthetics appeal

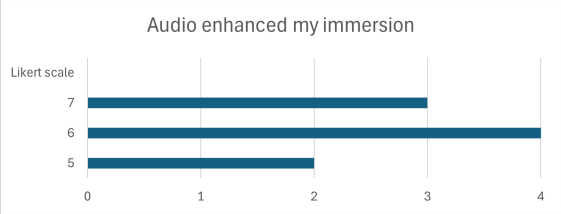

Figure 5.3: Audio enhanced the immersion

5.1.2 Sub theme 1.2: Disruption Caused by Audio Elements.

When asked if audio disrupted the participant's progression in the course, there were two main arguments for how. One of them was the honking from the cars, which the test users without paramedic experience found unrealistic and annoying. Participant HC4 said, "Tutingen fra bilene tenker jeg er noe urealistisk. Regner med at de fleste trafikanter har respekt for et skadested".[7] Implying the unrealistic aspect of car honking in such scenarios, suggesting that most drivers would respect an accident scene.

However, the participants with paramedic experience emphasized the opposite. Participant HC3 said, "Man skulle gjerne droppet tuting, men det skjer i virkeligheten, så det kan man ikke gjøre noe med".[8] They acknowledged that while they would prefer to avoid car honking, it does occur in reality, so it cannot be ignored, subsequently enhancing the realism.

Participant HC4 remarked, "Positivt at lydbilde er sammensatt og at man hører trafikk og vær".[9] Appreciating the complex audio environment, including traffic and weather sounds. Participant HC1 commented, "Det tok ikke fokus vekk, men det forsterket scenarioet. Det gjorde scenarioet mer realistisk. Tutingen gir meg samme reaksjon som ute, jeg blir irritert og det blir jeg også ute. Fikk en realistisk reaksjon".[10] HC1 notes that car honking didn't distract but enhanced the scenario's realism, evoking a genuine reaction like being outdoors.

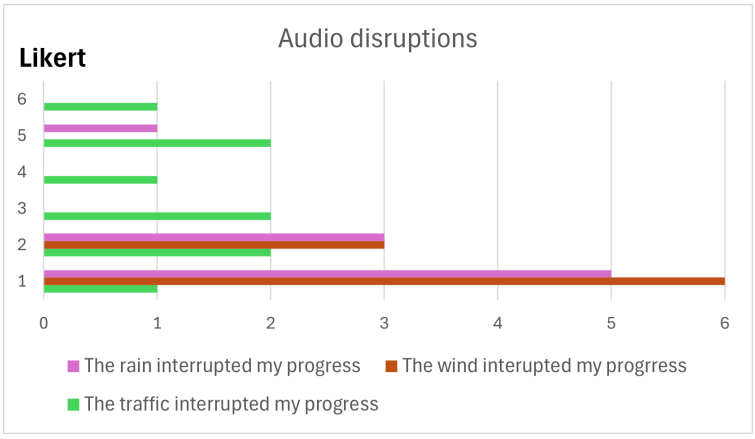

Figure 5.4: Excerpt from UES - Audio disruptors

Participant LC2 stated, "Tutingen var det eneste som irriterte meg, men regn og vind ga en ekstra level of immersion. Det frustrerte meg ikke, det var bare tutingen som frustrerte meg.

[7] I think the honking from the cars is somewhat unrealistic. I assume most drivers have respect for an accident scene.

[8] One would ideally drop the honking, but it happens in reality, so there's nothing to be done about it.

[9] It's positive that the soundscape is complex and that you can hear traffic and weather.

[10] It did not distract me, but rather enhanced the scenario. It made the scenario more realistic. The honking gives me the same reaction as outside, I get irritated and I also get irritated outside. I got a realistic reaction.

Jeg liker på en måte at det er litt frustrerende, for man skal jo prøve å holde seg rolig, for å jobbe med det man skal jobbe med".[11] Confessing to being more focused on car honking than wind and rain, finding it irritating yet contributing to a heightened sense of immersion, suggesting that audio can draw one into the scenario.

Additionally, the participants who tested the "low competence" version, where the instructor explains every step of the procedure in great detail, reported that the amount of talking made them lose focus, which will be explained in further detail in theme 4.

5.2 Theme 2: Engagement and Enjoyment.

The prototype's second objective aimed to provide the target audience with a novel, enjoyable, engaging learning experience. As suggested by Ginelle Testa[80], student motivation for learning increases when they enjoy themselves. This notion, highly relevant to immersive applications, explores factors influencing engagement and enjoyment within this subtheme.

5.2.1 Sub theme 2.1: Enhanced Interactivity.

The sub-theme Enhanced Interaction resonates with Principle 11 in Chapter 3.3, underscoring the importance of promoting active engagement through input devices in VR environments. Additionally, it embraces principle 7 of facilitating error-based learning as a possibility for allowing users to learn through experiential learning.

The preference for practical learning experiences emerged among the test participants, with many favoring simulations over traditional educational methods. Participants shared how the VR environment enriched their learning journeys compared to other mediums like videos, online courses, and text-based materials. For instance, participant HC3 noted, "Da jeg gikk ambulansefag før hadde man mye lesing og praktisk, jeg liker ikke lesing, jeg liker det praktiske, å teste gjennom en simulering. Det hjelper meg å lære at dette er en simulering"[12] Underscoring the value of practical learning experiences through simulations.

Another participant HC4 emphasized, "Selve ulykkesstedet vil nok være vanskelig å gjengi i en tradisjonell simulering. Det vil i hvert fall være svært ressurskrevende. Tenker dette er en av styrkene til VR som medium."[13] Highlighting the challenges of replicating realistic scenarios in traditional simulations. Lastly, within the LC group, participant LC2 mentioned "Det er vanskelig å få til den samme innlevelsen i andre typer medier, som i denne simuleringen. Og jeg føler at jeg lærte mye mer av å gjøre dette i VR, i forhold til andre læringsmedium."[14] The participants acknowledged VR's distinct advantages, such as its capacity to replicate realistic scenarios and enable users to interact with the curriculum actively rather than passively absorbing knowledge.

Additionally, HC1 further supports the benefits of VR over e-learning courses, stating, "Ja, det passer bedre enn e-læringskurs da dette er et interaktivt program. Det er på høyde med simulering ved hjelp av levende markører. Men det er mer interessant fordi man tar

[11] The honking was the only thing that irritated me, but the rain and wind added an extra level of immersion. It didn't frustrate me. It was just the honking that frustrated me. I like that it's a bit frustrating because you're supposed to try to stay calm and focus on the task at hand.

[12] When I studied ambulance services before, we had a lot of reading and practical exercises. I don't like reading. I prefer practical work and testing through a simulation. It helps me learn because this is a simulation.

[13] The accident scene would probably be difficult to reproduce in a traditional simulation. It would certainly be very resource-intensive. I think this is one of the strengths of VR as a medium.

[14] It is difficult to achieve the same level of immersion in other types of media as in this simulation. I feel that I learned much more from doing this in VR than from other learning media.

i bruk annen teknologi."[15] A key driver is the application's interactivity, which promotes engagement and enjoyment. Additionally, the application's technological side makes the simulation more attractive than its current physical counterpart.

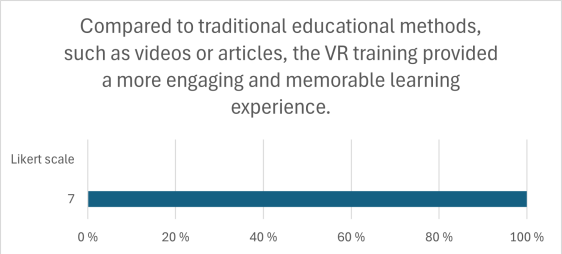

Figure 5.5: Participants level of agreeing to comparison

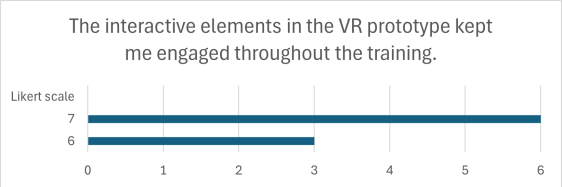

Figure 5.6: Level of engagement

[15] Yes, it is better than e-learning courses because this is an interactive program. It is on par with simulation using live markers. But it is more interesting because different technologies are used.

5.2.2 Sub theme 2.2: Intrinsic Motivation

As the participants have roots in either medicine or innovation and are interested in VR, they should be intrinsically motivated to partake in the research. When asked about their feelings regarding using new technology in learning, HC1 expressed excitement about innovation and the opportunity to think differently. Stating, "Jeg syntes det er spennende med utvikling og å ta i bruk ny teknologi. Og tenke litt annerledes, og så er det jo litt å tenke på hva en kan gjøre for å skape motivasjon da, ikke sant? Læreglede, og da må man faktisk tilføre noe nytt og gjøre noe som ikke har blitt gjort før."[16]

Similarly, participants from the LC group shared positive sentiments about exploring new technology in training. They enjoyed and appreciated VR's interactive nature, highlighting its novelty and amusement value in the learning process.

LC1 stated, "Jeg satt akkurat og tenkte på det. Det virker som at VR passer perfekt til akkurat det her, sånn du kommer til en case og du må gjøre ting fysisk. I andre fag, som ikke er så praktiske, så kan det være vanskelig å bruke VR. Men det passer veldig godt her, hvor det er noe fysisk som skjer, og det ikke er noe ekstremt krevende fysisk hvor du må trene motorikken enda mer, det er bare fysiske rutiner. Det er en bra match". [17] This statement underscores VR's unique immersive quality, which can significantly enhance the learning experience compared to traditional media. It emphasizes the intrinsic motivation driven by the application's novelty and engagement, which can lead to deeper learning and greater involvement in the educational process.

"The various scenes and activities in the VR prototype maintained my interest and motivation to learn."

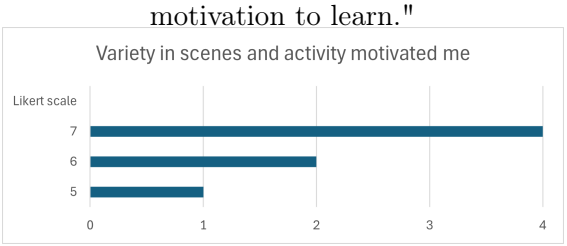

Figure 5.7: Interest and motivation to learn, Likert Scale

"I would like to use VR simulations like this for future training and education."

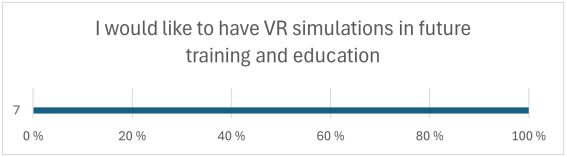

Figure 5.8: Participants level of agreeing, Likert scale

5.2.3 Sub theme 2.3: Seamless Integration.

This sub-theme entails examining how different scenes seamlessly connect, their influence on the user experience, the significance of an introductory scene, and the duration allowed for reflection before decision-making, as well as ensuring a cohesive flow throughout the interaction. It aligns closely with Principle 5, "Structured Exploration," and Principle 10, "Design for Reflection."

- Principle 10, "Design for Reflection," emphasizes the inclusion of opportunities for reflection to reinforce learning, balancing action-oriented tasks with moments for contemplation and self-assessment.

[16] I find it exciting to develop and adopt new technology. And thinking a bit differently, it's also about what you can do to create motivation, right? Joy of learning, and then you have to add something new and do something that hasn't been done before.

[17] I was thinking about it. It seems like VR fits perfectly for this, where you come to a case and have to do things physically. It can be difficult to use VR in other subjects that are not so practical. But it fits very well here, where something physical is happening, and it is not extremely physically demanding, where you have to train your motor skills even more. It's just physical routines. It's a good match.

- Principle 5, "Structured Exploration," advocates for guided exploration to maintain focus and engagement, employing pacing and constrained choices to direct learners' attention effectively.

During the VR experience, participants acknowledged the significance of the establishing shot in the ambulance driving scene in enhancing immersion. Participant LC1 appreciated its narrative aspect, stating that it effectively set the scene. HC2 and HC4 noted that it significantly increased the sense of immersion. HC3 expressed appreciation for specific elements of the scene, such as the blue light effects and ambient sounds, which contributed to the overall immersion:

- Participant LC1: "Jeg likte det mer sånn historiefortellende og etablerende, det er et kjempebra startpunkt. Det er vel ofte der sånne «caser» starter også". [18]
- Participant HC4: "Dette var en svært god scene som var med på å øke innlevelsesgraden". [19]
- Participant HC3: "Jeg syntes blålyseffekten er alltid kul, det hjelper til på simuleringen. Jeg likte lydene, det gav inntrykk av miljøet. Man blir introdusert, og jeg liker oppbyggningen. Dette hadde vært dårlig om man var introdusert til pasient med en gang". [20]
- Participant HC2: "Jeg kommer litt i settingen, blir satt i modus og det gjør opplevelsen mer realistisk". [21]
- Participant LC5: " Dette likte jeg, det var med på å sette stemningen og sette meg inn i "skoene " til ambulansepersonen om du forstår. " [22]

[18] I liked it more as a storytelling and establishing element. It is a great starting point. That's often where such "cases" start as well.

[19] This was a very good scene that helped to increase the level of immersion.

[20] I think the blue light effect is always cool. It helps with the simulation. I liked the sounds. They gave an impression of the environment. You get introduced, and I like the setup. It would have been bad if you were introduced to the patient right away.

[21] I get into the setting, it puts me in the right mode, and it makes the experience more realistic.

[22] I liked this, it helped set the mood and put me in the "shoes" of the paramedic, if you understand.

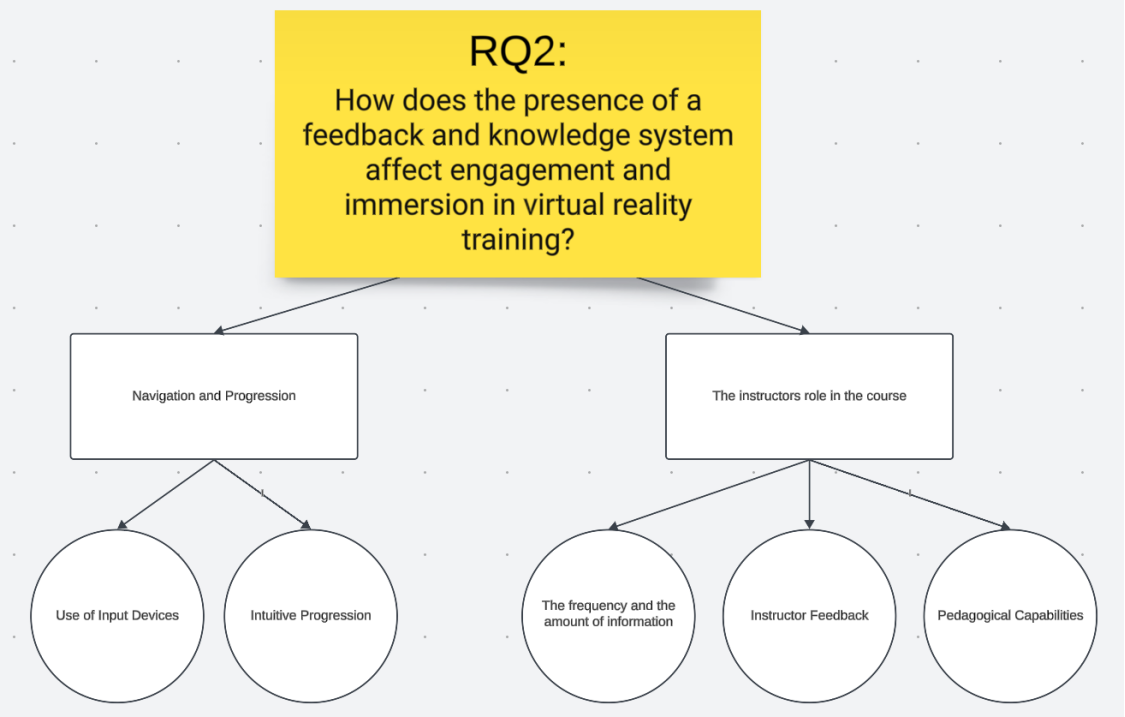

Figure 5.9: ThematicAnalysisRQ2

5.3 Theme 3: Navigation and Progression.

The controllers were one of the main obstacles for the participants in completing the course. Through observation, it was clear that the participants struggled to identify which buttons to use on the Oculus Touch controllers to interact with the environment. The main two prerequisites for completing the course are paramedic experience and VR experience. The paramedic test group mainly struggled with the technical aspect of the VR hardware, and the student test group had more problems completing the ABCDE procedure.

5.3.1 Sub theme 3.1: Use of Input Devices.

Understanding the functions of the various buttons on the Oculus Touch controllers is crucial for user interaction and UI navigation. All participants encountered difficulties in this area, particularly when they gripped objects and interacted with the UI, which the researchers mapped to two different trigger buttons. This issue could have been mitigated by explicitly highlighting the difference to the participants.

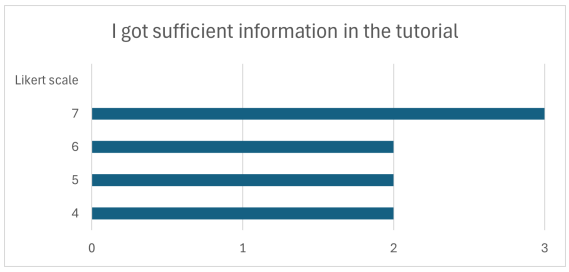

Figure 5.10: Sufficient information tutorial scene

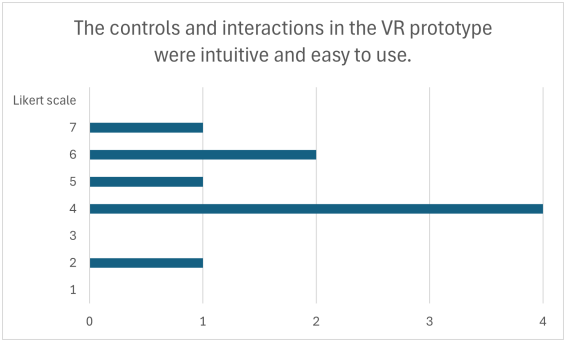

Figure 5.11: Intuitive controllers

Participant HC1 said, “Jeg blir veldig opptatt av bruk av VR kontrollene, det tar oppmerksomheten min når jeg glemmer hvilke knapper jeg skal trykke på. Det tar min konsentrasjon. Jeg klarer ikke konsentrere meg om hvordan jeg skal løse problemene med bruk av teknologien og det jeg skal gjøre i kurset. Klarer ikke multitaske på dette nivået.” [23] This comment highlights the distraction caused by the complexity of the controls, which impacts the overall learning experience. Furthermore, observation showed that when participant HC1 was too locked in on figuring out the controls in the main part of the course, it would significantly affect the progression.

Aditionally, participant LC1 states: "Jeg tror jeg ville brukt enda litt lenger tid på opplæringen om hvordan ting fungerer. Etter min opplevelse nå da. Nå rushet jeg jo gjennom, men det føltes litt «rushed». At det er en veldig kjapp innføring i hvordan kontrollerene fungerer. Det kunne sikkert vært enda litt enklere å få en innføring i hvordan kontrollerene fungerer". [24] Feedback necessitates a more thorough review of controllers and highlights the potential drawbacks of a rushed introduction, which can hinder the effective use of the input devices.

HC3 stated, "Ja, man bruker sin egen motorikk og det gir en følelse av at man er på scenen."[25] This connects to interaction and kinesthetics, adhering to Principle 11: "Active Engagement through Hand Controls." It underscores how physical interaction can enhance the sense of presence and immersion.

LC2 stated, "Jeg liker generelt ikke så godt snap turns, det er litt distraherende for meg. Det er vanskelig å leve seg inn i det hvis man plutselig snapper. Jeg likte generelt instruktørens bevegelser, selv om noen av animasjonene var litt rare". [26] This comment highlights the principle of "Aspirational Adaptivity," which underscores the possibilities of dynamic branching in VR. It points to the need for customizable control options to enhance user experience and immersion.

However, during a single playthrough, the participants gradually got confident in the correct buttons, suggesting that while initial confusion was prevalent, familiarity with the controls improved with practice.

5.3.2 Sub theme 3.2: Intuitive Progression.

With the possibility of asking for help from the instructor, the participants always had the option to get a specific explanation of how to progress in the course if they were stuck and did not know what to do. However, LC2 stated that «For eksempel hvis man ser på han, så hører man litt bedre eller høyere stemme. Det hadde vært deilig at, hvis du gjorde en feil, så bare sa han hva du gjorde feil. ».[27] This was not an implemented feature, which allowed the player to make unlimited mistakes.

Through observation, one of the main problems that led to participant mistakes was the interaction of the dialog options from the question panel that appeared at the start of the ABCDE procedure. Several participants assumed that asking questions to the patient and

[23] I become very focused on using the VR controllers, which distracts me when I forget which buttons to press. It takes my concentration. I can’t focus on how to solve the problems with using the technology and what I need to do in the course. I can’t multitask at this level.

[24] I think I would have spent even more time on the training on how things work. Based on my experience now. I rushed through it, but it felt a bit ’rushed.’ It’s a very quick introduction to how the controllers work. It could probably have been even easier to get an introduction to how the controllers work.

[25] Yes, you use your own motor skills and it gives a feeling of being on stage.

[26] I generally don’t like snap turns, they are a bit distracting for me. It’s hard to immerse yourself if you suddenly snap. I generally liked the instructor’s movements, although some of the animations were a bit odd.

[27] For example, if you look at him, you hear a bit better or louder voice. It would be nice if, when you made a mistake, he would tell you what you did wrong.

the patient responding without any problems would confirm that the patient had no airway issues.

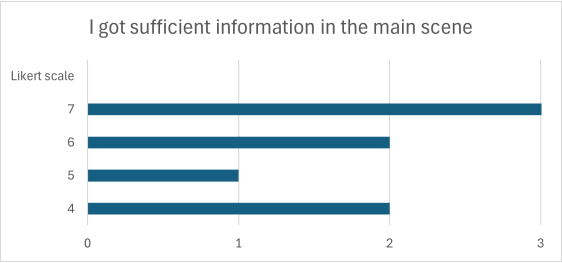

Figure 5.12: Sufficient information main scene

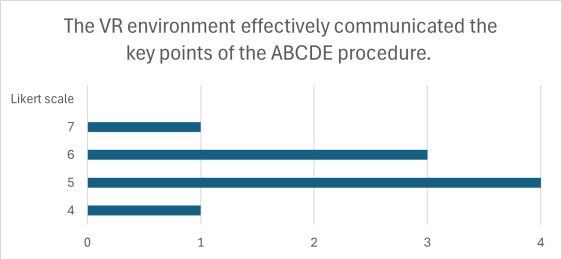

Figure 5.13: Effective communication ABCDE procedure

Another key observation was that the participants did not know when or if they had completed a step in the procedure. Several participants repeatedly pressed the patient's forehead for a capillary refill examination before applying the Oximeter when the procedure required both actions to progress.

Participants also needed help using the stethoscope and listening to the four breathing zones. They were either unaware of how long it took to listen to each zone or did not notice the two zones under the patient's ribcage.

Lastly, most participants accidentally interacted with the patient's mouth while performing the capillary refill. This was because they needed a clear indication of how to check the capillary refill. The participants assumed they had to interact with the patient's forehead using the grab trigger like they had interacted with other steps in the procedure.

Participants provided varied responses regarding the time given for reflection before taking action. Some participants (HC4) mentioned that they did not reflect much during the session but found opportunities for reflection afterward. Others (HC2) appreciated the absence of time constraints, allowing them to immerse themselves in the experience without feeling rushed fully: Participant HC4: "Jeg gjorde meg ikke mange refleksjoner underveis, men i etterkant av selve sesjonen. Tenker det er bra at man går gjennom hele drillen før man eventuelt reflekterer." [28]
Participant HC3: "Det var ikke noe tidsbegrensning, så det likte jeg."[29]

5.4 Theme 4: The instructors' role/presence in the course.

The instructor played an essential role in the course. He conveyed important information and specifically instructed the participants on completing the tasks and progressing the course. As previously mentioned, the amount of monologue within the two versions caters to a high and low-competence user, containing different instructions. This theme considers how the instructor affected the participants' ability to complete the course.

[28] I did not reflect much during the session, but afterward. I think it is good to go through the entire drill before reflecting.
[29] There was no time limit, which I liked.

5.4.1 Sub theme 4.1: The frequency and the amount of information from the instructor.

The test group of participants with paramedic experience reported that the information was sufficient and that they understood what to do. They realized that each time the instructor explained a new step, they completed the previous one. Participant HC3 stated «Ja, man blir jo forberedt på hva man skal undersøke og generelt hva man undersøker. Det holder mitt fokus på rett plass».[30] The instructor's monologue did not distract or discourage the participants in this group.

The group with no paramedic experience reported that they would most likely be unable to complete the course without the instructor's assistance. However, they reported that the instructor provided too much information, as participant LC3 said, «Ja, jeg hadde bare lyst til å begynne. Jeg skjønte allerede hva jeg skulle gjøre».[31] To further compound to this notion, as LC4 states: "Det var ganske mye snakking, jeg følte at jeg var i en forelesning og ville egentlig bare prøve meg frem enn å vente på at snakkingen var ferdig." [32]

Participant LC2 stated that "Jeg følte at noen ganger så var det litt mellomrom og pause mellom setninger og handlinger, altså hvis jeg gjorde noe så kunne det ta fem sekunder før jeg hørte «nå har du gjort det», så fortsatte jeg å gjøre ting. For eksempel når jeg hørte på pusten, så stod jeg å ventet på at han skulle si «bra jobbet», men hvis han hadde sagt «du har litt mer igjen» for eksempel eller at «du må prøve på nytt» så hadde jeg forstått det bedre».[33] This was a recurring issue, as the participants interacted repeatedly with the patient without knowing whether they had completed or failed the current task.

The other main argument was the amount of information given by the instructor. The participants who tested the "high competence" version, where the instructor had substantially reduced monologue, stated that the amount of monologue from the instructor was appropriate. They also emphasized the positive effect of asking the instructor for help on each procedure step, as HC4 states: "Timingen og frekvensen av instruksjoner var god. Likte også muligheten til å kunne be om tilleggsinformasjon". [34]

5.4.2 Sub theme 4.2: Instructor feedback.

Through observation, the researchers noticed that the participants sometimes tried an interaction without any progress, but then they realized they could ask the instructor for help. All participants utilized this option at some point in the course and reported that it was helpful. Participant HC4 said «Jeg benyttet meg flere ganger av muligheten til tilleggsinformasjon for å fullføre drillen».[35] Additionally, mentioning that it was nowhere in the course, the participant felt that the instructor should give more feedback: "Nei, ved behov var det enkelt å få ytterligere informasjon fra instruktøren. "

HC2 states, that in cases where the participant was stuck, it was especially helpful with concrete actions: "Det var derimot en stor hjelp å kunne spørre assistenten om hva jeg

[30] Yes, you get prepared for what to examine and generally what you are examining. It keeps my focus in the right place.

[31] Yes, I just wanted to start. I already understood what I needed to do.

[32] There was quite a lot of talking, I felt like I was in a lecture and just wanted to try it out rather than wait for the talking to finish.

[33] I felt that sometimes there were gaps and pauses between sentences and actions, for example, if I did something it could take five seconds before I heard "now you've done it", so I continued to do things. For example, when I was listening to the breathing, I stood and waited for him to say "good job", but if he had said "you have a little more to go" or "you need to try again", I would have understood it better.

[34] The timing and frequency of instructions were good. I also liked the ability to request additional information.

