School of Information Systems

**THE LIVED EXPERIENCE OF VIRTUAL ENVIRONMENTS:
A PHENOMENOLOGICAL STUDY**

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Declaration

To the best of my knowledge and belief this thesis contains no material previously published by any other person except where due acknowledgment has been made.

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university.

Human Ethics (For projects involving human participants/tissue, etc.) The research presented and reported in this thesis was conducted in accordance with the National Health and Medical Research Council National Statement on Ethical Conduct in Human Research (2007) – updated March 2014. The proposed research study received human research ethics approval from the Curtin University Human Research Ethics Committee (EC00262), Approval Number #RDBS-15-15

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Abstract

The potential of entertainment 3D virtual environments (VEs) such as videogames and virtual worlds to engage and immerse users, represent real world environments, and match the learning expectations of contemporary tech-savvy learners have made them appear as a viable option for training purposes. VEs have been increasingly prototyped in hazardous environments safety training to train employees in hazard identification, emergency evacuation, quick-decision making and technical skills.

Many studies begin from researching VEs in non-entertainment contexts with predefined theories such as presence theory, or concentrating on a specific aspect such as the avatar, interaction or fun. Furthermore, although human-computer interaction literature has maintained that the context of use is important for user experience, research is often conducted with questionnaires and surveys in experimental or quasi-experimental settings instead of studying end-users performing real activities in their work setting. Consequently, there is not much in-depth research on the users' experience of VEs.

This qualitative study seeks to complement previous studies by performing an in-depth study of the users' lived experience of 3D VEs. The participants of the study consist of employees using VEs for hazardous environments training in the gas and chemical sectors in Western Australia. The aim of the study is to understand how the users experience VEs in a hazardous environments context. The study sets out to describe the general structure, or the essence, of the VE experience, as well as identify the invariant constituents of the experience. Giorgi's (2009; 1985) descriptive phenomenological method was chosen to structure the study as a rigorous approach to study experience. The data was collected with semi-structured interviews in order to gather rich qualitative data for the phenomenological analysis.

The key findings of the study indicate that the users are active participants in forming the VE experience. Four interrelated invariant constituents were identified that form the general structure of the experience. These are, *1) acting-through-the-controller*, *2) action-oriented awareness*, *3) constructing and maintaining VE logic*, and *4) VE is compared and fulfilled with the real*. The findings reveal what is present to the users' consciousness during the various phases of the VE experience. For

example, findings show how technology is a part of the experience, how the users actively judge the logic of the VE activities, and how the VE experience is similar to and different from real world experience. These aspects of the experience directly affect what the users perceive or do not perceive in the VE, and how the activities get performed. These findings also show why it is important to use real end-users to evaluate VEs. Involving actual end-users in a real situation rather than test users in a laboratory environment helps the evaluation move beyond usability testing to reveal how the VE is actually used and experienced, and how the designed VE logic might differ from the users' logic during the use and why.

The insight obtained from this research may provide significantly useful guidelines and fresh perspectives for VE training environment developers and encourage the involvement of end-users more directly in the development process. The findings of the study also suggest that the descriptive phenomenological method is useful for studying VEs from an open position instead of highlighting predefined VE aspects such as graphics or the role of the avatar. This may lead to a more holistic understanding of the VE experience. Such strand of research is still largely underexplored and therefore this study opens up many new research opportunities.

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List of Abbreviations

HCI	Human-computer interaction
HMD	Head-mounted display
MMORPG	Massively multiplayer online role-playing game
SG	Serious game
3D VE	Three-dimensional virtual environment that is a representation of a similar kind of a physical environment
VE	Virtual environment
VR	Virtual reality
VTE	Virtual training environment
VW	Virtual world