[35] I took advantage of the option to request additional information multiple times to complete the drill.

skulle gjøre, helt spesifikt, i forhold til pasienten i denne VR-verdenen".[36]

Additionally, some participants had remarks around the audio quality of the instructor, indicating room for improvement. LC2 states: "Altså, jeg synes voicoveren er litt nedtonet, det høres ikke akkurat ut som en voice-actor akkurat. Det høres ut som en som «nå er det viktig å gjøre det, og det og det», så voice actoren kunne hatt litt mer trykk på ord for å være sånn «dette er viktig å få med deg». For å holde blodsirkulasjonen, så «MÅ» man, for å prøve og holde litt den flyten, for det var ikke motiverende å høre på, men han sa jo alt som trengte å bli sagt".[37]

5.4.3 Pedagogical Capabilities

This subtheme researches the instructor's role and tries to back up the claim that he does facilitate learning. When asked if the participants found support in the instructor, the participants had clear meanings:

- Participant LC2 states: "Ja, jeg hadde jo ikke klart det uten han. «Helpful» var det jo".[38] Aditionally, when asked if the instructor contributed to the overall learning experience, the participant stated "Ja, fordi da har jeg mer "confidence" når jeg skulle gjennomføre en oppgave. Og når det faktisk var riktig, så følte jeg faktisk at, ok, nå klarte jeg det, mens hvis jeg bare hadde gjettet som jeg gjorde med den tekstboblen, da følte jeg at jeg klarte ingenting". [39]

- Participant HC3 states: "Ja, dette er absolutt. Dette er muligheter med å simulere ting som man ikke alltid kan trene på i felt. Det utviklet mine kunnskaper i VR".[40] When asked if the training allowed the participant to push their current scill level, the participant stated: "Ja, hvis jeg ikke kunne det fra før hadde jeg lært det nå. Man involverer det praktiske, dette blir veldig praktisk. Det er prima for meg som ikke er glad i å lese." [41]

- Participant HC4 states: "Ja, siden jeg ikke har klinisk kompetanse var jeg helt avhengig av instruktøren for å fullføre læringsopplegget."[42] Additionally, when asked about the challenge presented by the instructor, the participant stated: "Likte at jeg hadde mulighet til å prøve meg frem før jeg ba om fasit og at dette var litt over mitt nåværende kompetansenivå."[43]

When asked how the instructor helped them progress through the material, the participants generally had similar answers:

[36]However, it was a great help to be able to ask the assistant what I should do, specifically regarding the patient in this VR world.

[37]Well, I think the voice-over is a bit subdued, it doesn't really sound like a voice actor. It sounds like someone saying "now it's important to do this, and this and that", so the voice actor could have put more emphasis on words to be like "this is important to note". To maintain blood circulation, you "MUST" do this, to try to keep that flow, because it wasn't motivating to listen to, but he did say everything that needed to be said.

[38]Yes, I wouldn't have managed without him. It was indeed "helpful".

[39]Yes, because then I had more "confidence" when I was performing a task. And when it was actually correct, I felt like, okay, now I did it, while if I had just guessed like I did with the text bubble, I felt like I achieved nothing.

[40]Yes, absolutely. These are opportunities to simulate things that you can't always practice in the field. It developed my knowledge in VR.

[41]Yes, if I didn't know it before, I learned it now. You involve the practical aspects, this becomes very practical. It's ideal for me as I'm not fond of reading.

[42]Yes, since I don't have clinical competence, I was completely dependent on the instructor to complete the learning program.

[43]I liked that I had the opportunity to try things out before asking for the solution and that this was a bit above my current skill level.

- Participant LC1 states: "Jeg synes han forklarte fint hva som skal gjøres nå, og hvilket utstyr som skal brukes".[44]
- Participant LC5 states: "Hmmm , ja instruktøren hjalp meg jo når jeg var usikker, han gav god informasjon om alle stegene og hva som var viktig".[45]

5.5 Results from questionaire

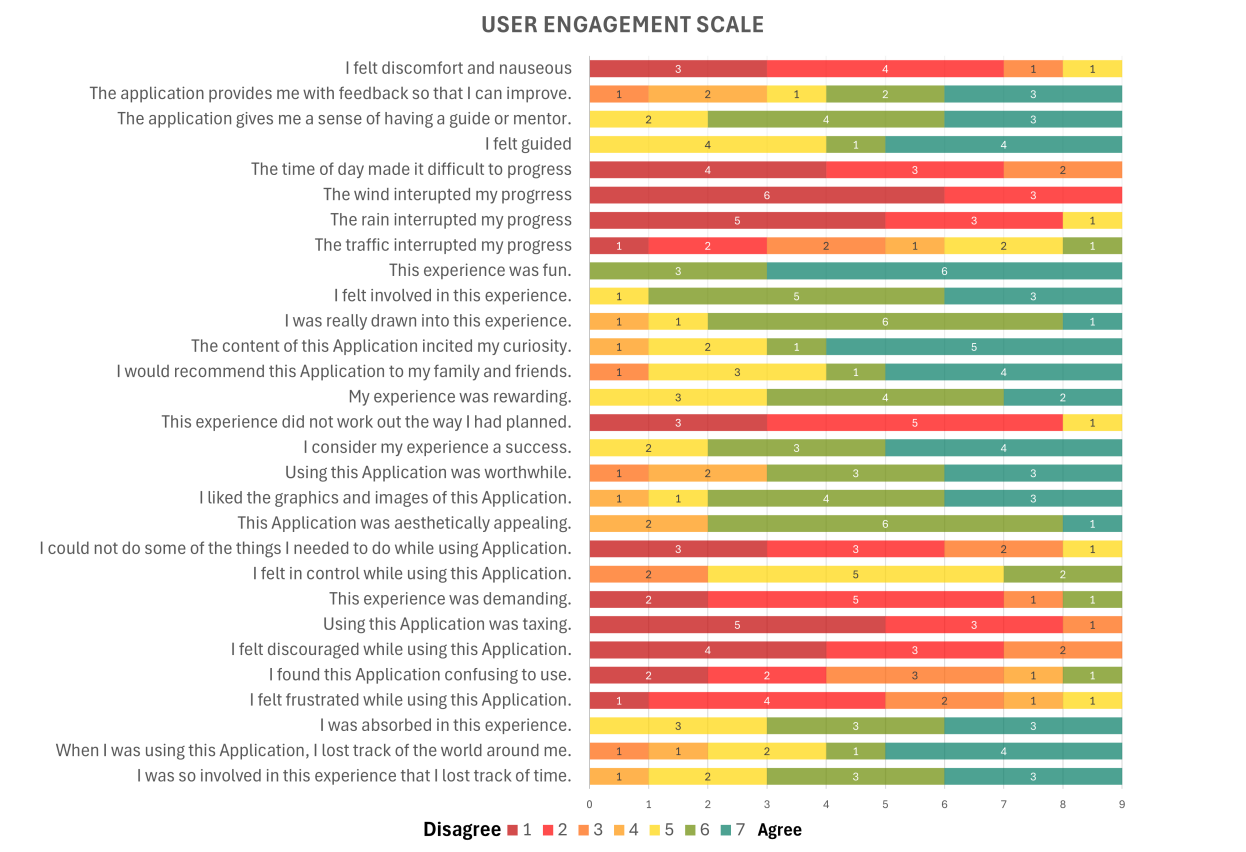

Figure 5.14: User Engagement Scale

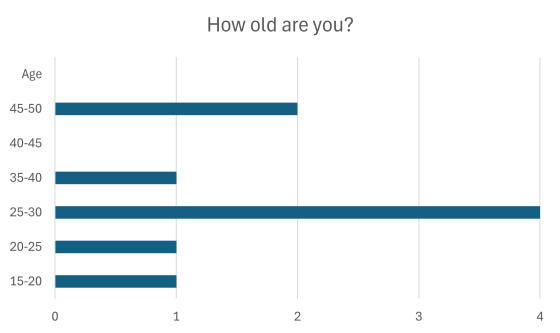

Figure 5.15: Participants' age

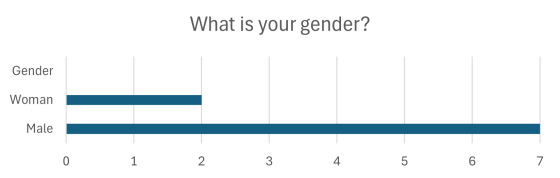

Figure 5.16: Participants' gender

[44] I think he explained well what needs to be done now and which equipment should be used.
[45] Hmm, yes, the instructor helped me when I was unsure, he provided good information about all the steps and what was important.

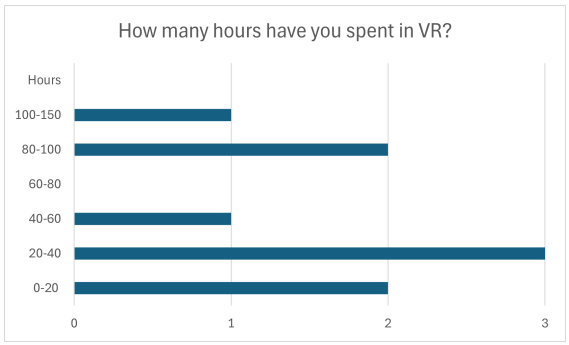

Figure 5.17: Participants' hours spent in the VR space

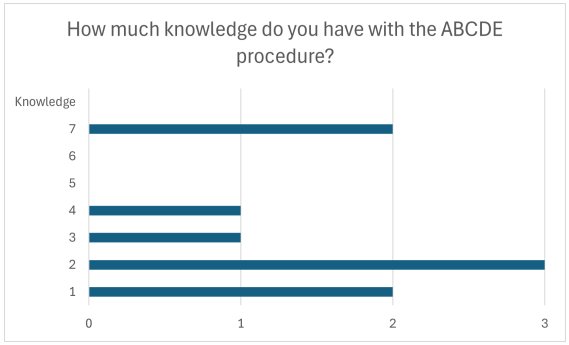

Figure 5.18: Participants' knowledge level of the ABCDE procedure

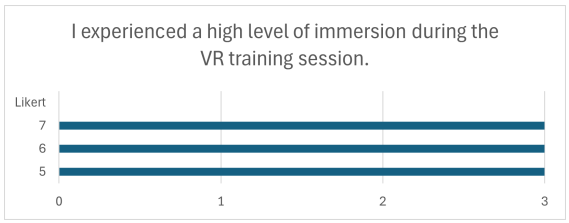

Figure 5.19: Participants' level of immersion

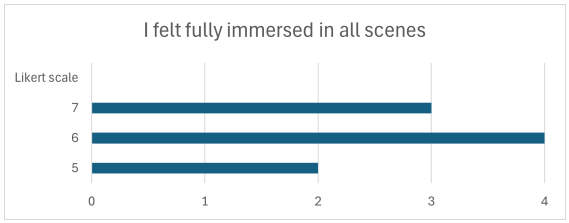

Figure 5.20: Immersion in all scenes

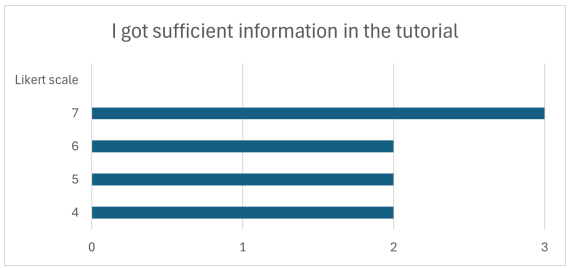

Figure 5.21: Sufficient information tutorial

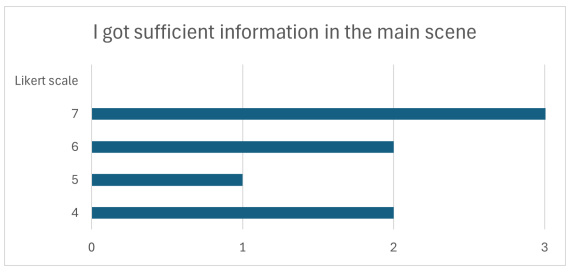

Figure 5.22: Sufficient information main

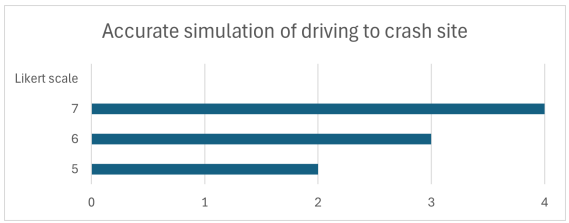

Figure 5.23: Accurrate simulation of car ride

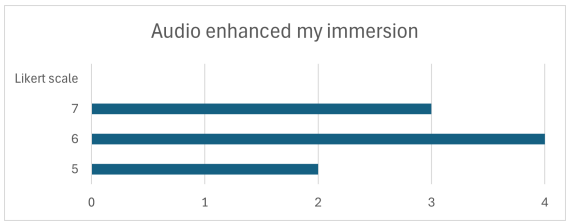

Figure 5.24: Audio enhanced immersion

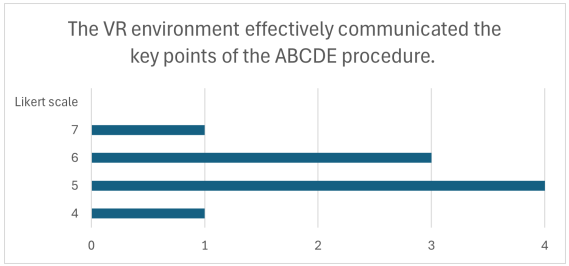

Figure 5.25: Environment communicated the ABCDE procedure

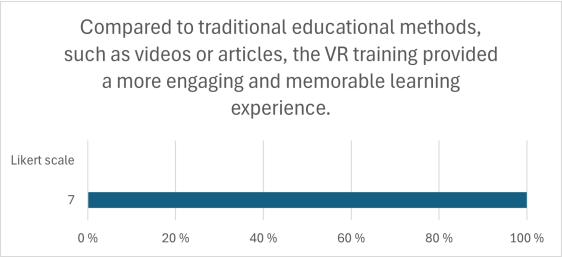

Figure 5.26: Compared to traditional education

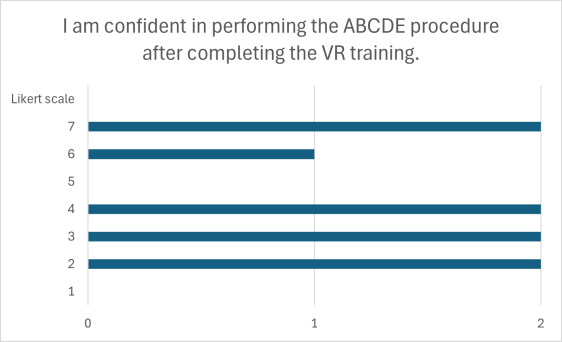

Figure 5.27: Confidence in performing ABCDE

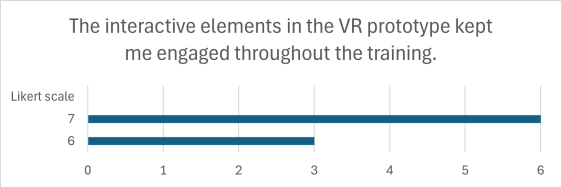

Figure 5.28: Interactive elements kept me engaged

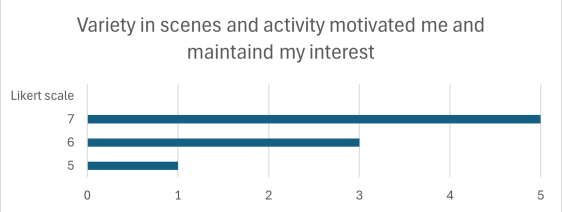

Figure 5.29: Variety of scenes motivated me

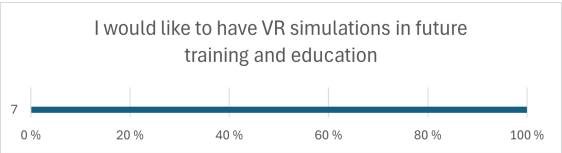

Figure 5.30: VR for future education

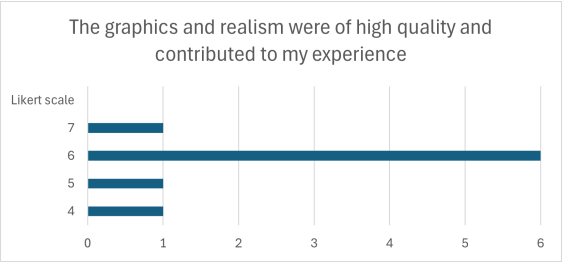

Figure 5.31: Graphics contributed to the experience

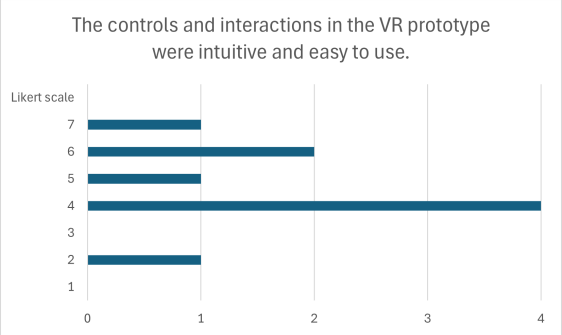

Figure 5.32: Controllers were intuitive

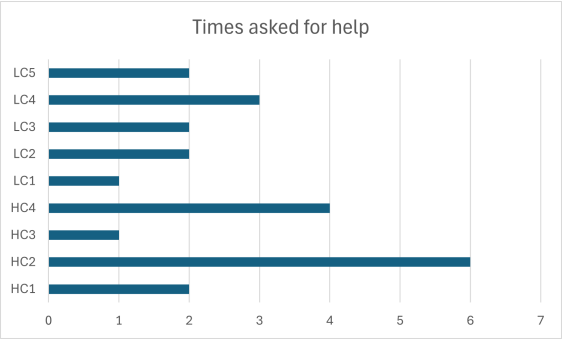

Figure 5.33: Times participants asked for help

Chapter 6

Future Development

During the last test round, the researchers identified several features and problems that needed iteration. However, considering the timeframe, the researchers needed to have the opportunity to address the issues. The missing features were requested through feedback from the post-test interviews, while they discovered unintended prototype behavior problems through observation during the usability tests. The researchers needed more time to optimize the application further than explained in Chapter 4.7. This section categorizes the problems into components within the MDA framework, explains these problems, and offers potential solutions. Additionally, it delves into optimization solutions and explains why certain aspects should be optimized.

6.1 List of improvements

1. **The question pad is showing on Airways** - *Mechanics.*

   Above the player's left hand is a dialog questions box, which is used in the "Disability" step of the ABCDE procedure to allow the player to ask questions to the patient. In the initial version of the prototype, this box was visible to the player throughout the main part of the course. However, through observation, the box could obstruct the player's view, so it was decided to make it visible at the start of the ABCDE test.

   As participant LC2 stated "Tekstboksen over venstre hånden gjorde meg forvirret når den ble vist i starten, jeg ble fokusert på den i stedet for å høre på instruktøren. Jeg trykket på flere av knappene på tekstboksen fordi jeg trodde det var meningen».

   The sudden appearance of the box could mislead the participants to believe that they were required to interact with it to complete the current task. Participants may toggle the visibility of the dialog questions box on or off by pressing the "X" button on the left controller, a feature not explicitly explained. A solution could be for the instructor to clearly explain how to toggle the box's visibility or for it to only become visible during the "Disability" step of the procedure. By doing so, the researchers believe the task clarity would be better, culminating in dynamics that would benefit the users. Possibly seen as misleading, the possibility of making errors at this point does not benefit the users but rather detracts from the engagement as it confuses them.

2. **Teleportation stopped working.** - *Mechanics.*

   During the development process, the researchers discovered that the anchors used for teleportation would randomly stop working as intended. The researchers tried several solutions to resolve the problem, but it persisted. This could be a bug in the XR Interaction Toolkit or Unity itself. However, since this problem only occurred at random

times, and the participants still had the opportunity to move around with the joysticks, the researchers considered this a minor problem. However, ensuring a reliable teleportation mechanism would enhance the user's ability to navigate the VR space and give autonomy to those who prefer specific navigation.

3. **Capillary refill is activated on accident.** - *Mechanics.*

   One of the leading causes of participant errors was the accidental activation of the capillary refill interaction. Participant HC4 explained "På grunn av realitetsgraden hadde jeg noen utfordringer med å sjekke frie luftveier. Dette fordi jeg prøvde å bruke begge hender som jeg ville gjort i virkeligheten. Skjønte fort at det var best å benytte en hånd i simulering»[1].

   Several participants moved their virtual hands up close to the patient's face to perform the "Airways" check, even though the prototype allowed the player to open the patient's mouth from a distance. Since the only requirement to activate the capillary refill is for the virtual hand to be close to the patient's forehead, this interaction was accidentally activated several times without the participants' intention. To solve this problem, assigning a button for this interaction and pressing it when close to the patient's forehead would be sufficient if the user was aware of the controllers beforehand.

   Another solution could be a timer with a UI to explain the interaction while the participant's virtual hand is in proximity to the patient's forehead. This adheres to principle nine in Chapter 3.3: timely and non-intrusive feedback. "Deliver feedback promptly and subtly to support ongoing learning." Including time limit mechanics that adhere to the gamification framework [citation]. Fixing this issue would enhance the mechanics of interaction accuracy and improve user engagement by reducing frustration and confusion.

4. **Breathing zones do not work correctly.** - *Mechanics.*

   The participant must grab the stethoscope and listen to both patients' lungs' upper and lower parts to complete the "Breathing" check in the procedure. These four zones are displayed by semi-transparent visual cues to guide the participant, which are only visible while grabbing the stethoscope. Each zone plays a breathing sound clip when the stethoscope is within its hitbox. When the sound clip is finished, the visual cue disappears, implying the check completion of that zone. However, the rapid movement of some participants between the zones resulted in no sound clip being played. If the participants released the stethoscope, they would have to check all four zones regardless of their previous progress.

   Participant LC5 stated that "Jeg hørte ikke alltid etter hva instruktøren sa, så jeg tok jo feil instrument flere ganger. Hmm, det kunne vært greit å hatt noe som viste fremgang når jeg skulle sjekke pustingen til pasienten."[2]An improvement could be to keep track of how many zones the participant checked and not reset the progression if they released the stethoscope. As Participant LC5 previously suggested, visualizing this could also be achieved through a minimalistic UI, displaying the number of checked zones. This solution aligns with the feedback mechanism that the user can use to learn about progress. Furthermore, this adheres to principle two, Minimalistic UI design,

[1] Due to the level of realism, I had some challenges checking the airways. This was because I tried to use both hands as I would in real life. I quickly realized it was best to use one hand in the simulation.

[2] I didn't always listen to what the instructor said, so I used the wrong instrument several times. Hmm, it would have been helpful to have something showing progress when I was checking the patient's breathing.

and principle nine, timely and non-intrusive feedback. Additionally, fixing this would improve task tracking and feedback mechanics.

5. **Cars honking.** - *Dynamics.*

   The volume and frequency of the car honking should be tuned down. By adjusting the audio, the researchers believe that the users could expect an improved dynamic of realism and reduced annoyance. All the participants reported that it was annoying and unnecessary, even though the participants with medical backgrounds stated it was similar to a realistic scenario.

6. **Confusing controller buttons.** - *Mechanics.*

   Understanding the function of the different buttons on the controllers was a recurring issue for all the participants. The tutorial introduces and explains how to use the different buttons, triggers, and joysticks to interact with the environment, but the participants needed to remember this information. The main problem was the different buttons interacting with objects and UI.

   The instructor explains what controller triggers to use when interacting with the environment, but he does not mention how to access the main menu. Furthermore, a key bind graphic was added to the main menu, explaining which buttons to use for the different interactions. The tutorial displayed the same image above the table for object interactions, but participants mostly ignored it. Participant HC4 gave this feedback "Tutorial delen hadde det vært nyttig om instruktøren også leste opp instruksjonen om hvordan man får opp hovedmenyen»[3].

   Participant LC1 said «Jeg ville brukt enda litt mer tid på å lære meg kontrollerene. Det føles litt rushet med gjennomgangen, tutorialen kunne gjerne gått mer grundig gjennom bruken av kontrollerene»[4]. Students must understand the concepts and be able to apply them to the subsequent course. Similarly, Principle 3, "Gradual Complexity Scaffold," underscores the importance of incrementally introducing cognitive steps and progressively increasing task complexity.

   The researchers believe that simplifying controller interactions would make the VR application more user-friendly, improving ease of use and overall engagement. A solution to reduce the confusing controller buttons could be to merge the different interactions into one single trigger for all interactions or to differentiate by using a trigger for interacting with objects and the virtual hand to touch and activate the UI components, as discussed in the following section.

7. **Finger touch interaction with UI.** - *Mechanics.*

   A requested feature from one of the SMEs was to add the possibility of touching the UI elements with the virtual hand. This is consistent with the fourth principle, "Incorporate ongoing feedback to ensure contextual relevance and alignment with real-world standards." The researchers believe that implementing this feature could increase immersion while mitigating the need for a button on the controller to interact with the UI. This feature aligns with principle eleven: "Incorporate gestures and kinesthetic actions

[3]The tutorial part would have been more useful if the instructor had also read the instructions on how to access the main menu.

[4]I would have spent even more time learning the controls. The walkthrough feels a bit rushed; the tutorial could have gone more thoroughly through the use of the controls.

to manipulate content and reinforce learning." As the principle highlights, improving the mechanics of interaction realism and the dynamics of kinesthetic learning would enhance immersion and user engagement.

8. **The final score needs to count correctly.** - *Mechanics.*

   Through observation, the researchers discovered a problem with the score-counting system. One of the participants got an extra point for completing a task somewhere during the procedure. The solution is to ensure that the participant receives only one point for each task completed at each game state. The researchers consider this mechanic error a significant, critical flaw requiring immediate attention.

6.2 Future optimization

The high number of triangles on the ambulance model and the real-time lighting set for the siren cause fluctuating triangle counts during runtime as the draw calls get too high. This fluctuation leads to a noticeable drop in frames per second (FPS), especially when the user focuses their field of view (FOV) towards the ambulance and the patient. The ambulance light is set to real-time to accurately represent the siren on the roof, as baked lighting cannot be altered during runtime. As explained in Chapter 4.7, lighting is highly resource-intensive and requires careful optimization.

To minimize this drop in FPS, the researchers have suggested several effective solutions:

- **Optimize the Mesh:** Import the ambulance's FBX file into Blender and decimate the object. This process simplifies the mesh by reducing the polygon count, which can improve performance without compromising visual fidelity[19].
- **Layer-Based Lighting Optimization:** Organize the ambulance's body panels facing outwards into a specific layer that light should affect. Conversely, ensure light sources do not affect body panels and other interior planes[45].
- **Optimize Light Settings:** Consider reducing the intensity or range of the real-time light if it does not significantly affect the visual outcome. A consideration here would be not allowing the sirene light to reach the patient.
- **Simplify Materials and Textures:** Reduce the complexity of materials and textures used on the ambulance model. Lower-resolution textures or fewer material layers can decrease the rendering load.

Chapter 7

Discussions

This discussion will build upon the thematic analysis and delve deeper into the research questions outlined in Chapter 1.2, using insights from the thematic analysis as a foundation. Initially, the researchers had a clear focus on Research Question 1, driven by their interest in developing and designing VR applications with practical implications. They aimed to investigate design strategies and methodologies that enhance immersion and engagement within VR environments.

As the project progressed, the importance of the instructor's role within the application became apparent, leading to additional research questions, precisely Research Questions 2 and 2.1.

7.1 Regarding Research Question 1

"What development strategies and methodologies can enhance immersion in educational VR applications, ensuring users' engaging and immersive learning experience?"

To ground the development of the VR application, the researchers anchored their work in an adapted framework, with the principles presented in Chapter 3.3 serving as the foundation. From the thematic analysis, it was evident that multiple elements affect user engagement and immersion. The researchers defined functional and non-functional requirements by utilizing Volere, as detailed in Chapter 4.8.2. These requirements, partially grounded in the principles, helped identify key elements to enhance immersion and engagement.

Through testing, it became clear that the principles were a strong foundation. Highlighting elements like UI, exploration, interactions, and more subtle factors such as feedback, reflection, and error-based learning. Participants consistently mentioned realistic graphics and audio as crucial for creating a lifelike and engaging experience. As explained in Chapter 2.9, the MDA framework highlights that application users first notice the game's aesthetics rather than the mechanics. The overall realism of the graphics significantly contributed to their sense of presence. Detailed and high-fidelity graphics provided a tangible context that satisfied the participants, aligning with the concrete experience (CE) stage of experiential learning (EL), as mentioned in Chapter 2.8.3.

Another recurring theme was the participants' appreciation for the autonomy and opportunity to make mistakes without punishment. The absence of time limits was particularly valued, allowing them to think and reflect at their own pace. The forgiving environment enabled users to learn from their mistakes and explore the environment freely. This aligns with the principles of active and error-based learning. Participants valued the freedom to interact with the virtual environment and the gradual increase in task complexity, which helped them build confidence over time. This approach is consistent with EL theory, particularly

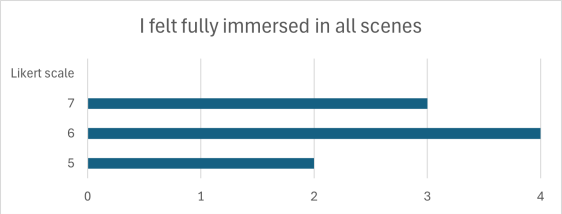

Figure 7.1: Participants' immersion in all scenes

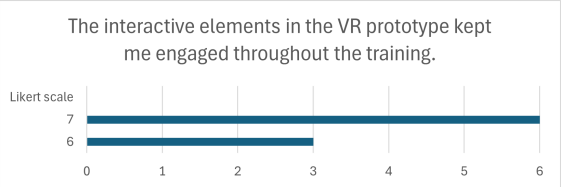

Figure 7.2: Interactive elements kept participants engaged

the active experimentation (AE) stage, where learners apply their skills in progressively challenging scenarios, as mentioned in Chapter 2.8.3.

The seamless integration of different scenes and the establishing shot significantly contributed to the immersive experience. Participants noted that smooth transitions between scenarios and the narrative structure of the VR application helped maintain their immersion. Establishing shots, which set the scene and context, drew users into the scenario and enhanced their engagement. This technique helped create a cohesive and engaging narrative, supporting the principle of structured exploration.

Realism extended beyond graphics and audio to include the accurate representation of uniforms, ambulance cars, and other equipment. Participants emphasized how these realistic elements heightened their sense of immersion and engagement. For example, seeing an instructor dressed in a realistic uniform adhering to Norwegian standards or interacting with a detailed ambulance model made the training more authentic and relevant. This attention to detail supported making the training environment as realistic and relevant as possible, making the whole scenario more trustworthy.

The principles were pivotal in the development process, steering the researchers towards creating a user-centered and immersive VR application. The researchers could design an engaging and effective environment by adhering to principles such as making the application beginner-friendly, minimizing text dependence, including SMEs, and promoting active engagement. The iterative design process, informed by continuous user feedback, ensured the application remained relevant and user-friendly. This approach aligns with HCD principles, emphasizing the importance of iterative testing and refinement, as well as is highly tied together with the principle of involving SMEs throughout the development.

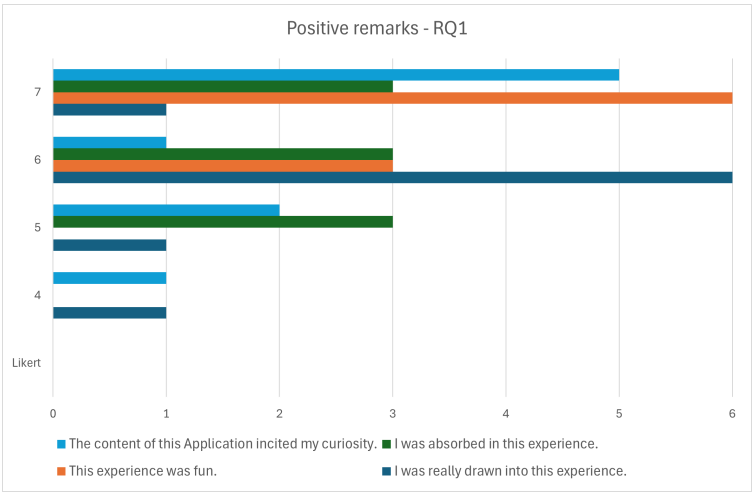

Figure 7.3: Level of agreement with positive statements - Excerpt from User Engagement Scale

Experiential learning allowed the researchers to pace the application's content, enabling

participants to think and reflect before taking action. Combined with the absence of time limits, it allowed users to reflect as intended, leading the researchers to conclude that they could use experiential learning as a pacing tool. Gamification and the MDA framework helped break the application into components, which made it easier to define intrinsic and extrinsic motivators and identify areas that could be gamified. The adapted principles were beneficial in the design, working well alongside the HCD framework. The importance of including SMEs throughout the development significantly helped the development process and ground the tasks in the relevant curriculum.

As evidenced by the levels of appreciation, engagement, and immersion experienced by the users in this research and the data presented in the associated graphs, the researchers are confident that the methodologies and strategies employed have yielded significant results. The chosen methodologies and frameworks have a solid synergic effect, and to have HCD as a core that the principles, frameworks, and theories revolve around has proven to work. Because of this, the researchers believe the methodologies and frameworks are tools for structuring the development and generating immersive and engaging content.

7.1.1 Regarding Research Question 1.2

"How does incorporating dynamic environmental disruptors influence the engagement levels of users in virtual reality environments?"

Early in the prototype development, the researchers focused on implementing audio elements initially thought to function as disruptors for users. These disruptors would be considered disruptive because of their high volume and intensity, as mentioned in Chapter 4.6. Contrary to expectations, these audio elements did not negatively impact the users. Instead, they enhanced the immersive experience by providing a realistic and engaging environment. Participants even remarked that these disruptors could bring them back into the scenario, highlighting their positive impact on immersion.

Participants mentioned that environmental sounds, such as wind and rain, added to the realism and presence in the environment. The ambient audio helped create a more authentic environment, making the experience more engaging and realistic. Creating compelling scenarios necessitates lifelike and complementary audio that fits the visual story. The audio and visuals combine within the scene to create a symbiotic atmosphere that conveys urgency during cold, windy, and rainy conditions. Additionally, the honking of cars contributed to this sense of urgency and stood out as a significant element enhancing the immersion of the scene.

Participants had mixed reactions to the car honking. While some, particularly those with higher competence in the field, appreciated its realism, others found its frequency and loudness potentially distracting. Despite this, the overall impact of the wind, rain, and traffic noises was to create an atmosphere that allowed for high immersion, emphasizing the importance of good audio design that integrates well with the visuals.

The findings suggest that audio disruptors, as implemented in this VR application, do not detract from the immersive experience but rather elevate engagement levels. While complementary audio cues such as wind and rain enhance realism without being disruptive, the honking disrupts some participants. The honking received various remarks, with many participants stating it was annoying. The data shows that numerous participants found the traffic noise interrupted their progress. However, it does elevate the aesthetics in the form of urgency within the scene and helps keep some users engaged and within the experience. The wide range of findings suggests that the honking audio needs reworking and balancing with a lower frequency and volume.

7.2 Regarding Research Question 2

"How does the presence of a feedback and knowledge system affect engagement and immersion in virtual reality training?"

The prototype needed to effectively convey information about both the use of the VR headset and the required actions to complete the ABCDE procedure. Several methods were used to convey this information from text boxes, audio, and graphics, adhering to the Gradual Complexity Scaffold, Minimalistic UI Design, Minimize Text Dependence principles, and Timely and Non-intrusive Feedback principles, as mentioned in Chapter 3.3. The researchers intentionally implemented these methods to reduce the player's cognitive load while providing the necessary information to complete the course.

However, participants needed help with the Oculus Touch controllers, particularly distinguishing between different buttons for gripping objects and interacting with the UI. During observations, this problem was the leading cause of affecting the player's engagement and breaking the virtual reality immersion. This complexity distracted participants, as evidenced by HC1's comment about the complexity of the controls diverting their attention from the course content.

The tutorial scene included an image of the controller buttons' layout and instructions on how to open the "Main Menu" so that the participants could review the button functions at any time during the course. However, through observations, participants mostly overlooked the image. Despite the initial difficulties of interaction with the environment, the participants became more confident with time and practice, suggesting that while initial engagement was hindered, immersion improved over time with familiarity.

Several participants repeatedly performed the same interactions while waiting for a response from the instructor, but the instructor only gave feedback when the participants performed the correct interaction. LC2's desire for audible feedback indicates a need for more interactive and responsive systems that guide users through procedures. Suggestions were to add more auditory cues or visual indicators, like the stethoscope zones, during the breathing check. These immediate confirmation and guidance methods can enhance user engagement and maintain immersion in the training environment. A text box above the patient questions iPad provided further information about the required actions at the current level. However, similar to the image of the controller button layout, this text needed to be more noticed.

7.2.1 Regarding Research Question 2.1

"What is the optimal balance between providing necessary information and maintaining engagement? "

The instructor's presence was crucial for both the high-competence and the low-competence groups. HC participants appreciated the continuous guidance and support from the instructor, while the LC participants relied heavily on the instructor's detailed instructions. Participants from both groups found the ability to ask for additional information vital, as it provided specific help when needed. Most participants chose this option because it provided a short and specific description of the measures needed to complete the current step.

Using the Aspirational Adaptivity principle, a screening scene was implemented, conforming to the user's needs and comprehension levels, thus allowing the participants to choose between a high-competence or a low-competence version of the prototype. The LC group, who tested the low competence version, reported that they found the instructor's monologue

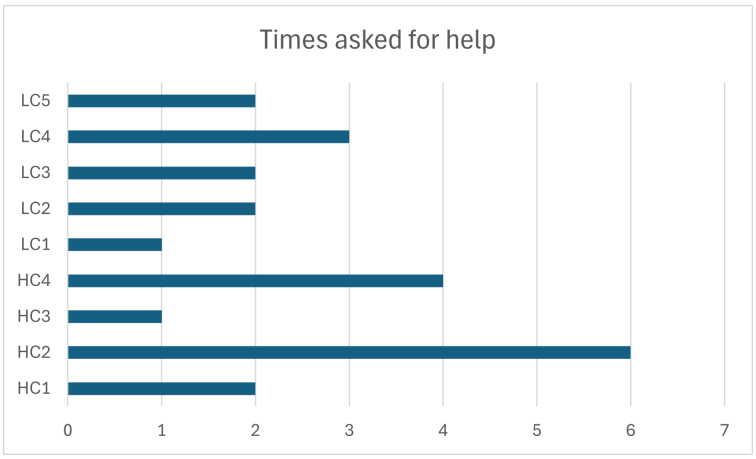

Figure 7.4: Times participants asked for help

overwhelming, suggesting that too much information can disengage users. Furthermore, the HC group, who tested the high competence version, stated that the instructor's frequency and amount of information were adequate and well-balanced.

During testing, it became apparent that the participants lost focus and engagement when the instructor talked for a prolonged time. Instead of focusing and actively listening to the instructor, the participants started interacting with the environment before the instructor talked. This problem was most apparent during the ABCDE procedure in the main scene.

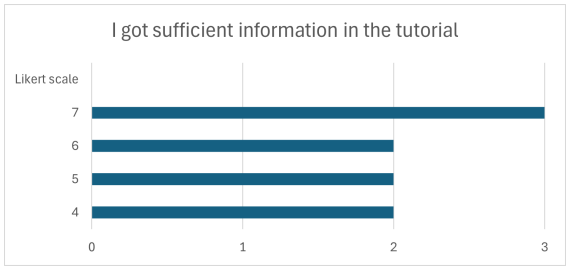

Figure 7.5: Sufficient information tutorial

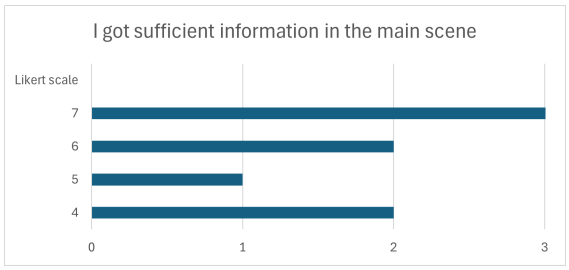

Figure 7.6: Sufficient information main scene

However, several participants stated during the tutorial that they wanted more detailed information about hand controller use because they felt they needed more time during this course segment. Subsequently, the unsubstantial introduction to input devices hinders the users from absorbing the learning outcomes because they focus instead on using them. Finding the optimal balance between providing necessary information and maintaining engagement largely depends on the user's preexisting experience with VR and knowledge about the ABCDE procedure.

The researchers believe that too much information, or the lack of vital information, conflicts with the Experiential Learning Theory's four stages, making the players unprepared for the subsequent course sections. The information and curriculum must be paced appropriately to ensure users can absorb it at a manageable rate as they progress through the course. Aligning information delivery with experiential learning principles will give users the necessary time to experience, reflect, conceptualize, and experiment, following the four stages of experiential learning. Simplifying controls and focusing on relevant information will help users achieve the intended learning outcomes. Giving users autonomy to choose their competence level further elevates their chances of being guided into a branch that provides higher immersion and engagement.

Chapter 8

Conclusions

The core of this thesis is to develop an immersive VR training application for paramedics through strategic design and implementation. The research focused on identifying development strategies and methodologies to enhance immersion and engagement and provide a practical and educational experience. The development of MediVR was grounded in pedagogical theories, HCD, gamification in education, and principles regarding VR development, including the MDA framework.

The application featured realistic graphics, dynamic audio elements, and interactive scenarios to create a compelling training environment. Key findings highlighted the importance of various elements. Realistic audio and visuals enhanced user immersion and provided a lifelike experience crucial for practical training. User autonomy and error tolerance allowed participants to explore and learn from their mistakes, aligning with experiential learning principles. Seamless integration ensured a smooth learning curve and maintained user engagement throughout the training. The presence of a feedback and knowledge system was also critically analyzed, revealing its impact on user engagement and immersion. Participants appreciated the continuous guidance and the ability to access additional information as needed, which helped them navigate the training scenarios effectively.

The integration of HCD as a core and collaboration with SMEs played a pivotal role in the development of MediVR. These collaborations were not just about content creation but also about incorporating user feedback. This approach ensured that the content was relevant, accurate, and tailored to the users' needs, thus enhancing the overall quality and effectiveness of the training tool.

Acknowledging the potential challenges that users may face when using VR technology for medical training is crucial. VR usage involves a dual-dimensional challenge: understanding the subject matter and mastering the technology. Users need to be up to par with the technology to experience a confrontation with the subject matter. The principle of gradual complexity was not met, as evidenced by data gathering. Subsequently, information regarding the use of input devices fell short. Culminating an inherent barrier to immersion can only be overcome by educating users on the input devices and HMDs. This necessity highlights the importance of providing comprehensive tutorials and user-friendly interfaces to facilitate a smoother transition into the immersive experience.

This research is highly relevant to VR educational applications, particularly within paramedic training. The findings contribute to understanding how immersive technologies can be harnessed to create effective training environments. The strategies applied in this research can serve as an inspiration for future developments in similar domains. The development and deployment of MediVR demonstrate that immersive VR training applications, designed with HCD principles and robust pedagogical frameworks, can effectively reach the intended learning outcomes. The insights gained from this research emphasize the importance of realistic

simulations, user autonomy, and structured feedback in creating an engaging and effective educational tool.

In conclusion, MediVR represents a step forward in utilizing VR technology for paramedic training. It presents a scalable solution that can easily be added to at its current level. However, with its inadequate introduction to VR input devices, data shows that many participants face problems and do not experience an immersive and engaging time. This is causing users not to be able to engage with the content but rather to stay busy trying to figure out the technology. This research underscores the potential of VR as a transformative tool in education, capable of delivering a flexible, engaging, and practical training experience.

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Appendix A

Pact analysis

A.1 People

The intended target group for the application encompasses individuals with varying levels of pre-existing knowledge in pre-hospital care. Therefore, it is essential to consider two versions of the prototype: one tailored for users with less prior knowledge and another for those with more advanced understanding. In designing the application, it is imperative to ensure that it is enjoyable and accessible even to users without experience with VR. The user interface and interactions should be intuitive and straightforward, allowing first-timers to navigate the VR environment easily. Also, clear instructions and guidance should be provided within the application to help users understand how to interact with the virtual scenarios effectively.

The primary stakeholders involved in the project include Sørlandet Sykehus, who serves as the project sponsor and is responsible for potential implementation. As the project giver, Sørlandet Sykehus is crucial in providing guidance, resources, and support throughout the development process. Their insights and requirements shape the project's direction and ensure alignment with the needs of the healthcare institution. Additionally, the University of Agder serves as a critical stakeholder, representing the students responsible for developing the application.

- **Students:** Students in the paramedical field begin their specialization at the beginning of their second year in high school, at 16+. They typically have limited experience with the curriculum and may need more familiarity with the subject matter. However, they often exhibit a more remarkable aptitude for learning the technological prerequisites of VR.
- **Apprentices:** These individuals are in training to become pre-hospital care workers. They may have varying experience and knowledge in medical procedures and require guidance and support during training.
- **Paramedics:** Experienced professionals who provide emergency medical care. They may use the VR training prototype to refresh their skills, practice new techniques, or stay updated with the latest protocols.
- **Instructors:** Instructors are the backbone of the VR training sessions. They assess when and how to implement the immersive experience into the curriculum. They are crucial in guiding apprentices and paramedics through the training scenarios, providing feedback, and assessing performance.
- **Other Medical Personnel:** This category includes nurses, doctors, and other healthcare professionals who stand to gain significantly from VR training. The application can enhance their emergency medical skills or help them stay updated with best practices, boosting their confidence and competence in their respective roles.

A.2 Activities

The users are directed into an immersive experience facilitated by an HMD. Through this medium, they engage with a scenario designed to guide them through the systematic review of the ABCDE protocol. This is facilitated by both a virtual instructor and a virtual patient. Before starting the course, users are prompted to select a route aligned with their existing knowledge within the curriculum. This step ensures the learning experience is tailored to the individual user's expertise and familiarity with the subject matter. Once the route is selected, users are presented with prerequisites to progress further in the course. These prerequisites involve utilizing various medical tools to assess the severity of the patient's condition and engaging in conversations to identify potential head trauma. To engage with the components within the course and move around the scenes, the users will utilize the hand controllers. Users' actions are closely monitored and compared against correct procedures. This allows for real-time feedback and assessment of user performance. Ultimately, the application culminates in presenting users with a score, measuring their proficiency and understanding of the ABCDE protocol.

A.3 Context

The application, designed for use with the Meta Quest 3 standalone headset, allows individual and group learning experiences. Leveraging the untethered nature of the Meta Quest 3, the application can be deployed without the need for additional hardware, providing a convenient solution for users. Users can engage in self-directed learning and practice ABCDE procedures within a simulated environment in individual settings. In group scenarios, facilitators can utilize the application to guide collaborative activities and discussions among participants. The capability to broadcast the application to larger screens also enables group learning sessions and facilitates remote participation. This combination of accessibility and functionality makes the application suitable for procedural training and skill development in various educational contexts.

A.4 Technology

The application is designed specifically for the Meta Quest 3 headset, an advancement from its predecessors, the Quest 2 and Quest 1. Although developed with the Quest 3 in mind, it functions with the Quest 2 headset but performs somewhat less. The Quest 3 boasts significant improvements over the Quest 2, offering enhanced performance and ergonomics. The application utilizes the input capabilities of the Meta Quest 3 headset to provide users with a fully immersive experience. Users interact with the virtual environment primarily through hand gestures, including grabbing and pinching. The headset interprets these inputs, updating the positions of the user's hands within the virtual space. On the output side, the Meta Quest 3 headset is the primary output device, presenting users with an immersive experience through visual and auditory cues.

Appendix B

Personas

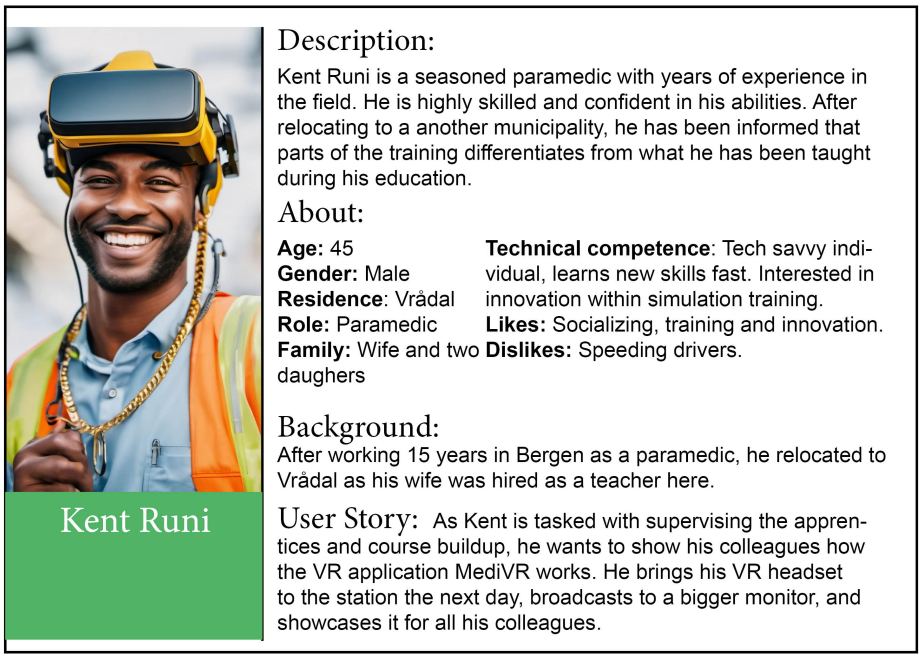
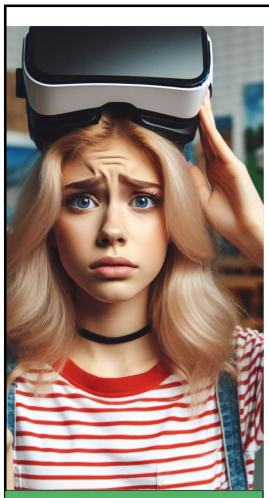


Figure B.1: Persona image generated with AI



Chanèth Loneseth

Description:

Chanèth Loneseth is a 16 year old who has just started her specialization within paramedicine in Highschool. She is eager to learn and has high hopes for her career. She enjoys practical assignments as well as working in a collective sense.

About:

Age: 16
Gender: Female
Residence: Grimstad
Role: Student
Family: Two younger brothers and a father and mother.

Technical competence: Very little technical competence, never tried VR before.
Likes: Knitting, fishing and socializing.
Dislikes: Carnivores

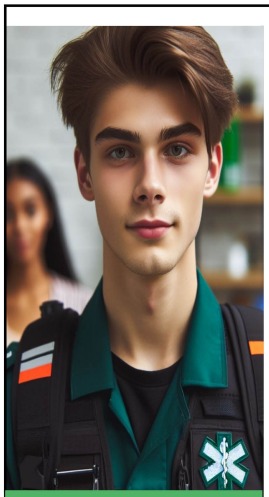
Background:

Following her mothers footsteps, Chaneth decided to become a paramedic, following her life long dream.

User Story:

Chanèth has never been immersed in VR experiences before, and she is somewhat reluctant in trying it. She has been informed that MediVR is being tested in education, as to give the students an introduction to the ABCDE's in the field.

Figure B.2: Persona image generated with AI



Jon Roger Ulfheim

Description:

Jon Roger Ulfheim has just graduated Highschool, marking the outset of him start as an apprentice in paramedicine. He has excelled the theoretical parts within the study, but has lacked in practical assignments.

About:

Age: 18
Gender: Male
Residence: Arendal
Role: Apprentice
Family: Mother and father

Technical competence: Has general knowledge about computers.
Likes: Computer games and working out.
Dislikes: Procrastination and loudmouths.

Background:

Jon is a person who always seems to go in another direction than his friends, finding inspiration in reading a news article about paramedics, started his interest within the field.

User Story:

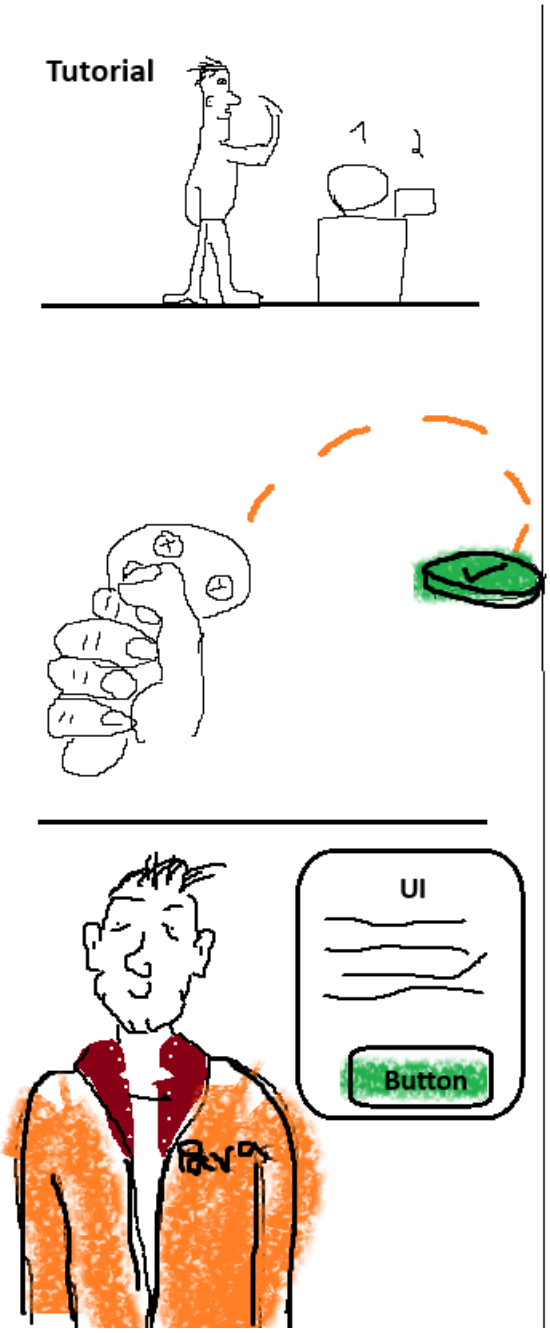
As Jon has got the theoretical parts in place, he is now tasked with to prepare for his PHTLS exam. He knows that this exam is monumental within the studies and he wishes to study for this on his free time. Therefore, he borrows a VR headset and completes MediVR many times in preperation.

Figure B.3: Persona image generated with AI

Figure B.4: Persona image generated with AI

Appendix C

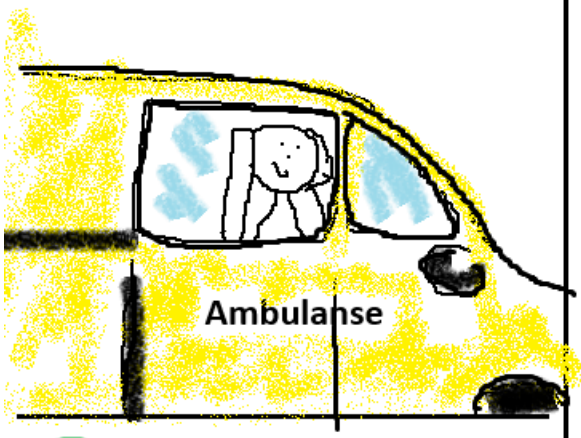
Storyboards



La spiller gå gjennom en enkel introduksjon til VR. I denne tutorialen skal spiller bli kjent med kontrollerne. I første stasjon vil spilleren gjennomføre enkle oppgaver som å kaste og plassere objekter hensiktsmessig.

Mellom hver stasjon skal spilleren bli introdusert til bevegelse, instruer spiller til å enten bruke joystick til å bevege seg (locomotion) eller teleportere seg til sirkler som er plassert mellom hver stasjon.

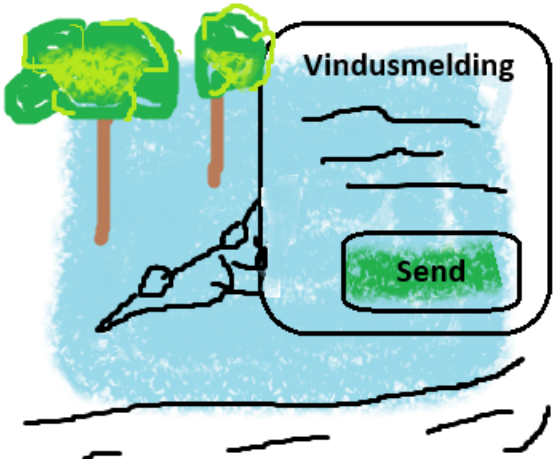
Inkluder UI i tutorial, her skal konseptene med UI bli beskrevet fra instruktør. Ved trykk på knappen i fremvist UI, skal spilleren bli sendt til scene nummer 2.