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Chapter 1: Introduction

As I leave Whiterun, my recently acquired home, I decide to walk to my destination across the meadows. There is a dungeon not too far away, which I plan to visit. The scenery looks beautiful and serene. A bird is singing somewhere, and I can see mountains in the distance. Also the sky looks amazing. I see a couple of giants further in the distance, herding their mammoths. I plan to go around them as I do not want to make them angry – I know I cannot fight them, as my character just is not strong enough yet. As I am strolling the meadows, I look around on the ground for plants, mushrooms and other possible items to pick up for future use. I am not good in Alchemy, or too much interested in developing that skill, but at least I might find something to sell to get more money. All of a sudden I hear a screech from a distance. When I turn to look around, I see my first-ever flying dragon in a stronghold nearby. Becoming slightly nervous, I bring up my Inventory to check if my spells, armor and weapons are up for the possible encounter…
(The researcher's description on playing *The Elder Scrolls V: Skyrim* (Bethesda Game Studios 2011))

1.1 Background

The increasing number of people interacting with various kinds of virtual environments (VEs) such as video games and virtual worlds for entertainment is indicating that these interactive media are engaging. Contemporary VEs can immerse users to interact with environments that have increasingly detailed graphics, narratives and activities. The users can experience what it might be like to drive a tank in some distant galaxy in a futuristic battle that has never taken place in real life as in the *Halo* series (Bungie; 343 Industries) or to explore the roads and meadows of *Skyrim* (Bethesda Game Studios 2011) for engaging encounters and adventures. They can immerse themselves to massively multiplayer online role-playing games (MMORPG) such as *World of Warcraft* (Blizzard Entertainment) or to virtual worlds such as *Second Life* (Linden Lab) to create avatars to represent their identity, and interact with other likeminded people.

The fact that users can spend hours on end with VE activities has also raised interests in using VEs in non-entertainment contexts, such as education and professional development (Gee 2008; Petit dit Dariel et al. 2013; Prensky 2003). Several aspects of VEs appear compelling for non-entertainment use: the sense of immersion and presence as if in another world or an environment, and users' connection with their avatars, interaction and narratives, to name a few. VEs have been claimed to be able to represent real-life processes and activities for engaging interaction (Annetta et al. 2014; Dalgarno and Lee 2010; Dede 2009; Gamor 2014; Mouaheb et al. 2012). It has also been suggested that VEs could better match the expectations of contemporary learners who are increasingly used to digital technology (Michael and Chen 2006). It has also been argued that VEs could make professional development more engaging and fun, and therefore more effective (Michael and Chen 2006; Reiners et al. 2013).

In professional development, VEs have been increasingly prototyped for hazardous environments safety training (Tichon and Burgess-Limerick 2011). VEs have appeared as a potential option to train people for example in hazard identification, emergency evacuation, quick-decision making and technical skills. Training people in the real environment can be dangerous and sometimes impossible, as it could affect production or pose a serious threat to health and safety. VEs have thus been seen as a way to cut costs, and to train people in a safe environment that closely resembles the real environment (Kizil 2003). Although institutions have begun to adopt VEs for training, the literature still primarily consists of studies that have examined VEs through prototype environments, survey studies and quick feedback: there are few qualitative studies that rigorously analyze how the users' VE experience during an actual use situation takes place.

It has been proposed that *context of use* is an important factor of human-computer interaction and user experience (Dourish 2001; Svanæs 2014). Based on this claim, it should not be assumed that aspects of VE experience from an entertainment context are directly transferrable to a professional development context, or that they would even be important in that context. Such assumptions could actually inhibit the development of VEs and direct them to possibly wrong directions. Therefore, we should begin by understanding the users' experience.

As a non-entertainment context where VEs have been employed as a method of professional development, hazardous environments training provides a promising field for research. In order to better understand the VE experience, it would be pertinent to complement existing VE studies with studying end-users performing real tasks in their actual work setting. VE research and development would benefit from a qualitative research approach that explicitly examines *experience*.