Etablerende skudd -

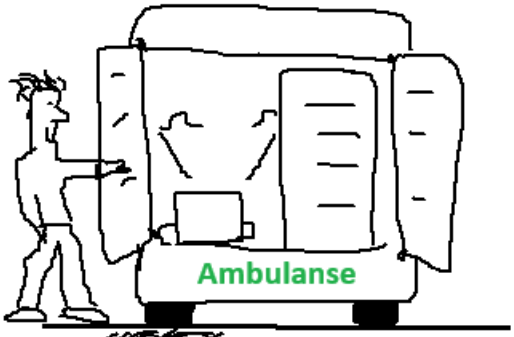
Etter å ha blitt ferdig med tutorial, skal spiller starte scene hvor man sitter på med instruktør mot krasjområdet. Ombord i bilen skal instruktøren forklare konsepter og hva som er viktig når en kjører ambulanse.

På vei til krasjområdet ser man bilen og skadet person ligge ved veikanten. Skadeomfang uvisst.



Instruktør forklarer vidusmelding, hva som er viktig med vindusmelding og hva en slik melding skal inneholde.

Når vindusmelding er ferdig, skal spiller trykke på send, for å sende melding til AMK. Ved trykk av knapp, blir spiller sendt videre til hovedscenen.



Ved ankomst skadestedet, skal instruktøren vise vei til baksiden av ambulanse, hvor spiller skal hente ut nødvendig utstyr som skal bæres bort til skadestedet. Ved hjelp av navigasjon og knapper skal bruker navigere til krasjområdet.

Ved ankomst pasient, skal instruktør instruere spiller gjennom ABCDE prosedyren, og gi spiller råd for gjennomføring. Spiller skal da benytte seg av en rekke forskjellige utstyr for å "redde pasienten".

Ved kursets slutt, skal spiller bli presentert sin totale score. Her vil alle valg tatt akkumulere ned til en score. Annen metrics som antall spurt om hjelp, antall feil, tid, og andre ting også presenteres til spiller.

Appendix D

Volere Shells - Functional Requirements

Requirements #: 1 *Requirement Types;* **Functional**

Description: USERS SHOULD BE ABLE TO CHOOSE THEIR OWN PATH BASED ON THEIR COMPETENCE LEVEL WITHIN THE ABCDE PROCEDURE.

Rationale: DIFFERENT USERS MAY HAVE VARYING LEVELS OF EXPERTISE IN THE ABCDE PROCEDURE, REQUIRING PERSONALIZED TRAINING PATHS TO OPTIMIZE LEARNING OUTCOMES.

Fit Criterion: THE APPLICATION PROVIDES USERS OPTIONS FOR SELECTING A PATH ALIGNED WITH THEIR COMPETENCY LEVEL. PATHS ARE CLEARLY LABELED AND DIFFERENTIATED BASED ON COMPLEXITY.

Originator: **Developer**

Priority: **High**

Volere

Requirements #: 2 *Requirement Types;* **Functional**

Description: USERS SHOULD BE ABLE TO INTERACT WITH VR ELEMENTS IN THE PREPARATION SCENE TO FAMILIARIZE THEMSELVES WITH VR CONTROLS.

Rationale: PROVIDING USERS WITH HANDS-ON INTERACTION IN THE PREPARATION SCENE HELPS BUILD CONFIDENCE AND PROFICIENCY IN USING VR CONTROLS BEFORE ENGAGING IN MORE COMPLEX SCENARIOS.

Fit Criterion: USERS CAN NAVIGATE THE VR ENVIRONMENT USING HAND CONTROLLERS. INTERACTABLE OBJECTS ARE PLACED WITHIN THE SCENE FOR USERS TO PICK UP, MOVE, AND INTERACT WITH. UI ELEMENTS, SUCH AS BUTTONS AND MENUS, ARE PRESENT AND RESPONSIVE TO USER INPUT.

Originator: **Developer**

Priority: **High**

Volere

Requirements #: 3 *Requirement Types;* **Functional**

Description: IMPLEMENT THE ABILITY FOR USERS TO GRAB OBJECTS IN THE MAIN SCENE.

Rationale: ENHANCES USER INTERACTION AND ENGAGEMENT BY ALLOWING MANIPULATION OF VIRTUAL OBJECTS, ALLOWS USERS TO COMPLETE TASKS.

Fit Criterion: USERS CAN USE HAND CONTROLLERS TO GRAB AND MANIPULATE OBJECTS WITHIN THE VR ENVIRONMENT.

Originator: **Developer**

Priority: **High**

Volere

Requirements #: 3 *Requirement Types;* Functional

Description: PROVIDE THE ABILITY FOR USERS TO TELEPORT TO PREDEFINED ANCHORS WITHIN THE ENVIRONMENT.

Rationale: ENABLES SEAMLESS NAVIGATION AND EXPLORATION OF DIFFERENT AREAS WITHIN THE VR ENVIRONMENT.

Fit Criterion: USERS CAN SELECT AND TELEPORT TO DESIGNATED LOCATIONS BY USING HAND GESTURES.

Originator: Developer

Priority: Medium

Volere

Requirements #: 5 *Requirement Types;* Functional

Description: PROVIDE THE ABILITY FOR USERS TO MOVE USING CONTINOUS MOVE LOCOMOTION

Rationale: ENABLES SEAMLESS NAVIGATION AND EXPLORATION OF DIFFERENT AREAS WITHIN THE VR ENVIRONMENT.

Fit Criterion: THE USER IS ABLE TO USE THE CONTROLLERS TO MOVE WITH THE USE OF THE JOYSTICK.

Originator: Developer

Priority: Medium

Volere

Requirements #: 6 *Requirement Types;* Functional

Description: PROVIDE INSTRUCTION FROM A VIRTUAL INSTRUCTOR THROUGHOUT THE TRAINING SESSION.

Rationale: OFFERS GUIDANCE AND SUPPORT TO USERS, ENHANCING THEIR LEARNING EXPERIENCE.

Fit Criterion: THE VIRTUAL INSTRUCTOR PROVIDES REAL-TIME FEEDBACK AND ASSISTANCE BASED ON USER ACTIONS AND PERFORMANCE.

Originator: Developer

Priority: High

Volere

Requirements #: 7 *Requirement Types;* Functional

Description: DISPLAY PERFORMANCE METRICS ON A SCOREBOARD AT THE END OF THE TRAINING SESSION.

Rationale: PROVIDES USERS WITH FEEDBACK ON THEIR PERFORMANCE AND PROGRESS.

Fit Criterion: THE SCOREBOARD SHOWS RELEVANT METRICS, SUCH AS ACCURACY AND ASSISTANCE REQUESTS, TO EVALUATE USER PERFORMANCE.

Originator: Developer

Priority: High

Volere

Requirements #: 8 *Requirement Types;* Functional

Description: DOWNLOAD AND IMPLEMENT A THERMOMETER THAT CAN BE USED WITH THE VIRTUAL PATIENT

Rationale: ALLOWS UISER TO CHECK THE TEMPERATURE ON THE PATIENT, AS A PART OF THE EXPOSURE COMPONENT WITHIN THE ABCDE'S.

Fit Criterion: A GRABBABLE MODEL IS IN WITHIN THE VICINITY OF THE USER AND CAN BE USED ON THE PATIENT.

Originator: Client

Priority: High

Volere

Requirements #: 9 *Requirement Types;* Functional

Description: DOWNLOAD AND IMPLEMENT A OXIMETER THAT CAN BE USED WITH THE VIRTUAL PATIENT

Rationale: ALLOWS UISER TO CHECK THE SP02 AND PULSE ON THE PATIENT, AS A PART OF THE CIRCULATION COMPONENT WITHIN THE ABCDE'S.

Fit Criterion: A GRABBABLE MODEL IS IN WITHIN THE VICINITY OF THE USER AND CAN BE USED ON THE PATIENT.

Originator: Client

Priority: High

Volere

Requirements #: 10 *Requirement Types;* Functional

Description: DOWNLOAD AND IMPLEMENT A STETHOSCOPE THAT CAN BE USED WITH THE VIRTUAL PATIENT

Rationale: ALLOWS UISER TO CHECK THE BREATHING OF THE PATIENT, AS A PART OF THE BREATHING COMPONENT WITHIN THE ABCDE'S.

Fit Criterion: A GRABBABLE MODEL IS IN WITHIN THE VICINITY OF THE USER AND CAN BE USED ON THE PATIENT, TO LISTEN TO THE BREATHING CAPABILITIES OF THE PATIENT. .

Originator: Client

Priority: High

Volere

Requirements #: 11 *Requirement Types;* Functional

Description: ALLOW USERS TO OPEN THE MOUTH OF THE PATIENT

Rationale: ALLOW USERS TO INSPECT THE MOUTH CAVITY AND AIRWAYS OF THE PATIENT, AND REMOVE ANY FOREIGN OBJECTS.

Fit Criterion: THE USER SHOULD BE ABLE TO MOVE THEIR HANDS AND GRAB THE MOUTH OF THE PATIENT IN ORDER TO OPEN THE MOUTH, THEREAFTER REMOVE ANY FOREIGN OBJECTS.

Originator: Client

Priority: High

Volere

Requirements #: 12 *Requirement Types;* Functional

Description: ENABLE USERS TO ENGAGE IN A DIALOGUE WITH THE VIRTUAL PATIENT TO ASSESS FOR SIGNS OF HEAD TRAUMA.

Rationale: FACILITATES COMPREHENSIVE EVALUATION OF THE PATIENT'S CONDITION AND ENHANCES REALISM IN THE TRAINING SCENARIO.

Fit Criterion: USERS CAN INITIATE AND PARTICIPATE IN A DIALOGUE WITH THE VIRTUAL PATIENT, ASKING RELEVANT QUESTIONS TO ASCERTAIN SYMPTOMS OF HEAD TRAUMA, SUCH AS LOSS OF CONSCIOUSNESS, CONFUSION, OR MEMORY LOSS. THE VIRTUAL PATIENT RESPONDS DYNAMICALLY TO USER INQUIRIES, AND MOVES LIMBS UPON COMMANDS.

Originator: Client

Priority: High

Volere

Requirements #: 13 *Requirement Types;* Functional

Description: CREATE A MAIN MENU THAT CAN BE INTERACTED WITH AT ANY POINT OF THE COURSE AND IN ANY SCENE, WHERE THE USER CAN CHANGE SCENE, SEE CONTROLS AND CHANGE SETTINGS.

Rationale: ALLOWS THE USER TO NAVIGATE THROUGH THE APPLICATION AND EDIT SETTINGS TO THEIR PREFERENCES.

Fit Criterion: USERS NAVIGATE THE MENU USING HAND CONTROLLERS, SELECTING OPTIONS WITH BUTTON PRESSES. SELECTED OPTIONS SMOOTHLY TRANSITION USERS TO CORRESPONDING SCENES OR FUNCTIONALITIES.

Originator: Developer

Priority: Medium

Volere

Requirements #: 14 *Requirement Types;* Functional

Description: ENABLE USERS TO ASSESS CAPILLARY REFILL IN THE PATIENT'S FOREHEAD AS PART OF THE ABCDE PROCEDURE.

Rationale: FACILITATES EVALUATION OF THE PATIENT'S CIRCULATORY STATUS AND AIDS IN IDENTIFYING POTENTIAL CIRCULATION ISSUES.

Fit Criterion: USERS CAN PERFORM CAPILLARY REFILL ASSESSMENT BY APPLYING PRESSURE TO THE PATIENT'S FOREHEAD AND OBSERVING THE TIME IT TAKES FOR BLOOD FLOW TO RETURN. THE VIRTUAL PATIENT'S FOREHEAD VISIBLY CHANGES COLOR TO INDICATE CAPILLARY REFILL, PROVIDING FEEDBACK TO USERS ON THE ASSESSMENT OUTCOME.

Originator: Developer

Priority: High

Volere

Requirements #: 15 *Requirement Types;* Functional

Description: SNAP OBJECTS INTO ORIGINAL PLACE WHEN USER RELEASES GRABBED OBJECTS

Rationale: ALLOWS THE USER TO HAVE BETTER CONTROL OVER WHERE THE USED EQUIPMENT ARE AT ANY GIVEN TIME.

Fit Criterion: WHEN USERS RELEASE THE BUTTEN PRESSED UPON GRABBING AN OBJECT, RELEASING THE SAME BUTTON SHOULD SNAP THE OBJECT BACK INTO THE ORIGINAL POSITIION.

Originator: Tester

Priority: Medium

Volere

Requirements #: 16 *Requirement Types;* Functional

Description: PROVIDE USERS WITH THE ABILITY TO ASSESS WHETHER THE PATIENT IS IN CRITICAL CONDITION.

Rationale: AS A FINAL PART OF THE COURSE, THE USER SHOULD DETERMINE BASED ON FINDINGS WHETHER OR NOT THE PATIENT IS IN CRITICAL CONDITION.

Fit Criterion: USERS CAN PRESS EITHER OF THE TWO BUTTONS TO INDICATE THEIR ASSESSMENT OF THE PATIENT'S CONDITION.

Originator: Developer

Priority: Medium

Volere

Appendix E

Volere Shells - Non-functional Requirements

Requirements #: 17 *Requirement Types;* Non-Functional

Description: DEVELOP AN INTRODUCTIONARY SCENE WHERE THE USER IS DRIVING TOWARDS THE CRASH SITE

Rationale: THIS ALLOWS THE USER TO FEEL IMMERSED IN THE ACTION, AS WELL AS SETS THE STAGE FOR THE MAIN SCENE.

Fit Criterion: THE ACTIONS ARE ADHERING TO HOW THE PARAMEDICS PROGRESS THROUGH REAL LIFE SCENARIOS, ALLOWING THE USERS TO FEEL IMMERSED.

Originator: Developer

Priority: Medium

Volere

Requirements #: 18 *Requirement Types;* Non-Functional

Description: POPULATE MAIN SCENE WITH ROADS, TERRAIN AND TREES.

Rationale: THIS ALLOWS THE USER TO FEEL IMMERSED IN THE ENVIRONMENT

Fit Criterion: THE AREA WHERE THE USER IS IMMERSED, ARE MORE LIFE LIKE AND ENGAGING.

Originator: Developer

Priority: Medium

Volere

Requirements #: 19 *Requirement Types;* Non-Functional

Description: ADD A WIND ZONE TO THE MAIN SCENE

Rationale: THIS MAKES THE TREES SWAY IN THE WIND

Fit Criterion: THE AREA WHERE THE USER IS IMMERSED, ARE MORE LIFE LIKE AND ENGAGING.

Originator: Developer
Priority: Medium

Volere

Requirements #: 20 *Requirement Types;* Non-Functional

Description: DEVELOP AND MODEL REALISTIC AND LIFELIKE 3D MODELS FOR ALL THE ACTORS IN THE APPLICATION.

Rationale: GIVES THE USERS A MORE IMMERSED STATE WHEN INTERACTING WITH THE PROCEDURAL TRAINING.

Fit Criterion: THE MODELS OF BOTH THE INSTRUCTOR AND PATIENT ARE LOOKING REALISTINC WITH THEIR PROPORTIONS AND DESIGN.

Originator: Developer
Priority: Medium

Volere

Requirements #: 21 *Requirement Types;* Non-Functional

Description: IMPLEMENT A TRAFFIC SYSTEM AND POPULATE THE ROADS WITH THIS SYSTEM.

Rationale: GIVES THE USERS A MORE IMMERSED STATE WHEN IN THE INTRODUCTION SCENE AS WELL AS THE MAIN SCENE.

Fit Criterion: THE TRAFFIC BUILDS UP NEAD THE CRASH SITE, AND DRIVES THROUGH THE CRASH SITE.

Originator: Developer
Priority: Medium

Volere

Requirements #: 22 *Requirement Types;* Non-Functional

Description: IMPLEMENT A SCREEN THAT PRESENTSTHE DATA GAINED FROM ACTIVITIES IN THE ABCDE'S.

Rationale: GIVES THE USERS A MORE IMMERSED STATE WHEN IN THE MAIN SCENE, AS WELL AS GIVES A POSIBILITY OF MONITORING THE PATIENT'S VALUES.

Fit Criterion: A SCREEN THAT SHOWS THE USER THE VALUES OFTHE PATIENT, INCLUDES SP02, PULSE, TEMPERATURE AND BLOOD PRESSURE.

Originator: Developer

Priority: Medium

Volere

Requirements #: 23 *Requirement Types;* Non-Functional

Description: IMPLEMENT AUDIO SOURCES FOR RAIN, WIND, TRAFFIC AND HONKING.

Rationale: GIVES THE USERS A MORE IMMERSED STATE WHEN IN THE MAIN SCENE, AND BRINGS SOMEWHAT OF AN URGENCY TO THE EVALUATION OF THE PATIENT.

Fit Criterion: THE WIND MATCHES TREE'S SWAYING, AND COMPLIMENTS RAIN AND TRAFFIC.

Originator: Developer

Priority: Medium

Volere

Requirements #: 24 *Requirement Types;* Non-Functional

Description: ENSURE THAT THE VR APPLICATION CAN ACCOMMODATE A GROWING USER BASE AND FUTURE EXPANSIONS.

Rationale: ALLOWS FOR SEAMLESS SCALABILITY AND ADAPTABILITY TO CHANGING DEMANDS.

Fit Criterion: THE APPLICATION ARCHITECTURE SUPPORTS SCALABILITY, WITH A FRAMEWORK THAT IS EASY TO IMPLEMENT INTO.

Originator: Developer

Priority: Medium

Volere

Requirements #: 25 *Requirement Types;* Non-Functional

Description: DESIGN THE VR APPLICATION TO BE INTUITIVE AND EASY TO USE, EVEN FOR USERS WITH LIMITED VR EXPERIENCE.

Rationale: IMPROVES USER ENGAGEMENT AND SATISFACTION, LEADING TO HIGHER ADOPTION RATES.

Fit Criterion: USER INTERFACES AND INTERACTIONS FOLLOW VR USABILITY GUIDELINES, WITH CLEAR INSTRUCTIONS AND ASSISTANCE FEATURES.

Originator: Developer

Priority: Medium

Volere

Requirements #: 26 *Requirement Types;* Non-Functional

Description: ENSURE SMOOTH AND RESPONSIVE PERFORMANCE OF THE VR APPLICATION.

Rationale: ENHANCES USER IMMERSION AND PREVENTS MOTION SICKNESS CAUSED BY LAG OR DELAYS.

Fit Criterion: THE APPLICATION MAINTAINS A CONSISTENT FRAME RATE AND MINIMAL LOADING TIMES FOR SEAMLESS USER EXPERIENCE.

Originator: Developer

Priority: High

Volere

Requirements #: 27 *Requirement Types;* Non-Functional

Description: THE APPLICATION SHOULD GUIDE USERS THROUGH TASKS ONE STEP AT A TIME, PRESENTING INFORMATION AND CHALLENGES GRADUALLY TO MINIMIZE COGNITIVE OVERLOAD.

Rationale: BY SCAFFOLDING COGNITIVE EFFORT, USERS CAN FOCUS ON MASTERING INDIVIDUAL CONCEPTS OR SKILLS BEFORE PROGRESSING TO MORE COMPLEX TASKS, ENHANCING COMPREHENSION AND

Fit Criterion: USERS SHOULD DEMONSTRATE IMPROVED ACCURACY RATES, INDICATING EFFECTIVE MANAGEMENT OF COGNITIVE LOAD AND ENHANCED LEARNING OUTCOMES.

Originator: Developer

Priority: High

Volere

Requirements #: 28 *Requirement Types;* Non-Functional

Description: ENSURE THAT THE APPLICATION DELIVERS TIMELY FEEDBACK TO USERS' ACTIONS, PROVIDING CLEAR GUIDANCE AND REINFORCEMENT OF LEARNING OBJECTIVES.

Rationale: IMMEDIATE FEEDBACK ENABLES USERS TO CORRECT ERRORS AND REINFORCE CORRECT BEHAVIORS PROMPTLY, ENHANCING LEARNING EFFICIENCY AND EFFECTIVENESS.

Fit Criterion: USERS SHOULD DEMONSTRATE IMPROVED PERFORMANCE AND COMPREHENSION FOLLOWING FEEDBACK, WITH DECREASED INSTANCES OF ERRORS.

Originator: Developer

Priority: High

Volere

Requirements #: 29 *Requirement Types;* Non-Functional

Description: INCORPORATE MOMENTS WITHIN THE APPLICATION FOR USERS TO PAUSE AND REFLECT ON THEIR LEARNING EXPERIENCES, ENCOURAGING DEEPER UNDERSTANDING AND CONSOLIDATION OF KNOWLEDGE.

Rationale: REFLECTION PROMOTES COGNITIVE AWARENESS AND DEEPER ENGAGEMENT WITH LEARNING MATERIALS, FACILITATING RETENTION.

Fit Criterion: USERS SHOULD DEMONSTRATE INCREASED SELF-AWARENESS AND COMPREHENSION OF LEARNING OBJECTIVES, AS EVIDENCED BY REFLECTIVE ACTIVITIES AND IMPROVED PERFORMANCE ON SUBSEQUENT TASKS.

Originator: Developer

Priority: High

Volere

Requirements #: 30 *Requirement Types;* Non-Functional

Description: INCORPORATE GESTURES THAT ALIGN WITH THE CONTENT BEING TAUGHT, LEVERAGING THE NATURAL CONNECTION BETWEEN BODY MOVEMENTS AND COGNITIVE PROCESSES TO REINFORCE LEARNING.

Rationale: GESTURE-BASED INTERACTIONS ENHANCE USER ENGAGEMENT AND COGNITIVE PROCESSING, FACILITATING DEEPER ENCODING AND RETRIEVAL OF LEARNING MATERIALS.

Fit Criterion: USERS SHOULD DEMONSTRATE IMPROVED LEARNING OUTCOMES AND RETENTION OF INFORMATION WHEN GESTURES ARE INTEGRATED INTO INTERACTIVE LEARNING ACTIVITIES, COMPARED TO TRADITIONAL INSTRUCTION METHODS.

Originator: Developer

Priority: High

Volere

Appendix F

Full list of components - MDA

Mechanics	Dynamics	Aesthetics
Procedural Tasks	User Autonomy	Sense of Accomplishment
Realistic Audio	Real-time Feedback	Immersion
High-fidelity Graphics	Task Complexity	Presence
Instructor Guidance	Interaction with Instructor	Fellowship
Tools (thermometer, stethoscope, etc.)	Reflective Thinking	Challenge
Multimonitor Display	Monitoring	Urgency
Scoring System	Feedback	Competition
Placing Boxes	Scenario Transitions	Realism
Moving Objects	User Interaction	Engagement
User Interface (UI)	Controller Interaction	Ease of Use
Scene Changes	Dynamic Environment	Continuity
Establishing Shot	Setting Context	Anticipation
Sending "vindusmelding"	Communication	Responsiveness

Table F.1: Overview of Mechanics, Dynamics, and Aesthetics in MediVR

Appendix G

Full list of third-party downloaded assets

Table G.1: Full list of third-party downloaded assets

Name and URL	Description
Pulse Oximeter 3D Model	To be a part of the ABCDE procedure
Thermometer	To be a part of the ABCDE procedure
Medical Monitor	To illustrate patient levels
Road Signs	To populate the scenes
Trees	To populate the scenes and create a forest
Street Lamps	To populate the scenes and create sources of light
Sphygometer	To be a part of the ABCDE procedure
Car Wreck	To illustrate crash site (This asset has been removed from the website)
Road Architect	Plugin to design road system
Rain Maker	To create rain and atmosphere

Table G.2: Full list of third-party audio assets

Name	Description
Ambulance sirene	To be a part of the interior audio
Interior audio as car pulls over	Row 2, Cell 2
Car honking	As a part of the traffic
Car honking 2	As a part of the traffic
Car idle	As a part of the traffic
Car drive	As a part of the traffic
Coin bling	As a part of tutorial

Appendix H

Consent Form

Vil du delta i forskningsprosjektet MediVR?

Formålet med prosjektet
Dette er et spørsmål til deg om du vil delta i et forskningsprosjekt hvor formålet er å utforske hvordan virtuell virkelighet kan brukes i gjennomføring av ABCDE prosedyretrening. Prosjektet er et masterprosjekt, og det er definert fire forskjellige forskningsspørsmål.

1. What development strategies and methodologies can enhance immersion in educational VR applications, ensuring users' engaging and immersive learning experience?

   1.1 - How does incorporating dynamic environmental disruptors influence the engagement levels of users in virtual reality environments?

2. How does the presence of a feedback and knowledge system affect engagement and immersion in virtual reality training?

   2.1 - What is the optimal balance between providing necessary information and maintaining engagement?

Hvorfor får du spørsmål om å delta?
Du får denne forespørselen fordi du er engasjert i et testpanel som har som formål å teste og danne datagrunnlag for prosjektet.

Hvem er ansvarlig for forskningsprosjektet?
Universitetet i Agder er ansvarlig for personopplysningene som behandles i prosjektet og går under Fakultet for teknologi og realfag.

Prosjektleder er Førstelektor Morgan Konnestad fra Fakultet for teknologi og realfag

Det er frivillig å delta
Det er frivillig å delta i prosjektet. Det vil ikke ha noen negative konsekvenser for deg hvis du ikke vil delta eller senere velger å trekke deg.

Hva innebærer det for deg å delta?
Forskningen i dette prosjektet vil benytte seg av ulike metoder, inkludert spørreskjema, intervjuer og observasjoner gjennom brukertesting. Den eneste personopplysningen som vil bli samlet inn, er fødselsår. Informasjonen vil bli elektronisk registrert og dokumentert gjennom notater. Deltakelse i forskningsprosjektet vil kreve omtrent 30 minutter av deltakernes tid. Prosessen starter med et pre-intervju, hvor informasjon om deltakeren og bruken av virtuell virkelighet (VR) blir innhentet. Deretter vil selve testen bli gjennomført, og denne delen kan bli dokumentert ved hjelp av skjermopptak. Etter testens avslutning vil det gjennomføres et post-test intervju, som også vil bli dokumentert gjennom notater.

Figure H.1: Participant consent form - page 1

Om personvern
Vi vil bare bruke opplysningene om deg til formålene vi har fortalt om i dette skrivet. Vi behandler personopplysningene konfidensielt og i samsvar med personvernregelverket. Ved innhenting av data vil alle personopplysninger fortløpende bearbeidet slik at identifiserende opplysninger enten slettes, grupperes, eller omskrives, og opptak redigeres eller sladdes. Det er kun studentene Edvin Sæverås og Anders Mørk og interne medarbeidere som vil behandle og ha tilgang til opplysningene. All data vil bli lagret på interne enheter hvor dataen vil være kryptert med passord. Dersom noe form av data skal sendes, vil Uninetts Filesender bli anvendt, hvor dataen blir kryptert med passord og brukeren vil måtte ha unik konto, og tilgang til unik nettadresse for å åpne filer. All bruk av filesender vil bli limitert til et vindu på 24 timer, hvor all data vil bli destruert etter 24 timer. Deltakere vil ikke kunne identifiseres gjennom publikasjoner og alder i intervall på 5 år vil bli publisert.

Hva skjer med data når vi avslutter prosjektet?
Alle opplysninger innhentet vil bli anonymisert umiddelbart og når prosjektet avsluttes vil all data bli destruert. Planlagt sluttdato på prosjekt er 30.06.2024.

Hva gir oss rett til å behandle personopplysninger om deg?
Vi behandler datagrunnlag og opplysninger om deg og din deltakelse basert på ditt samtykke om detakelse.