1.2 The researcher's personal reflection

The initial focus and methodology of this study originated from my professional history as a user experience and instructional designer, and from a long personal enjoyment of video games. First of all, every gamer seems to know intuitively what a good game is like. While reading some of the studies conducted on serious games and virtual environments in professional development, my initial reaction as a gamer has often been, "well, these do not really seem to use what is great with videogames at all!" I sometime feel that what I see as the great things about videogames are reduced to a very linear click-and-learn mold. Also from a professional perspective, I have sensed that many of the VEs in professional development context were designed without good understanding of either interaction design or instructional design, or both. At the same time I felt that I did not want to evaluate or judge VEs based on my own preferences: perhaps there was something useful and interesting in these things I often took as "boring games". I wanted to understand VEs as a phenomenon in a non-entertainment context, and not through my own presupposed views about them but through the actual end-users' experience. In user experience design this kind of aim for design has long been around, but at the same time the aim to understand is always directed by the need to understand the users' experience *for* design. An interaction designer is always thinking in terms how to design useful interaction possibilities for the user – the same way understanding users from an *instructional* designer's perspective is always underpinned by the aim to design opportunities for learning. From such roles, the aim to understand VEs is never truly open, and could actually leave some important aspects of VE experience to periphery or even unnoticed. Therefore, with this study I wanted to go beyond my existing preferences and theories and to understand, as discussed in phenomenology, "what appears the way it appears" to the users in VE experience. I wanted to do this without making value judgments of

how good or bad the VEs were, or trying to prove a pre-chosen theory or a concept such as 'presence'. When I was searching for the way to approach this, phenomenology, and especially Giorgi's (2009) descriptive phenomenological method, appeared to me as a way to go beyond or at least suspend my presuppositions of the research topic phenomenon for the duration of this study, and to try to see it anew.

1.3 Purpose

The aim of this study is to understand the phenomenon of three-dimensional virtual environments through the users' lived experience, which means the experience of VEs as part of the users' everyday life instead of experiencing VEs for example in a usability lab during an experiment. The main research question of this study is: *How do users experience virtual environments in a hazardous environments training context?* The sub-questions of the study are as follows:

1. What is the 'essence' or the general structure of the VE experience like?
2. What are the invariant constituents of the VE experience?

The research questions follow the aims of a phenomenological analysis where phenomena, in this case the phenomenon of VEs, are approached from an open position and the researcher's existing theoretical and personal inclinations are suspended for the duration of the analysis. The qualitative research approach, *descriptive phenomenological method* (Giorgi 2009) employed in this study aims to rigorously describe the users' lived experience as it unfolds, and to determine what is essential for this experience.

Various companies in the mineral and chemical sectors have begun to explore the potential of VEs for professional development and training. Hazardous environments training was chosen as the research field due to its potential to provide a rich context to explore the experience of VEs in a non-entertainment context. Also unlike for example aviation, this context is slightly less studied. As phenomenology has not been employed in this context as a research approach, this study has the potential to complement previous studies done in the sector with insights on how the users' experience of VEs emerges during a hazardous environments training situation. This could direct the research and development of VEs to new areas, and to make more explicit how to develop VEs that are useful in professional development. Such results

have the potential to make VE development and training more efficient and more cost-effective, and thus decrease injuries and even save lives of those who work in hazardous environments. Furthermore, as the descriptive phenomenological approach analyses experience on a more psychologically general level, the results have the potential to transcend the context of this study, and be useful in other contexts of VE use as well.