Dersom du har spørsmål om prosjektet, eller ønsker å vite mer om dine rettigheter, ta kontakt med:

Veileder 1: Førstelektor Morgan Konnestad
Telefonnummer: 37 23 32 89
E-post: morgan.konnestad@uia.no

Veileder 1: Førsteamanuensis Ghislain Maurice Norbert Isabwe
Telefonnummer: 37 23 37 82
E-post: maurice.isabwe@uia.no

Masterstudent 1: Edvin Sæverås
Telefonnummer: 94 08 21 40
E-post: edvins@uia.no

Masterstudent 1: Anders Mørk
Telefonnummer: 41 22 19 48
E-post: anderm15@uia.no

Med vennlig hilsen

Morgan Konnestad	Edvin Sæverås	Anders Mørk
Prosjektansvarlig	Forsker	Forsker

Figure H.2: Participant consent form - page 2

På oppdrag fra Universietet i Agder har personverntjenestene ved Sikt – Kunnskapssektorens tjenesteleverandør, vurdert at behandlingen av personopplysninger i dette prosjektet er i samsvar med personvernregelverket.

Dine rettigheter

Så lenge du kan identifiseres i datamaterialet, har du rett til:

- å be om innsyn i hvilke opplysninger vi behandler om deg, og få utlevert en kopi av opplysningene,
- å få rettet opplysninger om deg som er feil eller misvisende,
- å få slettet personopplysninger om deg,
- å sende klage til Datatilsynet om behandlingen av dine personopplysninger.

Samtykkeerklæring

Jeg har mottatt og forstått informasjon om prosjektet MediVR og har fått anledning til å stille spørsmål. Jeg samtykker til:

- ☐ å delta i intervjuer, spørreskjema og observasjoner
- ☐ at intervju tas opp ved hjelp av opptaksutstyr
- ☐ at utdrag fra intervju og observasjoner kan inkluderes i publikasjoner, sitater vil anonymiseres.

Jeg samtykker til at mine opplysninger behandles frem til prosjektet er avsluttet

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Deltakers signatur	Dato og sted

Figure H.3: Participant consent form - page 3

Appendix I

Intervjuguide for MediVR-prototypen

En test vil ta mellom 40 til 60 minutter å fullføre, som inkluderer en gjennomspilling av prototypen i tillegg til å fylle ut User Engagement Scale (UES) og gjennomføre et semi-strukturert intervju.

Før-test Intervju

Etter at deltakeren har lest gjennom og akseptert samtykkeskjemaet, gjennomføres et før-test intervju. Dette intervjuet består av ti spørsmål som har som mål å etablere deltakernes forventninger og forhåndskunnskap innen VR og ABCDE-prosedyren.

- Hvor gammel er du?
- Har du brukt VR før?
- Hvis ja, hvor mange timer anslår du?
- Er du komfortabel med bruk av slik teknologi?
- Hvordan foretrekker du å lære nye prosedyrer?
- Hva synes du om å lære nye ting gjennom teknologi?
- Foretrekker du mer interaktiv praktisk læring eller tradisjonelle læringsmetoder?
- På en skala fra 1 - 7, hvor mye erfaring har du med ABCDE?
- Hvilke forventninger har du til en e-læringsressurs?

Når før-test intervjuet er fullført, vil de bli gitt et VR-headset og få beskjed om hvilken versjon av prototypen de skal teste, avhengig av deres nåværende kunnskap og erfaring med ABCDE-prosedyren. VR-gjennomspillingen blir vist på en PC og skjermopptak blir gjort, hvis deltakeren har gitt tillatelse til dette i samtykkeskjemaet.

Gjennomspilling

Etter at riktig versjon er valgt, forteller forskerne til deltakeren at de skal følge instruksjonene som blir gitt av simuleringen og prøve å fullføre oppgavene så godt de kan. Under gjennomspillingen gis det ikke veiledning fra forskerne, med mindre deltakeren sitter helt fast eller hvis prototypen, av en eller annen grunn, ikke fungerer som den skal.

Figure I.1: Interview Guide - page 1

User Engagement Scale

Besvares : 1 (helt uenig) - 7 (helt enig)		
Jeg var så engasjert i denne opplevelsen at jeg mistet følelsen av tid.	Svar:	
Da jeg brukte denne applikasjonen, mistet jeg følelsen av verden rundt meg.	Svar:	
Jeg var oppslukt i denne opplevelsen.	Svar:	
Jeg følte frustrasjon mens jeg brukte denne applikasjonen.	Svar:	
Jeg fant denne applikasjonen forvirrende å bruke.	Svar:	
Jeg mistet motivasjonen mens jeg brukte denne applikasjonen	Svar:	
Å bruke denne applikasjonen var belastende.	Svar:	
Denne opplevelsen var krevende.	Svar:	
Jeg følte meg i kontroll mens jeg brukte denne applikasjonen.	Svar:	
Jeg kunne ikke gjøre enkelte ting jeg trengte å gjøre mens jeg brukte applikasjonen.	Svar:	
Denne applikasjonen var estetisk tiltalende.	Svar:	
Jeg likte grafikken og bildene i denne applikasjonen.	Svar:	
Å bruke denne applikasjonen var verdifull.	Svar:	
Jeg betrakter opplevelsen min som vellykket.	Svar:	
Denne opplevelsen gikk ikke som planlagt.	Svar:	
Min opplevelse var givende.	Svar:	
Jeg ville anbefalt denne applikasjonen til kollegaer og venner.	Svar:	
Innholdet i denne applikasjonen vekket nysgjerrigheten min.	Svar:	
Jeg ble virkelig trukket inn i denne opplevelsen.	Svar:	
Jeg følte meg involvert i denne opplevelsen.	Svar:	
Denne opplevelsen var morsom.	Svar:	
Trafikken avbrøt fremgangen min.	Svar:	
Regnet avbrøt fremgangen min.	Svar:	
Vinden avbrøt fremgangen min.	Svar:	
Lyssetting gjorde det vanskelig å komme videre	Svar:	
Jeg følte meg veiledet.	Svar:	
Applikasjonen gir meg følelsen av å ha en veileder eller mentor.	Svar:	
Applikasjonen gir meg tilbakemelding slik at jeg kan bli bedre.	Svar:	
Jeg følte ubehag og ble kvalm.	Svar:	

Etter gjennomspillingen er fullført, blir deltakeren bedt om å fylle ut skjemaet for User Engagement Scale som er basert på deres opplevelse av gjennomspillingen. De får valget mellom å gjøre det selv eller å få spørsmålene lest opp av forskerne, for så å gi en Likert-skala vurdering for hvert spørsmål.

Etter-test Intervju

Til slutt gjennomføres et semi-strukturert intervju. Deltakeren blir stilt en rekke spørsmål som har som mål å avdekke fordeler og ulemper ved prototypen. Spørsmålene fokuserer på deltakernes nivå av innlevelse og engasjement og dekker hovedtemaene om realismen av grafikken og lyden, fordelene eller utfordringene med VR i trening og utdanning, og kvaliteten på informasjonen gitt under gjennomspillingen.

Figure I.2: Interview Guide - page 2

Spørsmål angående innhold:

- Hvordan vil du vurdere innlevelsen du opplevde under VR-treningsøkten? 1-7 (1=Lav 7=Høy)
- Kan du forklare hovedtrinnene eller prosedyrene du lærte under treningen?
- Var det noen deler av innholdet som du fant spesielt utfordrende å forstå?
- Jeg fikk tilstrekkelig informasjon og tilbakemelding under opplæringen 1-7(1=Uenig 7=Enig)
- Jeg fikk tilstrekkelig informasjon og tilbakemelding under hovedscenen? 1-7(1=Uenig 7=Enig)

Oppmuntre og opprettholde engasjement:

- Ga instruktøren klare forklaringer og veiledning som hjalp med å opprettholde ditt fokus?
- Hvordan vil du vurdere instruktørens evne til å holde kursinnholdet interessant og engasjerende? (1=Lav 7=Høy)

Scaffolding:

- Fant du instruktørens støtte og veiledning nyttig for å forstå materialet?
- Var det noen tilfeller hvor du følte at instruktøren burde ha gitt mer støtte?
- Kan du beskrive hvordan instruktøren hjalp deg med å komme videre gjennom materialet?
- Bidro instruktørens assistanse til din totale læringsopplevelse?

Experiential learning:

- Hadde du nok tid til å oppleve, reflektere og tenke før du tok handling under økten?
- Oppmuntret treningsøkten til aktiv deltakelse og engasjement i læringsprosessen?
- Kan du beskrive noen spesifikke øyeblikk hvor du lærte gjennom praktisk erfaring eller prøving og feiling?
- Påvirket mengden lyd fra instruktøren ditt engasjement i treningsøkten?
- Var det spesifikke punkter i økten hvor du følte at ditt engasjement svekket seg på grunn av overdreven lyd fra instruktøren?
- Hvordan påvirket timing og frekvens av lydinstruksjoner eller forklaringer ditt fokus og oppmerksomhet?
- Var det noen tilfeller hvor du følte at lydinstruksjoner var spesielt hjelpsomme eller distraherende?
- Kan du foreslå noen justeringer av lydelementene i treningen for å forbedre engasjement?

Figure I.3: Interview Guide - page 3

Etableringsbilde/Introduksjon (Scene To):

- Kan du beskrive hvordan etableringsbildet i ambulansens kjørescene påvirket din innlevelse i VR-opplevelsen?

Lydkilder og innlevelse:

- Hvordan påvirket de ulike lydkildene i VR-miljøet din totale innlevelse og fokus under treningen?
- Var det noen spesifikke lydelementer som utmerket seg for deg og enten positivt eller negativt påvirket din opplevelse?

Zone of Proximal Development

- Tillot treningen deg å utfordre ditt nåværende ferdighetsnivå?
- Hva syntes du om utfordringsnivået i treningsaktivitetene?
- Var det muligheter for å utfordre deg selv under økten for å lære nye konsepter eller ferdigheter?

Fordeler med VR for utdanningsinnhold:

- Sammenlignet med tradisjonelle læringsmetoder som PC-spill, videoer eller tekstbaserte materialer, hvordan oppfattet du VR som læringsressurs?
- Kan du beskrive noen spesifikke øyeblikk hvor VR-opplevelsen ga innsikt eller læringsmuligheter som ville vært vanskelige å oppnå gjennom andre medier?

MDA Framework:

- Hvordan påvirket VR-prototypens bruk av kontroller ditt engasjement med treningsscenariet?
- Når det gjelder estetikk, hvordan påvirket realismen til 3D-modellene, animasjonene og miljøet din totale innlevelse?

Likert Scale 1-7 (1 = uenig – 7 = enig)

- VR-miljøet simulerte nøyaktig opplevelsen av å være i en ambulanse på vei til en ulykkesscene.
- Lydelementene (f.eks. bilmotorer, pasientens pusting, vindlyd, tuting, sirene) forbedret min innlevelse i VR-scenarioet.
- Jeg følte meg fullstendig engasjert i VR-treningsopplevelsen gjennom alle tre scenene.
- VR-miljøet kommuniserte effektivt de viktigste punktene i ABCDE-prosedyren.
- Sammenlignet med tradisjonelle utdanningsmetoder, som videoer eller artikler, ga VR-treningen en mer engasjerende og minneverdig læringsopplevelse.
- Jeg er trygg på å utføre ABCDE-prosedyren etter å ha fullført VR-treningen.
- De interaktive elementene i VR-prototypen (f.eks. bruk av utstyr som samhandler med assistenten) holdt meg engasjert gjennom hele treningen.
- Variasjonen av scener og aktiviteter i VR-prototypen opprettholdt min interesse og motivasjon for å lære.
- Jeg vil bruke VR-simuleringer som dette for fremtidig trening og utdanning.
- VR-miljøets grafikk og visuelle kvalitet (realisme) var av høy kvalitet og bidro til min totale opplevelse.
- Kontrollene og interaksjonene i VR-prototypen var intuitive og enkle å bruke.

Figure I.4: Interview Guide - page 4

Appendix J

Transcribed interviews

J.1 Participant HC 1

J.1.1 Pre Test

Instruktør: Hvor gammel er du?
Svar: Jeg er 46 år gammel

Instruktør: Hvordan foretrekker du å lære nye prosedyrer?
Svar: eeh, det beste er kombinasjon mellom teorietisk og praktisk gjennomgang, det er pri en. Webinar, eller videoforelesning. Ja, vi har ikke kommet så langt at vi kan teste det ut med VR enda.

Instruktør: Hva syntes du om å lære nye ting gjennom ny teknologi?
Svar: Ja, det er ikke her jeg har min styrke da. Men jeg syntes det er spennende med utvikling og å ta i bruk ny teknologi. Og tenke litt annerledes, og så er det jo litt å tenke på hva en kan gjøre for å skape motivasjon da, ikke sant? Læreglede, og da må man faktisk tilføre noe nytt og gjøre noe som ikke har blitt gjort før.

Instruktør: Hvilke forventninger har du til en e-læringsressurs?
Svar: jeg forventer at det er, eeeh, at det gjør læringen mer interessant, enn det vanlige og tradisjonelle. Ja, litt mer interessant. eeeh, ja utfordre på en litt annerledes måte. Og ja, det å trene uten at det er satt i system, og at man kan trene når det passer. tilgjengelighet, når det passer meg å øve. Og at det da er brukervennlig også.

J.1.2 Post Test

Instruktør: Hvordan vil du rangere innlevelsen du opplevde under VR-treningsøkten? 1-7 (1=lav 7=høy)
Svar: 7

Instruktør: Kan du forklare hovedtrinnene eller prosedyrene du lærte under treningen?
Svar: Først en innføring i bruk av VR, var inne i en ambulanse og kom fram til et skadested med rapport, undersøkelse, primærundersøkelse.

Instruktør: Var det noen deler av innholdet du syntes var spesielt utfordrende å forstå?
Svar: Nei, men bruk av kontrollere var vanskelig. Det fungerte til slutt å bli kjent med kontrollere og teleportere, når man er inne ved pasienten så er det vanskelig å treffe riktige

ting. Enkelte vil ta dette fortere, de som er kjent med VR. Det er egentlig to ting man lærer her.

Instruktør: Fikk du tilstrekkelig informasjon og tilbakemelding under opplæringen? 1-7 (1=uenig 7=enig)
Svar: 6

Instruktør: Fikk du tilstrekkelig informasjon og tilbakemelding under hovedscenen? 1-7 (1=uenig 7=enig)
Svar: 5

Instruktør: Ga instruktøren klare forklaringer og veiledning som hjalp til med å opprettholde fokus?
Svar: Ja det tenker jeg, men jeg syntes det var litt rart at andre ting som puls og hudkvalitet ble undersøkt.

Instruktør: Hvordan vil du rangere instruktørens evne til å holde kursinnholdet interessant og engasjerende? (1=lav 7=høy)
Svar: 7

Instruktør: Fant du instruktørens støtte og veiledning nyttig for å forstå materialet?
Svar: Ja

Instruktør: Var det noen tilfeller hvor du følte at instruktøren burde ha gitt mer støtte?
Svar: Det hjelper veldig å se på instruktøre og få hjelp på den måte, eeeh ja det syntes jeg. Hmm, mitt problem ligger vel i å bruke systemet, det med kontrollerne og alt. Eh, ja det å kordinere sanser.

Instruktør: Kan du beskrive hvordan instruktøren hjalp deg med å komme deg gjennom materialet?
Svar: Jeg forstod instruktøren som en fasilitator som skulle veilede gjennom kurset.

Instruktør: Bidro instruktørens assistanse til din totale læringsopplevelse?
Svar: Ja, det følte jeg

Instruktør: Tillot treningen deg å utfordre ditt nåværende ferdighetsnivå?
Svar: Hmm, nei. Det vil jeg ikke si. Men jeg har jo kompetansen fra før. Det er relevant for min kompetanse, eeh. Men jeg vil si at jeg har utviklet meg i VR da. Det er jo todelt.

Instruktør: Hva synes du om nivået av utfordring i treningsaktivitetene?
Svar: Kurset gav ikke noen form for utfordring innen kompetansenivået. Men det er todelt, i forhold til VR så var det her utfordringen ligger. Bruk av VR. Høy kompetanse har gjerne høyere alder, da trenger man mer fokus på VR-biten. Men yngre med lavere kompetanse har gjerne mer kunnskap om VR, da er innhold det mer viktig å treffe.

Instruktør: Var det muligheter for å utfordre deg selv under økten for å lære nye konsepter eller ferdigheter?
Svar: Bruk av VR teknologi i læring som verktøy utfordrer, gjør at man ser nytteverdi.

Instruktør: Hadde du nok tid til å oppleve, reflektere og tenke før du tok handling under økten?
Svar: Ja, det er opp til meg selv. Det er ikke noe tidsbegrensing på kurset. Det er en viktig faktor. Ja men føler også på den muligheten at det er mindre press enn i et real life scenario.

Instruktør: Oppmuntret treningsøkten til aktiv deltakelse og engasjement i læringsprosessen?

Svar: Ja

Instruktør: Kan du beskrive noen spesifikke øyeblikk hvor du lærte gjennom praktisk erfaring eller prøving og feiling?
Svar: Ja det er tilbake det til det tekniske, det er her læringen ligger for min del. Det er et interaktivt program, som vi ikke har brukt tidligere. Vi har brukt videoer, så man må være trygg på VR, i bruken av VR.

Instruktør: Påvirket mengden lyd fra instruktøren ditt engasjement i treningsøkten?
Svar: Den var passelig. Hadde det vært mer, hadde det muligens tatt fokus vekk fra det jeg skulle gjøre.

Instruktør: Var det spesifikke punkter i økten hvor du følte at ditt engasjement svekket seg på grunn av overdreven lyd fra instruktøren?
Svar: Nei, det syntes jeg ikke.

Instruktør: Hvordan påvirket timingen og frekvensen av lydinstruksjoner eller forklaringer ditt fokus og oppmerksomhet?
Svar: eeh, nei. Nei, det gikk av seg selv, jeg hengte meg ikke opp i dette.

Instruktør: Var det noen tilfeller hvor du følte at lydinstruksjonene var spesielt hjelpsomme eller distraherende?
Svar: Hmm, Ja, det er når jeg har glemt noe eller ikke fått med meg noe. Å Repetere oppgave ved å se på instruktøren.

Instruktør: Kan du foreslå noen justeringer av lydelementene i treningen for å forbedre engasjementet?
Svar: Det vil jo variere fra kurs til kurs og hva en skal øve. Her føler jeg ikke at det er noen elementer jeg savner, akkurat i dette kurs konseptet og med min kompetanse.

Instruktør: Kan du beskrive hvordan etableringsbildet i ambulansens kjørescene bidro til din innlevelse i VR-opplevelsen?
Svar: Hmm, jeg føler det innleder på en god måte, det som skal skje. Jeg ble litt kvalm her.

Instruktør: Hvordan påvirket de ulike lydkildene i VR-miljøet din generelle innlevelse og fokus under treningen?
Svar: Det tok ikke fokus vekk, men det forsterket scenarioet. Det gjorde scenarioet mer realistisk. Tutingen gir meg samme reaksjon som ute, jeg blir irritert og det blir jeg også ute. Fikk en realistisk reaksjon.

Instruktør: Var det noen spesifikke lydelementer som skilte seg ut for deg og enten positivt eller negativt påvirket opplevelsen din?
Svar: Ja det må jo være Tutingen. Støy fra bilister.

Instruktør: Sammenlignet med tradisjonelle læringsmetoder som PC-spill, videoer eller tekstbaserte materialer, hvordan oppfattet du VR som læringsressurs?
Svar: Det gjør læringen mer interessant. Det gjør det gøyere og man blir motivert til å øve.

Instruktør: Kan du beskrive noen spesifikke øyeblikk hvor VR-opplevelsen ga innsikt eller læringsmuligheter som ville vært vanskelig å oppnå gjennom andre medier?
Svar: Ja, det passer bedre enn e-læringskurs da dette er et interaktivt program. Det er på høyde med simulering ved hjelp av levende markører. Men det er mer interessant fordi man tar i bruk annen teknologi.

Instruktør: Hvordan påvirket VR-prototypens bruk av kontroller ditt engasjement med treningsscenariet?
Svar: Jeg blir veldig opptatt av bruk av VR kontrollene, det tar oppmerksomheten min når jeg glemmer hvilke knapper jeg skal trykke på. Det tar min konsentrasjon. Jeg klarer ikke konsentrere meg om hvordan jeg skal løse problemene med bruk av teknologien og det jeg skal gjøre i kurset. Klarer ikke multitaske på dette nivået.

Instruktør: Når det gjelder estetikk, hvordan påvirket realismen til 3D-modellene, animasjonene og miljøet din totale innlevelse? (1=lav 7=høy)
Svar: 7

Likert Scale 1-7 (1=uenig 7=enig)
Instruktør: VR-miljøet simulerte nøyaktig opplevelsen av å være i en ambulanse på vei til et ulykkessted.
Svar: 7

Instruktør: De realistiske lydelementene (f.eks. bilmotorer, pasientpusting, vindlyd, tuting, sirene) forbedret min innlevelse i VR-scenariet.
Svar: 6

Instruktør: Jeg følte meg fullt engasjert i VR-treningsopplevelsen gjennom alle tre scenene.
Svar: 6

Instruktør: VR-miljøet kommuniserte effektivt hovedpunktene i ABCDE-prosedyren.
Svar: 6

Instruktør: Sammenlignet med tradisjonelle utdanningsmetoder, som videoer eller artikler, ga VR-treningen en mer engasjerende og minneverdig læringsopplevelse.
Svar: 7

Instruktør: Jeg er trygg på å utføre ABCDE-prosedyren etter å ha fullført VR-treningen.
Svar: 6

Instruktør: De interaktive elementene i VR-prototypen (f.eks. bruk av utstyr, interaksjon med assistenten) holdt meg engasjert gjennom hele treningen.
Svar: 7

Instruktør: Variasjonen av scener og aktiviteter i VR-prototypen opprettholdt min interesse og motivasjon til å lære.
Svar: 7

Instruktør: Jeg vil gjerne bruke VR-simuleringer som dette for fremtidig trening og utdanning.
Svar: 7

Instruktør: VR-miljøets grafikk og visuelle kvalitet (realisme) var av høy kvalitet og bidro til min totale opplevelse.
Svar: 6

Instruktør: Kontrollene og interaksjonene i VR-prototypen var intuitive og enkle å bruke.
Svar: 6

J.2 Participant HC 2

J.2.1 Pre Test

Instruktør: Hvor gammel er du?
Svar: Jeg er 48 år.

Instruktør: Hvordan foretrekker du å lære nye prosedyrer?
Svar: Noe er veldig viktig å gjøre praktisk, 60% praktisk 40% tradisjonell.

Instruktør: Hva synes du om å lære nye ting gjennom ny teknologi?
Svar: Gøy å prøve noe nytt.

Instruktør: Hvilke forventninger har du til en e-læringsressurs?
Svar: At det skal være innovativt, være interessant, settes i en ulykkessituasjon i trygge omgivelser, kan prøve og feile. Kan øve i en mer realistisk situasjon/omgivelser, kan tørre å gjøre feil, det er veldig viktig.

J.2.2 Post Test

Instruktør: Hvordan vil du rangere innlevelsen du opplevde under VR-treningsøkten? 1-7 (1=lav 7=høy)
Svar: 7

Instruktør: Kan du forklare hovedtrinnene eller prosedyrene du lærte under treningen?
Svar: Trinnvis vurdering, tenke på egen sikkerhet, plassering av bil, vindusmelding, ta med utstyr, og utføre primærundersøkelse ABCDE.

Instruktør: Var det noen deler av innholdet som du fant spesielt utfordrende å forstå?
Svar: Ikke noe i selve kurset, men det var vanskelig å huske hvilke knapper som gjorde hva med tanke på VR-kontrollere.

Instruktør: Jeg fikk tilstrekkelig informasjon og tilbakemelding under opplæringen 1-7 (1=Uenig 7=Enig)
Svar: 7

Instruktør: Jeg fikk tilstrekkelig informasjon og tilbakemelding under hovedscenen? 1-7 (1=uenig 7=enig)
Svar: 6

Instruktør: Ga instruktøren klare forklaringer og veiledning som hjalp til med å opprettholde fokus?
Svar: Ja.

Instruktør: Hvordan vil du vurdere instruktørens evne til å holde kursinnholdet interessant og engasjerende? 1-7 (1=Lav 7=Høy)
Svar: 7

Instruktør: Fant du instruktørens støtte og veiledning nyttig for å forstå materialet?
Svar: Ja.

Instruktør: Var det noen tilfeller hvor du følte at instruktøren burde ha gitt mer støtte?

Svar: Nei, siden jeg allerede har bred kompetanse og erfaring i ambulanseyrket og med ABCDE prosedyren, så visste jeg hvilke tiltak jeg måtte gjøre. Det var derimot en stor hjelp å kunne spørre assistenten om hva jeg skulle gjøre, helt spesifikt, i forhold til pasienten i denne VR-verdenen.

Instruktør: Kan du beskrive hvordan instruktøren hjalp deg med å komme videre gjennom materialet?
Svar: Han forklarte steg for steg hva jeg måtte gjøre for å fullføre kurset.

Instruktør: Bidro instruktørens assistanse til din totale læringsopplevelse?
Svar: Ja.

Instruktør: Tillot treningen deg å utfordre ditt nåværende ferdighetsnivå?
Svar: Ikke forbi mitt nåværende kunnskapsnivå, men det fungerte som en god repetisjon.

Instruktør: Hva synes du om nivået av utfordring i treningsaktivitetene?
Svar: Det var helt greit å få til, etter litt øving med VR aspektene i kurset.

Instruktør: Var det muligheter for å utfordre deg selv under økten for å lære nye konsepter eller ferdigheter?
Svar: Jeg vil si ja, det var mulighet for det, men det gjelder helst VR-delen av kurset.

Instruktør: Hadde du nok tid til å oppleve, reflektere og tenke før du tok handling under økten?
Svar: Ja, men det gikk litt fort mellom stegene. Instruktøren kunne gjerne ha ventet litt mellom stegene så jeg hadde fått tid til å se på pasienten og tallene på multimonitoren.

Instruktør: Oppmuntret treningsøkten til aktiv deltakelse og engasjement i læringsprosessen?
Svar: Ja, absolutt.

Instruktør: Kan du beskrive noen spesifikke øyeblikk hvor du lærte gjennom praktisk erfaring eller prøving og feiling?
Svar: Jeg brukte en del tid på å finne ut hvilken knapp som gjorde hva, i tillegg til å finne ut av noen av interaksjonene med pasienten.

Instruktør: Påvirket mengden lyd fra instruktøren ditt engasjement i treningsøkten?
Svar: Ja.

Instruktør: Var det spesifikke punkter i økten hvor du følte at ditt engasjement svekket seg på grunn av overdreven lyd fra instruktøren?
Svar: Nei.

Instruktør: Hvordan påvirket timingen og frekvensen av lydinstruksjoner eller forklaringer ditt fokus og oppmerksomhet?
Svar: Instruksjonene bidro til å følge en rød tråd gjennom kurset. Det ble ganske tydelig når man gjorde riktige valg, så fikk man tilbakemelding fra instruktøren.

Instruktør: Var det noen tilfeller hvor du følte at lydinstruksjonene var spesielt hjelpsomme eller distraherende?
Svar: Nei.

Instruktør: Kan du foreslå noen justeringer av lydelementene i treningen for å forbedre engasjementet?
Svar: Nei, ikke egentlig.

Instruktør: Kan du beskrive hvordan etableringsbildet i ambulansens kjørescene påvirket din innlevelse i VR-opplevelsen?
Svar: Jeg kommer litt i settingen, blir satt i modus og det gjør opplevelsen mer realistisk.

Instruktør: Hvordan påvirket de ulike lydkildene i VR-miljøet din generelle innlevelse og fokus under treningen?
Svar: Jeg synes det er viktig for helheten av opplevelsen. Jeg tenkte ikke så mye over det, men jeg hadde nok lagt mer merke til det hvis det hadde vært fjernet fra opplevelsen.

Instruktør: Var det noen spesifikke lydelementer som skilte seg ut for deg og enten positivt eller negativt påvirket opplevelsen din?
Svar: Ingenting negativt, sånn sett, og jeg likte helheten av det.

Instruktør: Sammenlignet med tradisjonelle læringsmetoder som PC-spill, videoer eller tekstbaserte materialer, hvordan oppfattet du VR som læringsressurs?
Svar: Det var mye mer engasjerende enn tradisjonelle metoder for læring siden man må fysisk bevege seg, noe som gjør at man er mer direkte involvert.

Instruktør: Kan du beskrive noen spesifikke øyeblikk hvor VR-opplevelsen ga innsikt eller læringsmuligheter som ville vært vanskelig å oppnå gjennom andre medier?
Svar: Det er et stort fokus på aktive tiltak, det at man må være fysisk involvert er på et større nivå enn andre medium.

Instruktør: Hvordan påvirket VR-prototypens bruk av kontroller ditt engasjement med treningsscenariet?
Svar: Det påvirket meg hovedsakelig positivt, men det var forvirring med hvilke knapper som gjør hva.

Instruktør: Når det gjelder estetikk, hvordan påvirket realismen til 3D-modellene, animasjonene og miljøet din totale innlevelse?
Svar: Jeg synes det var veldig bra, det gjorde opplevelsen mer virkelighetsnær.

Likert Scale 1-7 (1=uenig 7=enig)
Instruktør: VR-miljøet simulerte nøyaktig opplevelsen av å være i en ambulanse på vei til en ulykkesscene.
Svar: 7

Instruktør: Lydelementene (f.eks. bilmotorer, pasientens pusting, vindlyd, tuting, sirene) forbedret min innlevelse i VR-scenarioet.
Svar: 7

Instruktør: Jeg følte meg fullstendig engasjert i VR-treningsopplevelsen gjennom alle tre scenene.
Svar: 7

Instruktør: VR-miljøet kommuniserte effektivt de viktigste punktene i ABCDE-prosedyren.
Svar: 7

Instruktør: Sammenlignet med tradisjonelle utdanningsmetoder, som videoer eller artikler, ga VR-treningen en mer engasjerende og minneverdig læringsopplevelse.
Svar: 7

Instruktør: Jeg er trygg på å utføre ABCDE-prosedyren etter å ha fullført VR-treningen.
Svar: 7

Instruktør: De interaktive elementene i VR-prototypen (f.eks. bruk av utstyr som samhandler med assistenten) holdt meg engasjert gjennom hele treningen.
Svar: 7

Instruktør: Variasjonen av scener og aktiviteter i VR-prototypen opprettholdt min interesse og motivasjon for å lære.
Svar: 7

Instruktør: Jeg vil bruke VR-simuleringer som dette for fremtidig trening og utdanning.
Svar: 7

Instruktør: VR-miljøets grafikk og visuelle kvalitet (realisme) var av høy kvalitet og bidro til min totale opplevelse.
Svar: 7

Instruktør: Kontrollene og interaksjonene i VR-prototypen var intuitive og enkle å bruke.
Svar: 5

J.3 Participant HC 3

J.3.1 Pre Test

Instruktør: Hvor gammel er du?
Svar: Jeg er 18 år gammel.

Instruktør: Hvordan foretrekker du å lære nye prosedyrer?
Svar: Jeg foretrekker praktisk gjennomgang, gjerne med kollegaer, syntes det er veldig gøy.

Instruktør: Hva syntes du om å lære nye ting gjennom ny teknologi?
Svar: Jeg liker det veldig godt.

Instruktør: Hvilke forventninger har du til en e-læringsressurs?
Svar: Jeg vet ikke.

J.3.2 Post Test

Instruktør: Hvordan vil du vurdere innlevelsen du opplevde under VR-treningsøkten? 1-7 (1=Lav 7=Høy)
Svar: 6

Instruktør: Kan du forklare hovedtrinnene eller prosedyrene du lærte under treningen?
Svar: Det var en standard primærundersøkelse, det er prikk likt det vi gjør i virkeligheten. Det var vanskelig å se når man puster, pleier alltid å gå på puls på håndleddet. Dette gir en bedre indikasjon.

Instruktør: Var det noen deler av innholdet som du fant spesielt utfordrende å forstå?
Svar: Det var ganske tydelig forklart. Det var mest kontrollerne som var vanskelig, men siden jeg er yngre skjønner jeg det fort.

Instruktør: Jeg fikk tilstrekkelig informasjon og tilbakemelding under opplæringen 1-7(1=Uenig 7=Enig)
Svar: 5

Instruktør: Jeg fikk tilstrekkelig informasjon og tilbakemelding under hovedscenen? 1-7(1=uenig 7=enig)
Svar: 7

Instruktør: Ga instruktøren klare forklaringer og veiledning som hjalp med å opprettholde ditt fokus?
Svar: Ja, den var veldig tydelig, jeg forstod klart og tydelig hva han fyren som hjalp ønsket jeg skulle gjøre.

Instruktør: Hvordan vil du vurdere instruktørens evne til å holde kursinnholdet interessant og engasjerende? 1-7 (1=lite 7=mye)
Svar: 4

Instruktør: Fant du instruktørens støtte og veiledning nyttig for å forstå materialet?
Svar: Ja, absolutt.

Instruktør: Var det noen tilfeller hvor du følte at instruktøren burde ha gitt mer støtte?

Svar: Det var litt vanskelig i treningen at jeg ikke visste hvor jeg skulle plassere baller. Jeg legger ikke merke til teksten.

Instruktør: Kan du beskrive hvordan instruktøren hjalp deg med å komme videre gjennom materialet?
Svar: Han hjalp meg med å vise hvordan man skulle bevege seg. Han forklarer hva jeg skal undersøke, som er veldig bra.

Instruktør: Bidro instruktørens assistanse til din totale læringsopplevelse?
Svar: Ja, det syntes jeg.

Instruktør: Tillot treningen deg å utfordre ditt nåværende ferdighetsnivå?
Svar: Ja, dette er absolutt. Dette er muligheter med å simulere ting som man ikke alltid kan trene på i felt. Det utviklet mine kunnskaper i VR.

Instruktør: Hva synes du om nivået av utfordring i treningsaktivitetene?
Svar: Vanskelighetsgraden var oppnåelig. Begge deler av kursene.

Instruktør: Var det muligheter for å utfordre deg selv under økten for å lære nye konsepter eller ferdigheter?
Svar: Ja, hvis jeg ikke kunne det fra før hadde jeg lært det nå. Man involverer det praktiske, dette blir veldig praktisk. Det er prima for en person som meg som ikke er glad i å lese.

Instruktør: Hadde du nok tid til å oppleve, reflektere og tenke før du tok handling under økten?
Svar: Det var ikke noe tidsbegrensning, så det likte jeg.

Instruktør: Oppmuntret treningsøkten til aktiv deltakelse og engasjement i læringsprosessen?
Svar: Ja, det føles som jeg var en pasientbehandler.

Instruktør: Kan du beskrive noen spesifikke øyeblikk hvor du lærte gjennom praktisk erfaring eller prøving og feiling?
Svar: Generelt sett hele pasientkontakten likte jeg veldig godt.

Instruktør: Påvirket mengden lyd fra instruktøren ditt engasjement i treningsøkten?
Svar: Føler at på lav kunnskap fikk man veldig mye informasjon og fikk ting servert på sølvfat. Føler ikke at det tok vekk mitt engasjement, jeg er veldig ivrig i å prøve dette.

Instruktør: Var det spesifikke punkter i økten hvor du følte at ditt engasjement svekket seg på grunn av overdreven lyd fra instruktøren?
Svar: Nei, jeg kommer ikke på noe.

Instruktør: Hvordan påvirket timingen og frekvensen av lydinstruksjoner eller forklaringer ditt fokus og oppmerksomhet?
Svar: Ja, man blir jo forberedt på hva man skal undersøke og generelt hva man undersøker. Det holder mitt fokus på rett plass.

Instruktør: Var det noen tilfeller hvor du følte at lydinstruksjonene var spesielt hjelpsomme eller distraherende?
Svar: Jeg var aldri distrahert, så det hjalp meg veldig med å vite hva jeg skal gjøre.

Instruktør: Kan du foreslå noen justeringer av lydelementene i treningen for å forbedre engasjementet?

Svar: Nei, det er jo en mellomting, hvor man ikke får absolutt vite alt av ting man skal gjennomføre.

Instruktør: Kan du beskrive hvordan etableringsbildet i ambulansens kjørescene påvirket din innlevelse i VR-opplevelsen?
Svar: Jeg syntes blålyseffekten er alltid kul, det hjelper til på simuleringen. Jeg likte lydene, det gav inntrykk av miljøet. Man blir introdusert og jeg liker oppbyggingen, dette hadde vært dårlig om man var introdusert til pasient med en gang.

Instruktør: Hvordan påvirket de ulike lydkildene i VR-miljøet din generelle innlevelse og fokus under treningen?
Svar: Audio og tuting og den type ting var veldig bra, det hjalp meg og det hadde vært dårlig om det ikke var noe audio.

Instruktør: Var det noen spesifikke lydelementer som skilte seg ut for deg og enten positivt eller negativt påvirket opplevelsen din?
Svar: Nei, det var ikke noe negativt med lydene, man skulle gjerne droppet tuting, men det skjer i virkeligheten så det kan man ikke gjøre noe med.

Instruktør: Sammenlignet med tradisjonelle læringsmetoder som PC-spill, videoer eller tekstbaserte materialer, hvordan oppfattet du VR som læringsressurs?
Svar: Da jeg gikk ambulansefag før hadde man mye lesing og praktisk, jeg liker ikke lesing, jeg liker det praktiske, å teste gjennom en simulering. Det hjelper meg å lære at dette er en simulering.

Instruktør: Kan du beskrive noen spesifikke øyeblikk hvor VR-opplevelsen ga innsikt eller læringsmuligheter som ville vært vanskelig å oppnå gjennom andre medier?
Svar: Det blir jo for eksempel litt når man lærer om anatomi, lesing og bilder med punkter, den interaktive biten med å lære i et scenario gir meg mer utbytte.

Instruktør: Hvordan påvirket VR-prototypens bruk av kontroller ditt engasjement med treningsscenariet?
Svar: Jo, man bruker jo sin egen motorikk og det gir en følelse av at man er på scenen.

Instruktør: Når det gjelder estetikk, hvordan påvirket realismen til 3D-modellene, animasjonene og miljøet din totale innlevelse?
Svar: Ja, det var tydelig hva som skjedde. Man får frem tydelig skadeomfang og at man har truffet et tre.

Likert Scale 1-7 (1=uenig 7=enig)
Instruktør: VR-miljøet simulerte nøyaktig opplevelsen av å være i en ambulanse på vei til en ulykkesscene.
Svar: 7

Instruktør: Lydelementene (f.eks. bilmotorer, pasientens pusting, vindlyd, tuting, sirene) forbedret min innlevelse i VR-scenarioet.
Svar: 5

Instruktør: Jeg følte meg fullstendig engasjert i VR-treningsopplevelsen gjennom alle tre scenene.
Svar: 6

Instruktør: VR-miljøet kommuniserte effektivt de viktigste punktene i ABCDE-prosedyren.
Svar: 6

Instruktør: Sammenlignet med tradisjonelle utdanningsmetoder, som videoer eller artikler, ga VR-treningen en mer engasjerende og minneverdig læringsopplevelse.
Svar: 7

Instruktør: Jeg er trygg på å utføre ABCDE-prosedyren etter å ha fullført VR-treningen.
Svar: 7

Instruktør: De interaktive elementene i VR-prototypen (f.eks. bruk av utstyr som samhandler med assistenten) holdt meg engasjert gjennom hele treningen.
Svar: 7

Instruktør: Variasjonen av scener og aktiviteter i VR-prototypen opprettholdt min interesse og motivasjon for å lære.
Svar: 6

Instruktør: Jeg vil bruke VR-simuleringer som dette for fremtidig trening og utdanning.
Svar: 7

Instruktør: VR-miljøets grafikk og visuelle kvalitet (realisme) var av høy kvalitet og bidro til min totale opplevelse.
Svar: 5-6

Instruktør: Kontrollene og interaksjonene i VR-prototypen var intuitive og enkle å bruke.
Svar: 5

J.4 Participant HC 4

J.4.1 Pre Test

Instruktør: Hvor gammel er du?
Svar: 31

Instruktør: Hvordan foretrekker du å lære nye prosedyrer?
Svar: Selvstudie, helst digitalt.

Instruktør: Hva synes du om å lære nye ting gjennom ny teknologi?
Svar: Jeg synes det er veldig bra.

Instruktør: Hvilke forventninger har du til en e-læringsressurs?
Svar: Det er viktig at en e-læringsressurs har høy kvalitet og at innholdet er oppdatert.

J.4.2 Post Test

Instruktør: Hvordan vil du vurdere innlevelsen du opplevde under VR-treningsøkten? 1-7 (1=Lav 7=Høy)
Svar: 7

Instruktør: Kan du forklare hovedtrinnene eller prosedyrene du lærte under treningen?
Svar: Vindusmelding, Airways, Breathing, Circulation, D? Bevissthet og mobilitet? Environment.

Instruktør: Var det noen deler av innholdet som du fant spesielt utfordrende å forstå?
Svar: På grunn av realitetsgraden hadde jeg noen utfordringer med å sjekke frie luftveier. Dette fordi jeg prøvde å bruke begge hender som jeg ville gjort i virkeligheten. Skjønte fort at det var best å benytte en hånd i simulering.

Instruktør: Jeg fikk tilstrekkelig informasjon og tilbakemelding under opplæringen 1-7(1=Uenig 7=Enig)
Svar: 6

Instruktør: Jeg fikk tilstrekkelig informasjon og tilbakemelding under hovedscenen? 1-7(1=Uenig 7=Enig)
Svar: 7

Instruktør: Ga instruktøren klare forklaringer og veiledning som hjalp med å opprettholde ditt fokus?
Svar: Absolutt, veldig nyttig å kunne få tilleggsinformasjon hvis man stod fast.

Instruktør: Hvordan vil du vurdere instruktørens evne til å holde kursinnholdet interessant og engasjerende? (1=Lite 7=Mye)
Svar: 7

Instruktør: Fant du instruktørens støtte og veiledning nyttig for å forstå materialet?
Svar: Ja, siden jeg ikke har klinisk kompetanse var jeg helt avhengig av instruktøren for å fullføre læringsopplegget.

Instruktør: Var det noen tilfeller hvor du følte at instruktøren burde ha gitt mer støtte?
Svar: Nei, ved behov var det enkelt å få ytterligere informasjon fra instruktøren.

Instruktør: Kan du beskrive hvordan instruktøren hjalp deg med å komme videre gjennom materialet?
Svar: Ved flere anledninger var jeg usikker på riktig fremgangsmåte og benyttet muligheten for å få tilleggsinformasjon fra instruktør.

Instruktør: Bidro instruktørens assistanse til din totale læringsopplevelse?
Svar: Helt klart.

Instruktør: Tillot treningen deg å utfordre ditt nåværende ferdighetsnivå?
Svar: Absolutt, jeg tror at gjentatt repetisjon vil gi meg et høyere kompetansenivå.

Instruktør: Hva syntes du om utfordringsnivået i treningsaktivitetene?
Svar: Likte at jeg hadde mulighet til å prøve meg frem før jeg ba om fasit og at dette var litt over mitt nåværende kompetansenivå.

Instruktør: Var det muligheter for å utfordre deg selv under økten for å lære nye konsepter eller ferdigheter?
Svar: Ja, for meg var dette veldig lærerikt.

Instruktør: Hadde du nok tid til å oppleve, reflektere og tenke før du tok handling under økten?
Svar: Jeg gjorde meg ikke mange refleksjoner underveis, men i etterkant av selve sesjonen. Tenker det er bra at man går gjennom hele drillen før man eventuelt reflekterer.

Instruktør: Oppmuntret treningsøkten til aktiv deltakelse og engasjement i læringsprosessen?
Svar: Helt klart, man er avhengig av å være aktiv i læringsprosessen for å fullføre drillen.

Instruktør: Kan du beskrive noen spesifikke øyeblikk hvor du lærte gjennom praktisk erfaring eller prøving og feiling?
Svar: Det var positivt at man faktisk kunne lytte til åndedrett og muligheten til direkte kommunikasjon med pasient.

Instruktør: Påvirket mengden lyd fra instruktøren ditt engasjement i treningsøkten?
Svar: Det var mer virkelighetsnært at instruktøren forklarte med stemmen, kontra om det kun hadde vært tekstlig kommunikasjon.

Instruktør: Var det spesifikke punkter i økten hvor du følte at ditt engasjement svekket seg på grunn av overdreven lyd fra instruktøren?
Svar: Nei.

Instruktør: Hvordan påvirket timing og frekvens av lydinstruksjoner eller forklaringer ditt fokus og oppmerksomhet?
Svar: Timingen og frekvensen av instruksjoner var god. Likte også muligheten til å kunne be om tilleggsinformasjon.

Instruktør: Var det noen tilfeller hvor du følte at lydinstruksjoner var spesielt hjelpsomme eller distraherende?
Svar: Jeg benyttet meg flere ganger av muligheten til tilleggsinformasjon for å fullføre drillen. Ble ikke distrahert av instruksjonen.

Instruktør: Kan du foreslå noen justeringer av lydelementene i treningen for å forbedre engasjement?

Svar: Tutorial delen hadde det vært nyttig om instruktøren også leste opp instruksjonen om hvordan man får opp hovedmenyen.

Instruktør: Kan du beskrive hvordan etableringsbildet i ambulansens kjørescene påvirket din innlevelse i VR-opplevelsen?
Svar 2: Dette var en svært god scene som var med på å øke innlevelsesgraden.

Instruktør: Hvordan påvirket de ulike lydkildene i VR-miljøet din totale innlevelse og fokus under treningen?
Svar 2: Positivt at lydbilde er sammensatt og at man hører trafikk og vær.

Instruktør: Var det noen spesifikke lydelementer som utmerket seg for deg og enten positivt eller negativt påvirket din opplevelse?
Svar 2: Tutingen fra bilene tenker jeg er noe urealistisk. Regner med at de fleste trafikanter har respekt for et skadested.

Instruktør: Sammenlignet med tradisjonelle læringsmetoder som PC-spill, videoer eller tekstbaserte materialer, hvordan oppfattet du VR som læringsressurs?
Svar 2: Den store forskjellen for min del er at man trigger følelse på en helt annen måte i VR. Opplever dette som et bedre læringsverktøy fordi man er emosjonelt investert og det er en grad av gamification.

Instruktør: Kan du beskrive noen spesifikke øyeblikk hvor VR-opplevelsen ga innsikt eller læringsmuligheter som ville vært vanskelig å oppnå gjennom andre medier?
Svar 2: Selve ulykkesstedet vil nok være vanskelig å gjengi i en tradisjonell simulering. Det vil i hvert fall være svært ressurskrevende. Tenker dette er en av styrkene til VR som medium.

Instruktør: Hvordan påvirket VR-prototypens bruk av kontroller ditt engasjement med treningsscenariet?
Svar 2: Nyttig å få en rask innføring i kontrollene før start. Dette gjorde også at jeg var bedre forberedt på hvordan jeg kunne interagere i selve læringsmodulen.

Instruktør: Når det gjelder estetikk, hvordan påvirket realismen til 3D-modellene, animasjonene og miljøet din totale innlevelse?
Svar 2: Realismen var god og man føler virkelig at man er på et annet sted. Grafikken i VR er selvfølgelig ikke fotorealistisk, men tror ikke dette vil ha negativ påvirkning på læringsutbyttet.

Likert Scale 1-7 (1=uenig 7=enig)

Instruktør: VR-miljøet simulerte nøyaktig opplevelsen av å være i en ambulanse på vei til en ulykkesscene.
Svar 2: 6

Instruktør: Lydelementene (f.eks. bilmotorer, pasientens pusting, vindlyd, tuting, sirene) forbedret min innlevelse i VR-scenarioet.
Svar 2: 6

Instruktør: Jeg følte meg fullstendig engasjert i VR-treningsopplevelsen gjennom alle tre scenene.
Svar 2: 7

Instruktør: VR-miljøet kommuniserte effektivt de viktigste punktene i ABCDE-prosedyren.
Svar 2: 5

Instruktør: Sammenlignet med tradisjonelle utdanningsmetoder, som videoer eller artikler, ga VR-treningen en mer engasjerende og minneverdig læringsopplevelse.
Svar 2: 7

Instruktør: Jeg er trygg på å utføre ABCDE-prosedyren etter å ha fullført VR-treningen.
Svar 2: 4

Instruktør: De interaktive elementene i VR-prototypen (f.eks. bruk av utstyr som samhandler med assistenten) holdt meg engasjert gjennom hele treningen.
Svar 2: 7

Instruktør: Variasjonen av scener og aktiviteter i VR-prototypen opprettholdt min interesse og motivasjon for å lære.
Svar 2: 7

Instruktør: Jeg vil bruke VR-simuleringer som dette for fremtidig trening og utdanning.
Svar 2: 7

Instruktør: VR-miljøets grafikk og visuelle kvalitet (realisme) var av høy kvalitet og bidro til min totale opplevelse.
Svar 2: 6

Instruktør: Kontrollene og interaksjonene i VR-prototypen var intuitive og enkle å bruke.
Svar 2: 6

J.5 Participant LC 1

J.5.1 Pre Test

Instruktør: Hvor gammel er du?
Svar: 28 år

Instruktør: Hvordan foretrekker du å lære nye prosedyrer?
Svar: Jeg foretrekker å teste ut, med oppfølging.

Instruktør: Hva syntes du om å lære nye ting gjennom ny teknologi?
Svar: Det er gøy, spesielt VR.

Instruktør: Hvilke forventninger har du til en e-læringsressurs?
Svar: Om det er VR, tenker jeg at teknologien skal være så godt som sømløs selv om det ikke nødvendigvis er totalt realistisk. Greie metoder for å lære opp brukere i hvordan kontrollene fungerer, og enkel tilgang til oppfriskning til kontrollere.

J.5.2 Post Test

Instruktør: Hvordan vil du vurdere innlevelsen du opplevde under VR-treningsøkten? 1-7 (1=uenig 7=enig) 5
Svar: Jeg var ganske immersed faktisk, jeg gjorde jo ting uten å tenke meg om at jeg satt i et rom og brukte et VR headsett. Når jeg hadde hadde gjort et utslag med armen, så måtte jeg tenke at jeg var et annet sted. Så jeg synes det var ganske bra. Jeg vil si en høy 5 til 6, si en 5.

Instruktør: Kan du forklare hovedtrinnene eller prosedyrene du lærte under treningen?
Svar: Airways, breathing, circulation.. hva var det siste jeg gjorde? Var det den fingeren? Var det å stille spørsmål? Nei, det var å sjekke området. Environment var vel det.

Instruktør: Var det noen deler av innholdet som du fant spesielt utfordrende å forstå?
Svar: Jeg slet med å skjønne at jeg skulle høre på han, jeg var litt ivrig på å trykke på de spørsmålene til pasienten.

Instruktør: Jeg fikk tilstrekkelig informasjon og tilbakemelding under opplæringen 1-7(1=Uenig 7=Enig)
Svar: Vil si 4, men jeg synes det gikk litt fort gjennom den delen. Jeg kunne gjerne hatt litt mer grundig gjennomgang av kontrollerene.

Instruktør: Jeg fikk tilstrekkelig informasjon og tilbakemelding under hovedscenen? 1-7(1=Uenig 7=Enig)
Svar: Ligger på en 4 der, for jeg fikk ikke noe beskjed om jeg gjorde noe galt. Men, sånn hvordan teknologien fungerte, så fungerte det greit når jeg gjorde noe riktig, sånn som for eksempel med det pusteapparatet.

Instruktør: Ga instruktøren klare forklaringer og veiledning som hjalp med å opprettholde ditt fokus?
Svar: Ja, når jeg skjønte at jeg skulle høre på han.

Instruktør: Hvordan vil du vurdere instruktørens evne til å holde kursinnholdet interessant og engasjerende? 1-7 (1=lite 7=Mye)

Svar: Jeg ligger på en 5'er der.

Instruktør: Fant du instruktørens støtte og veiledning nyttig for å forstå materialet?
Svar: Ja, jeg hadde ikke klart det uten hjelp fra instruktøren.

Instruktør: Var det noen tilfeller hvor du følte at instruktøren burde ha gitt mer støtte?
Svar: Jeg ble litt distrahert av det tekst alternativet som kom opp, for eksempel. Hvis den popper opp, så må jeg trykke på den. Også stod det jo, hva var det som stod som oppgave, noe med luftrøret? Så da trodde jeg at jeg måtte få pasienten til å snakke.

Instruktør: Kan du beskrive hvordan instruktøren hjalp deg med å komme videre gjennom materialet?
Svar: Jeg synes han forklarte fint hva som skal gjøres nå, og hvilket utstyr som skal brukes.

Instruktør: Bidro instruktørens assistanse til din totale læringsopplevelse?
Svar: Ja.

Instruktør: Tillot treningen deg å utfordre ditt nåværende ferdighetsnivå?
Svar: Ja.

Instruktør: Hva syntes du om utfordringsnivået i treningsaktivitetene?
Svar: Jeg tror det er bra for folk som ikke er så kjent med VR som de fleste er. Jeg tror vanskelighetsgraden er ganske bra justert.

Instruktør: Var det muligheter for å utfordre deg selv under økten for å lære nye konsepter eller ferdigheter?
Svar: Ja.
Svar: Ja.

Instruktør: Hadde du nok tid til å oppleve, reflektere og tenke før du tok handling under økten?
Svar: Jeg tror jeg ville brukt enda litt lenger tid på opplæringen om hvordan ting fungerer. Etter min opplevelse nå da. Nå rushet jeg jo gjennom, men det føltes litt «rushed». At det er en veldig kjapp innføring i hvordan kontrollerene fungerer. Det kunne sikkert vært enda litt enklere å få en innføring i hvordan kontrollerene fungerer.

Instruktør: Oppmuntret treningsøkten til aktiv deltakelse og engasjement i læringsprosessen?
Svar: Ja, jeg synes det. Jeg følte meg engasjert og aktiv, ja. Jeg likte det, jeg synes det var gøy. Nå er jo jeg veldig pro VR, så jeg synes det var veldig gøy.

Instruktør: Kan du beskrive noen spesifikke øyeblikk hvor du lærte gjennom praktisk erfaring eller prøving og feiling?
Svar: Jeg tok fingeren på pannen på pasienten en del ganger, men jeg fikk ikke noe tilbakemelding på om det jeg gjorde var riktig eller ikke.

Instruktør: Påvirket mengden lyd fra instruktøren ditt engasjement i treningsøkten?
Svar: Jeg følte at nå har jeg bare lyst til å gjøre noe, jeg merket etter hvert at jeg hørte bare etter hvilket utstyr jeg skal bruke, også finner jeg det utstyret også ser jeg hvor det skal brukes. Så jeg tror ikke jeg hørte så veldig mye på han, sånn utfyllende.

Instruktør: Var det spesifikke punkter i økten hvor du følte at ditt engasjement svekket seg på grunn av overdreven lyd fra instruktøren?
Svar: Jeg hørte ikke på han i det hele tatt når jeg satt i bilen. Da satt jeg egentlig bare og testet VR. Da så jeg jo visuelt hva som var «casen», at noen hadde krasjet. Han instruktøren

hadde egentlig ikke trengt å stå der visuelt, han kunne heller blitt vist på en skjerm, i stedet for de spørsmålene, jeg tror det kunne vært like effektivt.

Instruktør: Hvordan påvirket timingen og frekvensen av lydinstruksjoner eller forklaringer ditt fokus og oppmerksomhet?
Svar: Det tok kanskje litt lang tid mellom hva jeg gjorde og feedback fra instruktøren. Dette gjorde at jeg muligens gjorde feil eller gjentok oppgaver. Jeg kunne trengt mer feedback underveis, spesielt hvis jeg gjorde noe feil.

Instruktør: Var det noen tilfeller hvor du følte at lydinstruksjonene var spesielt hjelpsomme eller distraherende?
Svar: Nei, ikke noe distraherende, de var jo hjelpsomme hele veien da man forstod at man skulle følge med.

Instruktør: Kan du foreslå noen justeringer av lydelementene i treningen for å forbedre engasjementet?
Svar: Det var vel ikke «spatial audio» nå? At det bare vare generell voiceover der spilleren er? For det føltes ikke ut som noe problem at jeg gikk rundt og gjorde min egen greie. Kanskje det kunne økt kvaliteten. Også tenkte jeg at man kunne hatt audio feedback på om man gjør noe riktig eller galt, det er jo et spill. Jeg vet ikke om det senker seriøsiteten om man gjør det. For jeg ventet litt på det, i forhold til det puste greiene, at han skulle si noe når jeg var ferdig.