1.4 Thesis Outline

This study is organized into seven chapters. Because phenomenology as an approach might be unfamiliar to the reader, Chapter 2 will present the philosophical and theoretical foundations of phenomenology. This is not to be taken as an empty history class or a list of concepts, but its aim is to tune in the reader to the phenomenological perspective, as the terminology and many of the concepts it uses could be otherwise mistakenly interpreted. Reading the chapter is therefore advised, as it will make the analysis and discussion in the proceeding chapters more approachable. Chapter 3, Literature Review, will begin the phenomenological examination of VEs from the literature. Randolph (2009) proposed phenomenology as a rigorous way to structure a qualitative literature review. The way various aspects of VEs have appeared to the authors in the literature is therefore approached in this chapter phenomenologically. The chapter moves from general aspects of VEs to how VEs have appeared in learning and hazardous environments training. Chapter 4, Methodology, will discuss phenomenology in relation to qualitative research, and introduces the chosen approach to phenomenological analysis, Giorgi's (2009; 1985) *descriptive phenomenological method*. This phenomenological approach, originally developed in psychology, was chosen, as it appeared useful and rigorous for the purposes of a qualitative research. Phenomenological philosophy has conducted phenomenological analyses based on the consciousness of the philosopher, but the descriptive method extends it to be used with research participants. It has been proposed that there can be no one method to follow in phenomenology. The chapter will therefore discuss how the analysis took place with Giorgi's method, which gives a useful scaffold but does not require strict step-by-step following. Chapter 4 also gives the outline of the research design (Table 3). Chapter 5, Results, will present in detail the general structure of the users' experience and the invariant constituents of the

experience. Chapter 6, Discussion, will reflect the findings to the literature. Chapter 7, Conclusion, will summarize this study and suggests future research opportunities.

Chapter 2: Philosophical underpinnings of phenomenology

2.1 Introduction

This chapter will give an overview of the origins of phenomenology as a philosophy. Creswell (2013) described two types of phenomenology, *transcendental* and *hermeneutical*. The former has been suggested to focus more on rigorous description of what appears when the latter involves more an interpretive process (Creswell 2014). As the aim of this study is to better understand how users experience VEs, the empirical section of this study will follow Giorgi's (2009) descriptive phenomenological method. Thus, the following chapter focuses more on the underpinnings of transcendental phenomenology instead of hermeneutical or interpretive phenomenology (e.g. van Manen 2014). Due to the fact that phenomenology as a qualitative research approach is not that well known and has its underpinnings strongly in phenomenological philosophy, it has been common for researchers to first introduce phenomenological *philosophy* in order for the reader to better understand phenomenological *research* (e.g. Creswell 2013; Moustakas 1994; Webster-Wright 2010).

The chapter begins by describing the origins of phenomenology around hundred years ago. Instead of being merely a mandatory section of history, it will show the importance of phenomenology for our time and age, and the potential it has for studying user experience. This will be followed with a section that familiarizes the reader with phenomenological core concepts and aims to reduce terminological confusion; certain words such as *consciousness*, *experience*, *meaning*, *subjective* and *objective* have sedimented historical baggage, and because of this, their meaning can be misunderstood. The key figures who established phenomenology and contributed to its early developments, realized they had to invent and reinvent terms they used in order to better communicate what phenomenology was about. As such, phenomenology employs some familiar terms differently. Therefore, it is important to familiarize oneself with the key concepts to truly understand phenomenology.

2.2 The origins of phenomenology

The birth of phenomenology can be located in the beginning of the 20th century. Foundations of phenomenology are often credited for the life's work of one man, Edmund Husserl (1859-1938) (Sokolowski 2000). Husserl began his career in mathematics and logic, writing his dissertation and his first publication, *Philosophy of Arithmetic* in this area. Around this time, he was also exposed to philosophy by attending to lectures of Franz Brentano (1838-1917). Brentano's views of philosophy as rigorous science and the psychological concept of *intentionality* made an impact to Husserl, and he changed from mathematics to philosophy (Moran 2002). Later on, Husserl became more critical towards Brentano's work of human consciousness and his form of 'descriptive psychology'. The form of the relationship was mutual in a sense that Brentano did not always seem to understand or support Husserl's developments in phenomenology (Moran 2002).

Husserl's work in phenomenology consists of six books, but more importantly, innumerable writings, notes and drafts through which he constantly reinvented and reiterated his perspective to better describe the radical premises of phenomenology (Moran 2002). These manuscripts are to this day being edited and published through Husserl Archives.