Instruktør: Kan du beskrive hvordan etableringsbildet i ambulansens kjørescene påvirket din innlevelse i VR-opplevelsen?
Svar: Jeg likte det mer sånn historiefortellende og etablerende, det er et kjempebra start-punkt. Det er vel ofte der sånne «caser» starter også.

Instruktør: Hvordan påvirket de ulike lydkildene i VR-miljøet din totale innlevelse og fokus under treningen?
Svar: Jeg tenkte ikke over vind og regn, det var bare tutingen. Men jeg synes vind og regn passet så godt til scenen at jeg tenkte ikke over det en gang, ja, det er sånn det er.

Instruktør: Var det noen spesifikke lydelementer som utmerket seg for deg og enten positivt eller negativt påvirket din opplevelse?
Svar: Tutingen var kjempeirriterende.

Instruktør: Sammenlignet med tradisjonelle læringsmetoder som PC-spill, videoer eller tekstbaserte materialer, hvordan oppfattet du VR som læringsressurs?
Svar: Definitivt mye større motivasjon for å fullføre akkurat det jeg skal holde på med nå, når jeg er inne i en scene, i stedet for å se en video eller lese en tekst, synes jeg. Det er en lav terskel «learning-by-doing».

Instruktør: Kan du beskrive noen spesifikke øyeblikk hvor VR-opplevelsen ga innsikt eller læringsmuligheter som ville vært vanskelig å oppnå gjennom andre medier?
Svar: Jeg satt akkurat og tenkte på det. Det virker som at VR passer perfekt til akkurat det her, sånn du kommer til en case og du må gjøre ting fysisk. I andre fag, som ikke er så praktiske, så kan det være vanskelig å bruke VR. Men det passer veldig godt her, hvor det er noe fysisk som skjer, og det ikke er noe ekstremt krevende fysisk hvor du må trene motorikken enda mer, det er bare fysiske rutiner. Det er en bra match.

Instruktør: Hvordan påvirket VR-prototypens bruk av kontroller ditt engasjement med treningsscenariet?

Svar: Jeg synes det fungerte ganske bra egentlig. Altså, når jeg stod i de situasjonene så fungerte det ganske sømløst. Det var noen ganger jeg stod litt for nærme og ikke fikk tak i de instrumentene jeg ville, men jeg kunne bare gå litt tilbake og da funket det greit.

Instruktør: Når det gjelder estetikk, hvordan påvirket realismen til 3D-modellene, animasjonene og miljøet din totale innlevelse?
Svar: Det hadde vært rart hvis det var tegneserie grafikk, jeg tror realisme er veien å gå. Når bilene begynte å tute og jeg ble irritert over det, så tenkte jeg ikke over at dette har dere lagt in med vilje. Det fungerte ganske bra på meg, at jeg ble frustrert av det.

Likert Scale 1-7 (1=uenig 7=enig)
Instruktør: VR-miljøet simulerte nøyaktig opplevelsen av å være i en ambulanse på vei til en ulykkesscene.
Svar: 5

Instruktør: Lydelementene (f.eks. bilmotorer, pasientens pusting, vindlyd, tuting, sirene) forbedret min innlevelse i VR-scenarioet.
Svar: 6

Instruktør: Jeg følte meg fullstendig engasjert i VR-treningsopplevelsen gjennom alle tre scenene.
Svar: 5

Instruktør: VR-miljøet kommuniserte effektivt de viktigste punktene i ABCDE-prosedyren.
Svar: 5

Instruktør: Sammenlignet med tradisjonelle utdanningsmetoder, som videoer eller artikler, ga VR-treningen en mer engasjerende og minneverdig læringsopplevelse.
Svar: 7

Instruktør: Jeg er trygg på å utføre ABCDE-prosedyren etter å ha fullført VR-treningen.
Svar: 2

Instruktør: De interaktive elementene i VR-prototypen (f.eks. bruk av utstyr som samhandler med assistenten) holdt meg engasjert gjennom hele treningen.
Svar: 6

Instruktør: Variasjonen av scener og aktiviteter i VR-prototypen opprettholdt min interesse og motivasjon for å lære.
Svar: 5

Instruktør: Jeg vil bruke VR-simuleringer som dette for fremtidig trening og utdanning.
Svar: 7

Instruktør: VR-miljøets grafikk og visuelle kvalitet (realisme) var av høy kvalitet og bidro til min totale opplevelse.
Svar: 6

Instruktør: Kontrollene og interaksjonene i VR-prototypen var intuitive og enkle å bruke.
Svar: 6

J.6 Participant LC 2

J.6.1 Pre Test

Instruktør: Hvor gammel er du?
Svar: 24 år.

Instruktør: Hvordan foretrekker du å lære nye prosedyrer?
Svar: Gjennom praktiske eksempler.

Instruktør: Hva synes du om å lære nye ting gjennom ny teknologi?
Svar: Veldig bra.

Instruktør: Hvilke forventninger har du til en e-læringsressurs?
Svar: Hmm, at de primære funksjonene fungerer til sin hensikt og at læringsutbytte er skjeddersydd av folk med kompetanse.

J.6.2 Post Test

Instruktør: Hvordan vil du vurdere innlevelsen du opplevde under VR-treningsøkten? 1-7 (1=Lav 7=Høy)
Svar: Jeg vil si en 5 kanskje.

Instruktør: Kan du forklare hovedtrinnene eller prosedyrene du lærte under treningen?
Svar: Hvilken prosess vi gikk gjennom? Altså jeg husker airways, breathing, circulation.. discomfort? "E" var vel.. den aller siste var jo.. var ikke det om de kunne bevege.. nei, jeg husker ikke.

Instruktør: Var det noen deler av innholdet som du fant spesielt utfordrende å forstå?
Svar: Eh først, jeg vet ikke om det var noe jeg gjorde feil, men jeg fikk jo opp den tekst greia litt tidlig. Så jeg trykket jo på alle knappene fordi jeg trodde jeg hadde trykket på feil knapp, fordi jeg trodde jeg måtte si noe og da var jeg litt mer fokusert på hva jeg skulle si og da fulgte jeg ikke like godt med på hva han sa, tror jeg. Jeg trodde jeg måtte si noe, men så skulle jeg ikke det helt enda.

Instruktør: Jeg fikk tilstrekkelig informasjon og tilbakemelding under opplæringen 1-7(1=Uenig 7=Enig)
Svar: Ja, jeg vil si det var litt midt på treet, si 4 da.

Instruktør: Jeg fikk tilstrekkelig informasjon og tilbakemelding under hovedscenen? 1-7(1=Uenig 7=Enig)
Svar: Ja, egentlig. Ja, jeg ville også hatt, hvis jeg gjorde noe feil, hvis du gjør det så kan de miste blodtilførsel, altså at det på en måte kommer en konsekvens. For da hadde jeg husket at da gjør jeg ikke det. Ja, jeg vil si 4.

Instruktør: Ga instruktøren klare forklaringer og veiledning som hjalp med å opprettholde ditt fokus?
Svar: Ja, det vil jeg si.

Instruktør: Hvordan vil du vurdere instruktørens evne til å holde kursinnholdet interessant og engasjerende? (1=Lite 7=Mye)

Svar: Altså, jeg synes voiceoveren er litt nedtonet, det høres ikke akkurat ut som en voice-actor akkurat. Det høres ut som en som «nå er det viktig å gjøre det, og det og det», så voice actoren kunne hatt litt mer trykk på ord for å være sånn «dette er viktig å få med deg». For å holde blodsirkulasjonen, så «MÅ» man, for å prøve og holde litt den flyten, for det var ikke motiverende å høre på, men han sa jo alt som trengte å bli sagt. Jeg vil si en 4'er, tror jeg, for hvis man sammenligner med andre, så er det et lite stykke igjen å gå. Jeg synes informasjonen jeg fikk, var bra, men presentasjonen kunne vært enda bedre.

Instruktør: Fant du instruktørens støtte og veiledning nyttig for å forstå materialet?
Svar: Ja, jeg hadde jo ikke klart det uten han. «Helpful» var det jo.

Instruktør: Var det noen tilfeller hvor du følte at instruktøren burde ha gitt mer støtte?
Svar: Nei, ikke mer hjelp, men at det kanskje kunne kommet tydeligere fram altså når, han sier jo «nå er det din tur» på en måte, men det var en periode i begynnelsen at jeg skjønte at jeg måtte vente før han var ferdig med å snakke. Da var jeg litt sånn, leitet etter hva som er riktig å gjøre her på en måte, det er litt vanskelig å forklare.

Instruktør: Kan du beskrive hvordan instruktøren hjalp deg med å komme videre gjennom materialet?
Svar: Ja, med litt tålmodighet så fikk man jo en klar oversikt.

Instruktør: Bidro instruktørens assistanse til din totale læringsopplevelse?
Svar: Ja, fordi da har jeg mer "confidence" når jeg skulle gjennomføre en oppgave. Og når det faktisk var riktig, så følte jeg faktisk at, ok, nå klarte jeg det, mens hvis jeg bare hadde gjettet som jeg gjorde med den tekstboblen, da følte jeg at jeg klarte ingenting.

Instruktør: Tillot treningen deg å utfordre ditt nåværende ferdighetsnivå?
Svar: Ja, det vil jeg påstå.

Instruktør: Hva syntes du om utfordringsnivået i treningsaktivitetene?
Svar: Jeg synes det var et helt greit utfordrende nivå, altså jeg fikk jo en helt forferdelig score. Men, altså, det var ikke for mye distraksjoner heller, til hovedoppgaven. Det var liksom tre instrumenter man kunne bruke, eller hva det var. Men ja, jeg tenker at de som kan en del om dette, de kan jo på en måte verktøyene, så det å håndtere stresset er vel de sitt største læringsutbytte. For da kan det jo kanskje være flere folk rundt som tar bilder, men for meg så synes jeg det var veldig bra.

Instruktør: Var det muligheter for å utfordre deg selv under økten for å lære nye konsepter eller ferdigheter?
Svar: Ja.

Instruktør: Hadde du nok tid til å oppleve, reflektere og tenke før du tok handling under økten?
Svar: Det eneste jeg synes var litt forvirrende var når jeg skulle trykke i panna til pasienten. Fordi da var jeg litt sånn, det kom jo liksom ikke noe som sa om jeg hadde gjort det riktig. Fordi det kom jo en liten markør, eller noe sånn, så når jeg trykket inn så forsvant den, så tenkte jeg «har jeg gjort det?», men når jeg tok fingeren vekk igjen, så kom den tilbake, så det ut som. Så jeg skjønte liksom ikke helt om jeg hadde gjort det eller ikke, så jeg stod jo bare og trykket som en galning. Men, uten om det, så synes jeg det meste var ganske bra.

Instruktør: Oppmuntret treningsøkten til aktiv deltakelse og engasjement i læringsprosessen?
Svar: Ja, det gjorde jeg. Hvis jeg hadde vært en medisinstudent, som hadde lest mange bøker, så hadde jeg definitivt synes det var mye mer oppfriskende enn å sitte å lese, men jeg

ville kanskje hatt litt mer tidspress. For nå kunne jeg bare stå å trykke, mens hvis det hadde vært en timer eller hvis man hadde sett blodet til pasienten «draine», så hadde jeg vært litt mer skjerpet. Jeg hadde nok følt et større press hvis jeg hadde sett blodet «draine», noe sånn da.

Instruktør: Kan du beskrive noen spesifikke øyeblikk hvor du lærte gjennom praktisk erfaring eller prøving og feiling?
Svar: Jeg vil jo si at jeg lærte gjennom trial and error i starten av undersøkelsen da jeg spurte pasienten alle spørsmålene. Jeg var litt ivrig, men jeg forstod jo etter hvert at det jeg gjorde var feil.

Instruktør: Påvirket mengden lyd fra instruktøren ditt engasjement i treningsøkten?
Svar: Ja, altså først og fremst, jeg følte det var en bra mengde informasjon. Jeg hørte på nøkkelord, når han snakket om «circulation» og sånn, og når han sa «finger» så leitet jeg etter noe jeg kunne sette på fingeren. Men jeg var også veldig aktiv, leitet etter ting å gjøre «sånn nå skal jeg gjøre dette».

Instruktør: Var det spesifikke punkter i økten hvor du følte at ditt engasjement svekket seg på grunn av overdreven lyd fra instruktøren?
Svar: Hmm, det er et vanskelig spørsmål. Jeg følte kanskje ikke at han instruktøren var skikkelig i fokus, hvis man sitter i bilen og er «locket» på han og ikke kan bevege seg rundt, og ser på han og han har øyekontakt, så hadde man kanskje hatt mer fokus på hva han sa. Men nå følte jeg at det var mer som en bakgrunnslyd. Jeg tror jeg hadde fulgt mer med på han hvis han hadde holdt det instrumentet han snakket om, for eksempel, for da hadde jeg skjønt at «han holder det, så da må jeg se etter det instrumentet og bruke det». For det var ikke alle instrumentene jeg visste hva het, men når jeg holdt over de, så kom det jo opp tekst.

Instruktør: Hvordan påvirket timing og frekvens av lydinstruksjoner eller forklaringer ditt fokus og oppmerksomhet?
Svar: Jeg følte at noen ganger så var det litt mellomrom og pause mellom setninger og handlinger, altså hvis jeg gjorde noe så kunne det ta fem sekunder før jeg hørte «nå har du gjort det», så fortsatte jeg å gjøre ting. For eksempel når jeg hørte på pusten, så stod jeg å ventet på at han skulle si «bra jobbet», men hvis han hadde sagt «du har litt mer igjen» for eksempel eller at «du må prøve på nytt» så hadde jeg forstått det bedre.

Instruktør: Var det noen tilfeller hvor du følte at lydinstruksjoner var spesielt hjelpsomme eller distraherende?
Svar: Nei, jeg følte ikke at det var distraherende.

Instruktør: Kan du foreslå noen justeringer av lydelementene i treningen for å forbedre engasjement?
Svar: Hvis stemmen til instruktøren alltid er litt høyere, litt mer i fokus, så hadde jeg fulgt mer med på han. Jeg følte mer at det var en bakgrunnsstemme som jeg hørte mens jeg så meg rundt. For eksempel hvis man ser på han, så hører man litt bedre eller høyere stemme. Det hadde vært deilig at, hvis du gjorde en feil, så bare sa han hva du gjorde feil.

Instruktør: Kan du beskrive hvordan etableringsbildet i ambulansens kjørescene påvirket din innlevelse i VR-opplevelsen?
Svar: Jeg tenkte jo at nå er vi på vei, og når han parkerte så sa han «female ditt og datt har krasjet og sånn» så da var jeg klar for, ok, nå skal vi redde noen. Så jeg følte det ga mer seriøsitet.

Instruktør: Hvordan påvirket de ulike lydkildene i VR-miljøet din totale innlevelse og fokus under treningen?

Svar: Tutingen var det eneste som irriterte meg, men regn og vind ga en ekstra level of immersion. Det frustrerte meg ikke, det var bare tutingen som frustrerte meg. Jeg liker på en måte at det er litt frustrerende, for man skal jo prøve å holde seg rolig, for å jobbe med det man skal jobbe med.

Instruktør: Var det noen spesifikke lydelementer som utmerket seg for deg og enten positivt eller negativt påvirket din opplevelse?
Svar: Tutingen irriterte meg.

Instruktør: Sammenlignet med tradisjonelle læringsmetoder som PC-spill, videoer eller tekstbaserte materialer, hvordan oppfattet du VR som læringsressurs?
Svar: Det ble jo mer realitet og man følte at det var litt mer press. Hvis du ser en side med tekst, så er det vanskelig å vite hvordan man skal opptre i situasjonen. Men når han står der og forklarer stegene og blir satt inn en praktisk situasjon gir bedre overblikk om hva man skal gjøre i en slik situasjon. Sånn motorisk, så husker man bedre hva man skal gjøre.

Instruktør: Kan du beskrive noen spesifikke øyeblikk hvor VR-opplevelsen ga innsikt eller læringsmuligheter som ville vært vanskelige å oppnå gjennom andre medier?
Svar: Det er vanskelig å få til den samme innlevelsen i andre typer medier, som i denne simuleringen. Og jeg føler at vi lærte mye mer av å gjøre dette i VR, i forhold til andre læringsmedium.

Instruktør: Hvordan påvirket VR-prototypens bruk av kontroller ditt engasjement med treningsscenariet?
Svar: Jeg liker generelt ikke så godt snap turns, det er litt distraherende for meg. Det er vanskelig å leve seg inn i det hvis man plutselig snapper. Jeg likte generelt instruktørens bevegelser, selv om noen av animasjonene var litt rare.

Instruktør: Når det gjelder estetikk, hvordan påvirket realismen til 3D-modellene, animasjonene og miljøet din totale innlevelse?
Svar: Det synes jeg var noe av det bedre, som gjorde mer komplett, var at ambulansen og helsepersonell fyren så ekte ut. Pasienten og bilen så ganske realistisk ut og det hjalp veldig til at jeg følte at jeg faktisk var i situasjonen og at jeg kunne konsentrere meg på å faktisk hjelpe den pasienten.

Likert Scale 1-7 (1=uenig 7=enig)
Instruktør: VR-miljøet simulerte nøyaktig opplevelsen av å være i en ambulanse på vei til en ulykkesscene.
Svar: Det var bra, en 5.

Instruktør: Lydelementene (f.eks. bilmotorer, pasientens pusting, vindlyd, tuting, sirene)forbedret min innlevelse i VR-scenarioet.
Svar: Ja, definitivt. Vil gi det en 6.

Instruktør: Jeg følte meg fullstendig engasjert i VR-treningsopplevelsen gjennom alle tre scenene.
Svar: 5.

Instruktør: VR-miljøet kommuniserte effektivt de viktigste punktene i ABCDE-prosedyren.
Svar: 5.

Instruktør: Sammenlignet med tradisjonelle utdanningsmetoder, som videoer eller artikler, ga VR-treningen en mer engasjerende og minneverdig læringsopplevelse.
Svar: 7.

Instruktør: Jeg er trygg på å utføre ABCDE-prosedyren etter å ha fullført VR-treningen.
Svar: Mer enn jeg var før. 2.

Instruktør: De interaktive elementene i VR-prototypen (f.eks. bruk av utstyr som samhandler med assistenten) holdt meg engasjert gjennom hele treningen.
Svar: Jeg synes det, 6 faktisk.

Instruktør: Variasjonen av scener og aktiviteter i VR-prototypen opprettholdt min interesse og motivasjon for å lære.
Svar: Ja, la oss si 5.

Instruktør: Jeg vil bruke VR-simuleringer som dette for fremtidig trening og utdanning.
Svar: 7.

Instruktør: VR-miljøets grafikk og visuelle kvalitet (realisme) var av høy kvalitet og bidro til min totale opplevelse.
Svar: Ja, 6 eller 7.

Instruktør: Kontrollene og interaksjonene i VR-prototypen var intuitive og enkle å bruke.
Svar: Jeg skjønte ikke helt teleporteringen, men vil si 6.

J.7 Participant LC 3

J.7.1 Pre Test

Instruktør: Hvor gammel er du?
Svar: 27 år.

Instruktør: Hvordan foretrekker du å lære nye prosedyrer?
Svar: Hmm, ja VR.

Instruktør: Hva synes du om å lære nye ting gjennom ny teknologi?
Svar: Jeg syntes det er kjekt.

Instruktør: Hvilke forventninger har du til en e-læringsressurs?
Svar: Det er viktig at den er enkel å forstå og engasjerende.

J.7.2 Post Test

Instruktør: Hvordan vil du vurdere innlevelsen du opplevde under VR-treningsøkten? 1-7 (1=Lav 7=Høy)
Svar: Ja, jeg ble jo ganske oppslukt. Det var ganske gøy. Jeg vil si 6 kanskje.

Instruktør: Kan du forklare hovedtrinnene eller prosedyrene du lærte under treningen?
Svar: Ja, eh først så ble jeg kjent med hvordan man gjør ting, eh puttet baller og blokker og så kjørte vi en tur til ulykkessted, så måtte jeg hente en sånn livreddende boks, multimonitor. Så sjekket jeg om pasienten hadde noe i munnen, så sjekket jeg puls, tror jeg, ja. Og så sjekket jeg termometer og så trykket jeg puls, eh tommelen. Så spurte jeg spørsmål, om ho var bevisst.

Instruktør: Var det noen deler av innholdet som du fant spesielt utfordrende å forstå?
Svar: Det var de knappene da altså. De var forvirrende.

Instruktør: Jeg fikk tilstrekkelig informasjon og tilbakemelding under opplæringen 1-7(1=Uenig 7=Enig)
Svar: Ja, mhm. 7.

Instruktør: Jeg fikk tilstrekkelig informasjon og tilbakemelding under hovedscenen? 1-7(1=Uenig 7=Enig)
Svar: Ja, 7.

Instruktør: Ga instruktøren klare forklaringer og veiledning som hjalp med å opprettholde ditt fokus?
Svar: Ja, det var litt mye beskjeder, kanskje litt mye instrukser på en gang, men det var jo bra at man kunne gå tilbake å spørre om hjelp.

Instruktør: Hvordan vil du vurdere instruktørens evne til å holde kursinnholdet interessant og engasjerende? (1=Lav 7=Høy)
Svar: Jeg vil si 4 der, han snakket litt mye.

Instruktør: Fant du instruktørens støtte og veiledning nyttig for å forstå materialet?

Svar: Eh jaa, halvveis. Eh det er sikkert min feil, men det var litt lavt volum. Også, som sagt, det var litt mye. Jeg blir fort distrahert, så når han snakker mye, så venter jeg på at han skal komme til poenget.

Instruktør: Var det noen tilfeller hvor du følte at instruktøren burde ha gitt mer støtte?
Svar: Nei.

Instruktør: Kan du beskrive hvordan instruktøren hjalp deg med å komme videre gjennom materialet?
Svar: Ja, han kom med instruksjoner og beskjeder og, ja, det var greit å ha noen å komme tilbake til hvis jeg trengte hjelp. Jeg spurte han flere ganger og det var nyttig.

Instruktør: Bidro instruktørens assistanse til din totale læringsopplevelse?
Svar: Eh, ja.

Instruktør: Tillot treningen deg å utfordre ditt nåværende ferdighetsnivå?
Svar: Jada, den gjør jo det, eller, man blir oppfrisket. Jeg hadde litt erfaring med ABCDE prosedyren fra før av.

Instruktør: Hva syntes du om utfordringsnivået i treningsaktivitetene?
Svar: Det var ikke så utfordrende, men det var utfordrende med teknologiene, på en måte. Knappene, jeg spiller jo ikke noen ting, playstation osv. Jeg spiller SIMS en sjelden gang hehe.

Instruktør: Var det muligheter for å utfordre deg selv under økten for å lære nye konsepter eller ferdigheter?
Svar: Ja, hadde jeg gjort en gang til så hadde jeg fått det til mye bedre.

Instruktør: Hadde du nok tid til å oppleve, reflektere og tenke før du tok handling under økten?
Svar: Ja, det var jo ikke noe tidspress.

Instruktør: Oppmuntret treningsøkten til aktiv deltakelse og engasjement i læringsprosessen?
Svar: Ehm, ja det jeg synes var kult var at når jeg skulle ta på pannen så var det en fysisk bevegelse og ikke en knapp.

Instruktør: Kan du beskrive noen spesifikke øyeblikk hvor du lærte gjennom praktisk erfaring eller prøving og feiling?
Svar: Ja, men jeg måtte prøve meg litt frem når jeg skulle sjekke pusten. Jeg visste ikke at jeg måtte holde instrumentet lenge på hvert sted.

Instruktør: Påvirket mengden lyd fra instruktøren ditt engasjement i treningsøkten?
Svar: Det var for mye audio.

Instruktør: Var det spesifikke punkter i økten hvor du følte at ditt engasjement svekket seg på grunn av overdreven lyd fra instruktøren?
Svar: Ja, jeg hadde bare lyst til å begynne. Jeg skjønte allerede hva jeg skulle gjøre.

Instruktør: Hvordan påvirket timing og frekvens av lydinstruksjoner eller forklaringer ditt fokus og oppmerksomhet?
Svar: Det var for mye hehe.

Instruktør: Var det noen tilfeller hvor du følte at lydinstruksjoner var spesielt hjelpsomme eller distraherende?

Svar: Eeh, det var jo spesielt hjelpsomt når jeg ba om hjelp da. Utenom det, så var det ikke distraherende.

Instruktør: Kan du foreslå noen justeringer av lydelementene i treningen for å forbedre engasjement?
Svar: Kortere, kort og konsist. Eller, det kommer sikkert an på da, men ja, litt kortere da.

Instruktør: Kan du beskrive hvordan etableringsbildet i ambulansens kjørescene påvirket din innlevelse i VR-opplevelsen?
Svar: Det var morsomt, det ga en interessant introduksjon til hoveddelen av kurset.

Instruktør: Hvordan påvirket de ulike lydkildene i VR-miljøet din totale innlevelse og fokus under treningen?
Svar: Ehm, jeg synes det var kult med den forskjellige audioen, men det var en bil som tutet og det synes jeg var irriterende.

Instruktør: Var det noen spesifikke lydelementer som utmerket seg for deg og enten positivt eller negativt påvirket din opplevelse?
Svar: Kanskje ikke positivt da, men nøytralt, så synes jeg vind og regn er koselig når man er inne i varmen. Men tutingen var irriterende.

Instruktør: Sammenlignet med tradisjonelle læringsmetoder som PC-spill, videoer eller tekstbaserte materialer, hvordan oppfattet du VR som læringsressurs?
Svar: VR er jo kult da, og gøy. Så det blir jo på en måte mere engasjerende med VR. Jeg synes jo det er kult. Det er ikke så mange måter å bli distrahert på da, av andre ting, som mobilen for eksempel.

Instruktør: Kan du beskrive noen spesifikke øyeblikk hvor VR-opplevelsen ga innsikt eller læringsmuligheter som ville vært vanskelige å oppnå gjennom andre medier?
Svar: Ja, i eh, altså man kunne jo fått det til i dataspill, men det hadde ikke vært det samme. Her, i VR, bruker man jo hendene.

Instruktør: Hvordan påvirket VR-prototypens bruk av kontroller ditt engasjement med treningsscenariet?
Svar: Positivt, det gjorde at det ble mer ekte.

Instruktør: Når det gjelder estetikk, hvordan påvirket realismen til 3D-modellene, animasjonene og miljøet din totale innlevelse?
Svar: Ja, det gjør jo at det føles mindre farlig i VR. Det så jo ikke veldig ekte ut, men til en viss grad. Det så jo mer realistisk ut enn en tegnefilm. Bak i ambulansen var veldig bra.

Likert Scale 1-7 (1=uenig 7=enig)
Instruktør: VR-miljøet simulerte nøyaktig opplevelsen av å være i en ambulanse på vei til en ulykkesscene.
Svar: Så vidt jeg vet, så føltes det realistisk. 5 eller 6.

Instruktør: Lydelementene (f.eks. bilmotorer, pasientens pusting, vindlyd, tuting, sirene) forbedret min innlevelse i VR-scenarioet.
Svar: 5

Instruktør: Jeg følte meg fullstendig engasjert i VR-treningsopplevelsen gjennom alle tre scenene.
Svar: Ja, 7.

Instruktør: VR-miljøet kommuniserte effektivt de viktigste punktene i ABCDE-prosedyren.

Svar: 4.

Instruktør: Sammenlignet med tradisjonelle utdanningsmetoder, som videoer eller artikler, ga VR-treningen en mer engasjerende og minneverdig læringsopplevelse.
Svar: 6.. nei, egentlig 7. Jeg er veldig fan av sånn læring, veldig hands-on læring.

Instruktør: Jeg er trygg på å utføre ABCDE-prosedyren etter å ha fullført VR-treningen.
Svar: Nei, det tror jeg ikke jeg kan si. 3.. nei, 2. Men det er jo ikke på grunn av deres kurs, det er jo fordi jeg er usikker selv. Ikke ta det personlig hehe.

Instruktør: De interaktive elementene i VR-prototypen (f.eks. bruk av utstyr som samhandler med assistenten) holdt meg engasjert gjennom hele treningen.
Svar 2: 6.. nei, 7.

Instruktør: Variasjonen av scener og aktiviteter i VR-prototypen opprettholdt min interesse og motivasjon for å lære.
Svar: 7.

Instruktør: Jeg vil bruke VR-simuleringer som dette for fremtidig trening og utdanning.
Svar: 7, 7!

Instruktør: VR-miljøets grafikk og visuelle kvalitet (realisme) var av høy kvalitet og bidro til min totale opplevelse.
Svar: 4.

Instruktør: Kontrollene og interaksjonene i VR-prototypen var intuitive og enkle å bruke.
Svar: 4.

J.8 Participant LC 4

J.8.1 Pre Test

Instruktør: Hvor gammel er du?
Svar: 26

Instruktør: Hvordan foretrekker du å lære nye prosedyrer?
Svar: Jeg foretrekker å lære gjennom bilder og audio.

Instruktør: Hva synes du om å lære nye ting gjennom teknologi?
Svar: Det kommer litt an på hva det gjelder, men jeg er som regel interessert i det.

Instruktør: Hvilke forventninger har du til en e-læringsressurs.
Svar: Hmm,at den er ordentlig utviklet og at det er nok hjelp tilgjengelig for å finne ut av hvordan man bruker ressursen.

J.8.2 Post Test

Instruktør: Hvordan vil du vurdere innlevelsen du opplevde under VR-treningsøkten? 1-7 (1=Lav 7=Høy)
Svar: 6

Instruktør: Kan du forklare hovedtrinnene eller prosedyrene du lærte under treningen?
Svar: Jeg sjekket munnen og pusting til pasienten. Så var det noe blodtrykk greier, tror jeg, også sjekket jeg temperaturen.

Instruktør: Var det noen deler av innholdet som du fant spesielt utfordrende å forstå?
Svar: Bruken av knappene var litt forvirrende i starten, men jeg kom inn i det etterhvert. Jeg var ikke klar over hva de knappene oppe på kontrollerene gjorde før langt inne i kurset.

Instruktør: Jeg fikk tilstrekkelig informasjon og tilbakemelding under opplæringen 1-7(1=Uenig 7=Enig)
Svar: 7

Instruktør: Jeg fikk tilstrekkelig informasjon og tilbakemelding under hovedscenen? 1-7(1=uenig 7=enig)
Svar: 7

Instruktør: Ga instruktøren klare forklaringer og veiledning som hjalp med å opprettholde ditt fokus?
Svar: Det var ganske mye snakking, jeg følte at jeg var i en forelesning og ville egentlig bare prøve meg frem enn å vente på at snakkingen var ferdig.

Instruktør: Hvordan vil du vurdere instruktørens evne til å holde kursinnholdet interessant og engasjerende? 1-7 (1=Lite 7=Mye)
Svar: 3

Instruktør: Fant du instruktørens støtte og veiledning nyttig for å forstå materialet?
Svar: Ja, i den innledningsdelen trengte jeg ikke å høre på han så mye, siden oppgavene var allerede beskrevet med tekst. Men på ulykkesstedet var det veldig nyttig å kunne spørre om hjelp.

Instruktør: Var det noen tilfeller hvor du følte at instruktøren burde ha gitt mer støtte?
Svar: Nei, ikke egentlig.

Instruktør: Kan du beskrive hvordan instruktøren hjalp deg med å komme videre gjennom materialet?
Svar: Han forklarte jo hva de forskjellige punktene handlet om også kunne jeg spørre han direkte om hjelp hvis jeg var usikker på hva jeg skulle gjøre.

Instruktør: Bidro instruktørens assistanse til din totale læringsopplevelse?
Svar: Ja, jeg vil si det.

Instruktør: Tillot treningen deg å utfordre ditt nåværende ferdighetsnivå?
Svar: Definitivt, både innen VR og ambulanse prosedyrene. Jeg har jo ingen peiling på ABCDE prosedyren da, eller nå har jeg jo litt haha.

Instruktør: Hva synes du om nivået av utfordring i treningsaktivitetene?
Svar: Jeg synes egentlig at oppgavene var ganske lette, så lenge man visste hva man skulle gjøre.

Instruktør: Var det muligheter for å utfordre deg selv under økten for å lære nye konsepter eller ferdigheter?
Svar: Ja, som sagt så lærte jeg mye nytt, spesielt i forhold til prosedyrene.

Instruktør: Hadde du nok tid til å oppleve, reflektere og tenke før du tok handling under økten?
Svar: Ja, jeg vil si det, altså man hadde jo ikke noe tidspress, så man kunne teste ut det man ville.

Instruktør: Oppmuntret treningsøkten til aktiv deltakelse og engasjement i læringsprosessen?
Svar: Mhm, absolutt, man går jo rundt og bruker ting hele tiden.

Instruktør: Kan du beskrive noen spesifikke øyeblikk hvor du lærte gjennom praktisk erfaring eller prøving og feiling?
Svar: Når jeg skulle teste pasienten, så var det en del trial and error ja. Jeg var usikker på hvilket instrument jeg skulle bruke, så jeg prøvde meg frem.

Instruktør: Påvirket mengden lyd fra instruktøren ditt engasjement i treningsøkten?
Svar: Jeg synes det var litt mye snakking som jeg nevnte tidligere. Jeg tenker nok at noe av den informasjonen ikke hadde trengt og være med.

Instruktør: Var det spesifikke punkter i økten hvor du følte at ditt engasjement svekket seg på grunn av overdreven lyd fra instruktøren?
Svar: Egentlig det jeg nettopp sa, at hver gang han startet å snakke så tok det veldig lang tid før han var ferdig og der ble jeg ofte litt distrahert.

Instruktør: Hvordan påvirket timingen og frekvensen av lydinstruksjoner eller forklaringer ditt fokus og oppmerksomhet?
Svar: Samme svar der, jeg mistet fokus og oppmerksomhet når han snakket så lenge som han gjorde.

Instruktør: Var det noen tilfeller hvor du følte at lydinstruksjonene var spesielt hjelpsomme eller distraherende?
Svar: Det var kult at pasienten svarte når man spurte henne spørsmål. Utenom det, så var det egentlig bare tutingen som var ganske irriterende i lengden.

Instruktør: Kan du foreslå noen justeringer av lydelementene i treningen for å forbedre engasjementet?
Svar: Kutte ned på lengden snakking fra han ambulanse mannen og kanskje bare fjerne tuting fra bilene totalt.

Instruktør: Kan du beskrive hvordan etableringsbildet i ambulansens kjørescene bidro til din innlevelse i VR-opplevelsen?
Svar: Det var kanskje den kuleste delen av kurset. Jeg er glad at jeg satt nede, for jeg vet fra tidligere erfaring at jeg hadde blitt svimmel hvis jeg sto oppreist haha.

Instruktør: Hvordan påvirket de ulike lydkildene i VR-miljøet din generelle innlevelse og fokus under treningen?
Svar: Jeg synes, totalt sett, at det var et bra sammensatt lydbilde. Foruten tutingen, som tok oppmerksomheten over andre audio elementer til tider, så synes jeg volumet på lyden var bra balansert. Jeg likte godt vinden og regnet i bakgrunnen, det økte helheten.

Instruktør: Var det noen spesifikke lydelementer som skilte seg ut for deg og enten positivt eller negativt påvirket opplevelsen din?
Svar: Som sagt tidligere, så var det tutingen som var litt irriterende. Engasjementet i stemmen til instruktøren kunne muligens vært litt bedre. Ellers vil jeg si at det forrige svaret mitt dekker de positive sidene av lydbildet i kurset.

Instruktør: Sammenlignet med tradisjonelle læringsmetoder som PC-spill, videoer eller tekstbaserte materialer, hvordan oppfattet du VR som læringsressurs?
Svar: Man blir jo mye mer involvert i læringen når man føler at man er der, at man kan gå rundt i den verdenen og plukke opp utstyr og diverse andre ting. Den muligheten er veldig annerledes enn i tradisjonelle læringsmetoder.

Instruktør: Kan du beskrive noen spesifikke øyeblikk hvor VR-opplevelsen ga innsikt eller læringsmuligheter som ville vært vanskelig å oppnå gjennom andre medier?
Svar: Det at man er til stede og kan bruke hode til å se rundt seg, at man kan bruke armene og hendene til å bevege seg og plukke opp ting, det er jo det som gjør VR interessant for min del.

Instruktør: Hvordan påvirket VR-prototypens bruk av kontroller ditt engasjement med treningsscenariet?
Svar: Alt virket veldig responsivt, men det var jo som sagt litt problemer å vende seg til kontrollerene.

Instruktør: Når det gjelder estetikk, hvordan påvirket realismen til 3D-modellene, animasjonene og miljøet din totale innlevelse?
Svar: Jeg synes realismen var bra, jeg hadde ikke noen problemer med å skjønne hva ting representerte. Jeg likte spesielt godt at ambulansen og instruktøren brukte det samme designet på bil og klær som norske ambulanser bruker.

Likert Scale 1-7 (1=uenig 7=enig)
Instruktør: VR-miljøet simulerte nøyaktig opplevelsen av å være i en ambulanse på vei til en ulykkesscene.
Svar: 7

Instruktør: Lydelementene (f.eks. bilmotorer, pasientens pusting, vindlyd, tuting, sirene) forbedret min innlevelse i VR-scenarioet.
Svar: 7

Instruktør: Jeg følte meg fullstendig engasjert i VR-treningsopplevelsen gjennom alle tre scenene.
Svar: 6

Instruktør: VR-miljøet kommuniserte effektivt de viktigste punktene i ABCDE-prosedyren.
Svar: 5

Instruktør: Sammenlignet med tradisjonelle utdanningsmetoder, som videoer eller artikler, ga VR-treningen en mer engasjerende og minneverdig læringsopplevelse.
Svar: 7

Instruktør: Jeg er trygg på å utføre ABCDE-prosedyren etter å ha fullført VR-treningen.
Svar: 4

Instruktør: De interaktive elementene i VR-prototypen (f.eks. bruk av utstyr som samhandler med assistenten) holdt meg engasjert gjennom hele treningen.
Svar: 7

Instruktør: Variasjonen av scener og aktiviteter i VR-prototypen opprettholdt min interesse og motivasjon for å lære.
Svar: 7

Instruktør: Jeg vil bruke VR-simuleringer som dette for fremtidig trening og utdanning.
Svar: 7

Instruktør: VR-miljøets grafikk og visuelle kvalitet (realisme) var av høy kvalitet og bidro til min totale opplevelse.
Svar: 6

Instruktør: Kontrollene og interaksjonene i VR-prototypen var intuitive og enkle å bruke.
Svar: 4

J.9 Participant LC 5

J.9.1 Pre Test

Instruktør: Hvor gammel er du?
Svar: 29

Instruktør: Hvordan foretrekker du å lære nye prosedyrer?
Svar: Jeg foretrekker å ha en blanding mellom teori og praktisk gjennomgang.

Instruktør: Hva synes du om å lære nye ting gjennom teknologi?
Svar: Dette liker jeg veldig godt.

Instruktør: Hvilke forventninger har du til en e-læringsressurs.
Svar: Jeg forventer at de er tilgjengelig når som helst, er strukturert på en måte som ikke er er for vanskelig i starten.

J.9.2 Post Test

Instruktør: Hvordan vil du vurdere innlevelsen du opplevde under VR-treningsøkten? 1-7 (1=Lav 7=Høy)
Svar: 5

Instruktør: Kan du forklare hovedtrinnene eller prosedyrene du lærte under treningen?
Svar: hmm, ja det var vel Airways og Breathing og circulation, jeg er usikker på de siste, kanskje det var discomfort og exposure?

Instruktør: Var det noen deler av innholdet som du fant spesielt utfordrende å forstå?
Svar: Jeg synes kanskje exposure var litt vagt, kanskje litt rart at man skal ta temperatur på E. Tenkte kanskje dette skulle vært på C. Ellers var det ikke noe som var spesielt vanskelig å forstå.

Instruktør: Jeg fikk tilstrekkelig informasjon og tilbakemelding under opplæringen 1-7(1=Uenig 7=Enig)
Svar: 5

Instruktør: Jeg fikk tilstrekkelig informasjon og tilbakemelding under hovedscenen? 1-7(1=uenig 7=enig)
Svar: 6

Instruktør: Ga instruktøren klare forklaringer og veiledning som hjalp med å opprettholde ditt fokus?
Svar: Ja, han gav klare instruksjoner og hjalp meg på rett vei når jeg var usikker.

Instruktør: Hvordan vil du vurdere instruktørens evne til å holde kursinnholdet interessant og engasjerende? 1-7 (1=lite 7=mye)
Svar: 5

Instruktør: Fant du instruktørens støtte og veiledning nyttig for å forstå materialet?
Svar: Ja, definitivt. Jeg hadde ikke visst hvor jeg skulle begynne uten han.

Instruktør: Var det noen tilfeller hvor du følte at instruktøren burde ha gitt mer støtte?

Svar: Nei, jeg syntes ikke det.

Instruktør: Kan du beskrive hvordan instruktøren hjalp deg med å komme videre gjennom materialet?
Svar: Hmmm , ja instruktøren hjalp meg jo når jeg var usikker, han gav god informasjon om alle stegene og hva som var viktig.

Instruktør: Bidro instruktørens assistanse til din totale læringsopplevelse?
Svar: Ja, absolutt. Det hadde jo vært umulig for meg om han ikke var med haha..

Instruktør: Tillot treningen deg å utfordre ditt nåværende ferdighetsnivå?
Svar: Ja det vil jeg si, jeg har hatt en stor økning i kunnskap om prosedyren etter å ha gått gjennom kurset.

Instruktør: Hva syntes du om utfordringsnivået i treningsaktivitetene?
Svar: Det var oppnåelig alt sammen. Med hjelpen til instruktøren fikk jeg til slutt alt sammen til.

Instruktør: Var det muligheter for å utfordre deg selv under økten for å lære nye konsepter eller ferdigheter?
Svar: Ja, det var det. Jeg hadde veldig lite kunnskap om ABCDE-prosedyren, så her ble alt utfordret hehe. Jeg likte også at man får mulighet til å prøve ting på nytt om man gjør feil, hmm, jeg mener at kurset liksom ikke løper fra meg de gangene jeg gjorde feil.

Instruktør: Hadde du nok tid til å oppleve, reflektere og tenke før du tok handling under økten?
Svar: Ja, det tror jeg. Jeg tenkte ikke så mye på det underveis. Men jeg fikk jo tid til tenke over kontroller og hva jeg hadde gjort i stegene. Det var jo ingen tidspress så jeg fikk tid til det tror jeg, ja.

Instruktør: Oppmuntret treningsøkten til aktiv deltakelse og engasjement i læringsprosessen?
Svar: Ja, definitivt. Man føler jo at man er med pasienten og instruktøren der, jeg likte veldig godt å kunne stå der og bruke egne armer for å gjøre ting. Man blir jo alene med instruktøren, så man er jo veldig aktiv i læringen.

Instruktør: Kan du beskrive noen spesifikke øyeblikk hvor du lærte gjennom praktisk erfaring eller prøving og feiling?
Svar: Jeg hørte ikke alltid etter hva instruktøren sa, så jeg tok jo feil instrument flere ganger. Hmm, det kunne vært greit å hatt noe som viste fremgang når jeg skulle sjekke pustingen til pasienten.

Instruktør: Påvirket mengden lyd fra instruktøren ditt engasjement i treningsøkten?
Svar: Ja til en viss grad. Jeg er jo litt utålmodig og når jeg var i headsettet ville jeg bare starte og gjøre noe. Han snakket en god del.

Instruktør: Var det spesifikke punkter i økten hvor du følte at ditt engasjement svekket seg på grunn av overdreven lyd fra instruktøren?
Svar: Ja, når jeg var kommet litt ut i kurset kjente jeg at jeg ble litt mindre engasjert. Jeg ville liksom bare gjøre noe.

Instruktør: Hvordan påvirket timingen og frekvensen av instruksjoner eller forklaringer ditt fokus og oppmerksomhet?
Svar: Det føltes riktig, når audio kom og forklaringen passet jo alltid til hvor jeg var på en måte. Det virker som dere hadde tenkt på strukturen på en måte.

Instruktør: Var det noen tilfeller hvor du følte at lydinstruksjonene var spesielt hjelpsomme eller distraherende?
Svar: Audioen var jo veldig hjelpsom, jeg hadde ikke klart det uten audioen. Men samtidig var det litt mye på en måte.

Instruktør: Kan du foreslå noen justeringer av lydelementene i treningen for å forbedre engasjementet?
Svar: Hmm. Jeg tror nok kanskje man kunne forsøkt å kutte ned audio i flere biter, kanskje la spilleren gå gjennom mindre steg, men at det er like mye audio. Jeg tror det er ventingen som gjorde meg utålmodig på en måte.

Instruktør: Kan du beskrive hvordan etableringsbildet i ambulansens kjørescene påvirket din innlevelse i VR-opplevelsen?
Svar: Dette likte jeg, det var med på å sette stemningen og sette meg inn i "skoene " til ambulansepersonen om du forstår.

Instruktør: Hvordan påvirket de ulike lydkildene i VR-miljøet din generelle innlevelse og fokus under treningen?
Svar: Jeg likte det veldig godt, det passet atmosfæren, og det var mye stemning på en måte. var mye effekter som jeg egentlig ikke la merke til der og da, men det var veldig kult atmosfære.

Instruktør: Var det noen spesifikke lydelementer som skilte seg ut for deg og enten positivt eller negativt påvirket opplevelsen din?
Svar: Tutingen var noe som jeg reagerte mer på enn andre lyder, den var veldig høy og jeg kvapp litt i starten haha.

Instruktør: Sammenlignet med tradisjonelle læringsmetoder som PC-spill, videoer eller tekstbaserte materialer, hvordan oppfattet du VR som læringsressurs?
Svar: Jeg likte godt at det var fysisk gjennomgang og ikke lesing eller se på video og den type. det var kult å lære gjennom en fysisk gjennomgang.

Instruktør: Kan du beskrive noen spesifikke øyeblikk hvor VR-opplevelsen ga innsikt eller læringsmuligheter som ville vært vanskelig å oppnå gjennom andre medier?
Svar: Ja altså ting som er fysisk som prosedyrer som dette er jo alltid flott å kunne gjøre slik. Jeg tror nok at det at man gjør dette med sin egen kropp hjelper på og er bedre enn å lese og slikt.

Instruktør: Hvordan påvirket VR-prototypens bruk av kontroller ditt engasjement med treningsscenariet?
Svar: Dette var veldig kult og gøy, det var litt vanskelig i starten men det gikk bedre til slutt.

Instruktør: Når det gjelder estetikk, hvordan påvirket realismen til 3D-modellene, animasjonene og miljøet din totale innlevelse?
Svar: Jeg likte veldig godt atmosfæren og hvordan ting så ut. Jeg syntes kanskje at instruktøren hadde litt merkelig animasjon.

Likert Scale 1-7 (1=uenig 7=enig)
Instruktør: VR-miljøet simulerte nøyaktig opplevelsen av å være i en ambulanse på vei til en ulykkesscene.
Svar: 6

Instruktør: Lydelementene (f.eks. bilmotorer, pasientens pusting, vindlyd, tuting, sirene) forbedret min innlevelse i VR-scenarioet.

Svar: 6

Instruktør: Jeg følte meg fullstendig engasjert i VR-treningsopplevelsen gjennom alle tre scenene.
Svar: 6

Instruktør: VR-miljøet kommuniserte effektivt de viktigste punktene i ABCDE-prosedyren.
Svar: 5

Instruktør: Sammenlignet med tradisjonelle utdanningsmetoder, som videoer eller artikler, ga VR-treningen en mer engasjerende og minneverdig læringsopplevelse.
Svar: 7

Instruktør: Jeg er trygg på å utføre ABCDE-prosedyren etter å ha fullført VR-treningen.
Svar: 3

Instruktør: De interaktive elementene i VR-prototypen (f.eks. bruk av utstyr som samhandler med assistenten) holdt meg engasjert gjennom hele treningen.
Svar: 6

Instruktør: Variasjonen av scener og aktiviteter i VR-prototypen opprettholdt min interesse og motivasjon for å lære.
Svar: 6

Instruktør: Jeg vil bruke VR-simuleringer som dette for fremtidig trening og utdanning.
Svar: 7

Instruktør: VR-miljøets grafikk og visuelle kvalitet (realisme) var av høy kvalitet og bidro til min totale opplevelse.
Svar: 6

Instruktør: Kontrollene og interaksjonene i VR-prototypen var intuitive og enkle å bruke.
Svar: 4

Appendix K

Evaluation forms

PHTLS VURDERINGSSKJEMA
Pasientundersøkelse

ASTEDSVURDERING

☐ Egensikkerhet

☐ Smitterisiko

Kandidat:

Dato:

Case nr.

PRIMÆRUNDERSØKELSE

X

Vurderer skademekanikk mtp stor blødning
Utfører «bloodswipe» v/aktuell skademekanikk
Tiltak v/ funn:
Direkte trykk mot blødning m/blødningskontroll.
☐ Opprettholder direkte trykk minst 10 min.
Turnike' korrekt plassert 5-10 cm over blødning.
Pakking av sår med kontinuelig blødningskontroll.

A

Vurdering av luftveiene
Inspeksjon av munnhulen Fjerner snus, tyggis etc.
Ser etter avvikende forhold som hevelse, rødhet, sår, løse tenner..
Lytter etter lyder fra luftvei
Tiltak v/ funn:
Kjeveløft m/sug/rens av luftvei hvis påkrevet
Leiring (sideleie, flatt leie, elevert overkropp).
Vurderer initial manuell nakkestabilisering.

B

Vurdering av pustearbeid
Vurderer pustefrekvens **RASK/LANGSOM/NORMAL/DYBDE**
Tiltak v/ funn:
Auskultasjon mtp sidelikhet i lungelyder. Dyspne' ?
Ser etter bruk av hjelpemuskulatur og evt.cyanose
Inspiserer toraxbevegelse mtp sidelik ventilasjon
Palperer toraks mtp ømhet og subkutant emfysem
Vurderer O2 behandling / ventilasjonsstøtte v/behov

C

Vurdering av sirkulasjonen
Vurdering av blekhet, fuktighet hud, pulskvalitet
Vurdering av kapillærfylling
Tiltak v/ funn: Fysisk undersøkelse av:
☐ Mage ☐ Bekken (ikke palpasjon) ☐ Lårben
Iverksetter sirkulasjonstøttende tiltak hvis nødvendig

D

Vurdering av bevissthet ACVPU
Vurderer **A**wake - **C**onfusion - **V**erbal - **P**ain -**U**nconscious
Kontrollerer kort- og langtidshukommelse
Tiltak v/ funn:
☐ Grov perifer nevrologisk u.s.
Sensibilitetsforandring, endret kraft i ekstremiteter, sidelikt
☐ Blodsukkermåling ☐ Pupillekontroll

E

Vurdering av omgivelser
Vurderer skademekanikk
Vurdering av miljøet rundt pasienten
F.eks. lukt, temperatur, medisinemballasje ved pas.
Avdekning i forhold til øvrige funn smertefokus etc.
Vurderer hypotermiprofylakse

SYKEHISTORIE

S
☐ Avdekket primærsymptom ?

O
☐ Oppstart primærsymptom?
Brå eller gradvis symptomdebut?

P
Hva forbedrer / forverrer ?

Q
Beskrivelse av ubehaget / smertene

R
Er det utstråling ?
Er det andre smerter / ubehag ?

S
Opplevd smerte NRS / VAS

T
Oppsto smertene umiddelbart ?
Har smertene blitt sterkere / mindre ?

A
Kjente allergier ?
Tidligere reaksjoner på medisiner ?

M
Faste medisiner ?

P
Inntatt medisiner nå ?
Tidligere kjente sykdommer ?
Nylige innleggelser i sykehus ?

L
Siste inntak av mat / drikke ?

E
Hva gjorde pas. før debut ?
Gjort noe spesielt siste dager ?

R
Risikofaktorer i hht traumemanual
Alder over 60 år ?
Alder under 5 år ?
Alvorlig underliggende grunnsykdom ?
Gravid pasient > uke 20 ?
Økt blødningsfare / antikoagulert ?
Ruspåvirkning ?

FYSISK UNDERSØKELSE
☐ Topp til tå / traumeundersøkelse
☐ Fokusert undersøkelse basert på funn.

RF		SpO2		HF		BT	
EKG		TEMP		GCS		BS	

Kryss av for vitalia som hentes inn

VURDERER ALVORLIGHETSGRAD: ☐
IKKE KRITISK / POTENSIELT KRITISK / KRITISK

VURDERT TIL: BESTÅTT ☐

VURDERT TIL: NY PRØVE ☐

VURDERT TIL: IKKE BESTÅTT ☐

Figure K.1: Prehospital Trauma Life Support - Evaluation form

AMLS VURDERINGSSKJEMA
Pasientundersøkelse

ANKOMSTVURDERING

☐ Egensikkerhet
☐ Smitterisiko

Kandidat:

Dato:

Case nr.

PRIMÆRUNDERSØKELSE

A — Vurdering av luftvei
Inspeksjon av munnhulen
Lytter etter lyder fra luftvei
Tiltak v/ funn:
☐ Kjeveløft / sug/rens av luftvei hvis påkrevet
☐ Leiring (sideleie, flatt leie, elevert torso).

B — Vurdering av pustearbeid
Vurderer pustefrekvens **RASK/LANGSOM/NORMAL**
☐ **Tiltak v/ funn:** Auskultasjon, vurderer vent.dybde,
Vurderer dyspnoè, inspeksjon og palpasjon thorax.
Vurderer O2 behandling / ventilasjonsstøtte v/behov

C — Vurdering av sirkulasjonen
Vurdering av blekhet
Vurdering av fuktighet i hud
Vurdering av kapillærfylling
Vurdering av pulskvalitet
Tiltak v/ funn: Fysisk undersøkelse av:
☐ 4 kvadranter på magen HVIS AKTUELT:
Iverksetter sirkulasjonstøttende tiltak hvis nødvendig

D — Vurdering av bevissthet ACVPU
Evt. bruk av smertestimuli
Kontrollerer kort- og langtidshukommelse
Tiltak v/ funn:
☐ Blodsukkermåling
☐ Pupillekontroll

E — Vurdering av omgivelser
Vurdering av miljøet rundt pasienten
F.eks. lukt, temperatur,medisinemballasje, levekår...
Avdekning i forhold til øvrige funn smertefokus etc.
Hypotermiprofylakse

VURDERER ALVORLIGHETSGRAD:
(Sett ring rundt kandidatens vurdering)
IKKE KRITISK / POTENSIELT KRITISK / KRITISK

SEKUNDÆR UNDERSØKELSE

FYSISK UNDERSØKELSE
Fokusert u.s. basert på funn i primær us.
(F.eks. nevrologisk undersøkelse)
Vurderer behov for fullstendig undersøkelse
Kryss av for vitalia som hentes inn

RF		SpO2		HF		BT	
EKG		TEMP		GCS		BS	

S — Avdekket primærsymptom ?

O — Oppstart primærsymptom?
Brå eller gradvis symptomdebut?

P — Hva forbedrer / forverrer ?

Q — Beskrivelse av ubehaget

R — Er det utstråling ?
Er det andre smerter / ubehag

S — Opplevd smerte NRS / VAS

T — Varighet på smerte / ubehag
Endring siden sympt.debut ?

A — Kjente allergier
Tidligere reaksjoner på medisiner ?

M — Faste medisiner
Inntatt medisiner nå

P — Tidligere kjente sykdommer ?
Nylige innleggelser i sykehus ?
Siste menstruasjon (hvis aktuelt)

L — Siste inntak av mat / drikke

E — Hva gjorde pas. før debut ?
Gjort noe spesielt siste dager ?
Sist sett i normaltilstand ?

R — RISIKOFAKTORER
Røyker pasienten ?
Familiære forhold / arvelighet ?
Overvekt ?
Annet ?

Figure K.2: Advanced Medical Life Support - Evaluation form

Appendix L

Downloadable build and project folder

Link to filesender:
https://filesender.sikt.no/?s=download&token=27669cd1-c1da-4402-905e-c54e88fa3904