What makes Husserl's work so distinctive and significant is that although he was naturally influenced by others who came before him, his definitive work made a paradigmatic leap that established a distinctively different tradition (Sokolowski 2000), one that is discussed, debated, critiqued, and build forward to this day by both his followers and critics. Some have even suggested phenomenological developments that have come after Husserl are merely misunderstandings or only "heresies" of his original ideas and concepts, which was also something Husserl experienced himself in the eve of his career and life (Moran 2002).

In addition to establishing the phenomenological movement, there is a pragmatic reason for Husserl's importance: he believed that both psychology and natural sciences had distanced themselves too far from the everyday life, and were becoming too abstract. Phenomenology was to become a new science (Husserl 2012), the science of origins, or "a rigorous science", something that would once again emphasize the everyday life and experience as the source of truth and understanding (Sokolowski 2000). As Himanka (2010) has put it, if there is no connection between the world we

experience and the world science describes, or as Merleau-Ponty (2010, x) argued, the world "which knowledge *speaks*, and in relation to which every scientific schematization is an abstract and derivative sign-language", there can be a danger that our structure of reality can become based on questionable underpinnings. For Husserl, experience was a much broader and complex concept than what empiricism allowed (Zahavi 2003, 37). As such, Husserl aimed to rebuild the bridge between our everyday experience and science (Himanka 2010, 96). Husserl's vision of phenomenology as the first science should be taken as an elaborate critique of natural sciences, but not as the aim to replace it. It should be taken as the opening for science to question its underpinnings and procedures instead of dogmatically following pre-existing methods. As such, phenomenology forces us, the ones for whom the world is manifested, to question our own deeply held beliefs about the world and what constitutes it.

Instead of putting the key authors of phenomenology on a historical timeline and discussing their work one by one, this chapter will continue by describing the key concepts of phenomenology. Specific authors are referred to when they have contributed to the discussed aspects of phenomenology that might be directly related to the research topic; for example, the aspect of embodiment by Maurice Merleau-Ponty (1908-1961) in his important work, *Phenomenology of Perception* (2010), or by a more contemporary author Don Ihde and his work in human-technology relationships and the role of the body in cyberspace (Ihde 2002). Still, the main focus is to describe phenomenological concepts in order to make explicit the basis of *doing* phenomenology: as Husserl (2012, 20) himself insisted, "transcendental phenomenology is not a theory…it is a science". As this is not a thesis about philosophy, the pragmatic function of understanding the research topic will always be in the focus.

Choosing specific authors to discuss in phenomenology can be difficult for the reason that phenomenology as a critical form of rigorous science is also critical towards its own origins: both practitioners and critics of phenomenology have tried to understand its key concepts since its foundation. For example, Martin Heidegger (1889-1976), a student and colleague of Husserl, was at the same time impressed by Husserl's work and took some aspects of it forward, but then became critical of some of Husserl's maxims. History of phenomenology and the development of its concepts can create a difficult maze to navigate. Sokolowski (2000) has argued that discussions

around phenomenology too often concentrate on nuances of the basic concepts and doubting the whole project. Likewise, Himanka (2010) has demanded that instead of repeating, explaining, and debating Husserl's claims and phenomenological principles, we should try to actually use them. That is why the emphasis of this work is to articulate key concepts of phenomenology in connection to the studied object: virtual environments. Specific care has been taken to maintain rigor in conceptual soundness to paint a coherent picture of phenomenology. Husserl himself, and also others who came after him, was critical against methods (Moran 2002). That is what makes phenomenology difficult to grasp and to be used in research: it was never intended as a rigid procedure, but could be considered more as a set of tools (Schmicking 2010) or recipes to be tried out (Himanka 2010).

Doing phenomenology requires the researcher to adapt a radically different attitude from the everyday life, one where he or she constantly questions his or her worldview and taken-for-granted concepts. As an approach, it aims to take the researcher to the heart of things (Schmicking 2010). Core concepts of phenomenology are described in the following section. Where suitable, these are illustrated and brought more closely in the human-computer interaction context by using various virtual environment experience descriptions as an example. In this way, adopting the phenomenological perspective begins already in this section.

2.3 What is phenomenology?

The underpinnings of phenomenology are in Continental philosophy, and the field of philosophy is where phenomenology is still most vibrantly discussed, commented, and debated today. Phenomenology is a radical approach to *do* philosophy and research. As Schmicking (2010) has explained, because phenomenology has never become a one clear method, *movement* instead of a *method* might be more accurate way to describe it (see also Spiegelberg 1975). It is increasingly used as a qualitative research approach in different fields (Creswell 2013), and its impact to qualitative research can be located especially through psychology (e.g. Colaizzi 1978; Giorgi 2012; Moustakas 1994; Polkinghorne 1989; Spiegelberg 1975).

A few core ideas define phenomenology that most phenomenologists might agree on. It is the way to get "To the Things" as Husserl visioned it (Spiegelberg 1975, 10). This can be done by studying the way things appear in experience and by

describing them as accurately as possible with as little conceptual and other personal presuppositions and prejudices (Spiegelberg 1975). Phenomenon comes from the Greek word *phāinomenon*, meaning, that which manifests itself (Heidegger 1978). As Heidegger has described it, it is the thing that leads us to the truth of things. Phenomenology is the science of phenomena. Instead by explanation and by default searching for causalities, it aims to get into the truth of matters by describing the manifestation of phenomena; how things manifest themselves to consciousness and the way they manifest themselves (Sokolowski 2000).

Various things that manifest themselves to us can be considered as phenomena. Therefore studies have ranged from physical objects to more intangible, for example, the perception of a cube (Ihde 2012), the experience of PowerPoint in teaching (Adams 2006), bypass surgery and insomnia (Moustakas 1994), or driving a car (van Lennep 1987; see also Merleau-Ponty 2010), to name a few.

A phenomenon can appear in different ways, and some phenomena can appear in more complex ways than others. A phenomenon does not have to be something one directly perceives. As Sokolowski (2000, 43) has illustrated, even if you have never been to China, you can still discuss and have opinions of various aspects of China, although actual China is absent in your direct perception. The same applies to fantasy objects such as video game characters or for example hallucinations: they do not exist as in actual, but they can still manifest themselves to us and we can experience them.

2.4 Key concepts of phenomenology

2.4.1 The basis of experience: intentionality, noema and noesis

The core principle of phenomenology, *intentionality*, asserts that our consciousness is always directed towards things: it is always consciousness *of* something. Instead of just empty thinking, we always think about something. For example, if I (the researcher) am thinking about a virtual environment, a specific one comes to my mind. In this case, my favorite video game series *Halo* (Bungie; 343 Industries). As it is called in phenomenology, I *intend* Halo as the virtual environment. The main thing here to understand is that I simply do not emptily think, a "virtual environment", but there is always something that corresponds to it and makes it an identifiable object to me.

To take this a step further, there are many ways I can experience Halo as the virtual environment. From the phenomenological perspective, objects can manifest themselves through different *modes of appearing* (Sokolowski 2000). First of all, I can directly *perceive* them. Halo presents itself to me through play, or while I watch others play it. Still, the way it presents itself in these cases is not the same mode of appearing. In the first case I am controlling what takes place in the game by using my fingers to control the game controller that controls my game character, Master Chief. In the case of watching the game being played, I have no direct access or agency to the game, and thus I do not feel or control with my body what takes place. Also what I am aware of in the game might differ based on my interactive status with it.

There are also other modes in which Halo can appear to me that are different from direct perception. For example, when I write and describe Halo for this thesis, I am *remembering* it. If I want to remember a specific object or an event in Halo, for example, how I performed with a Warthog vehicle (Figure 1) in one of the battle events in Halo 3 (Bungie 2007), I can *picture* this event.

Figure 1. Halo 3: Warthog Jumping the Dunes (commorancy 2007 CC BY 2.0)

I might also try to bring back to mind how the gameplay felt like with the controls. My experience of a phenomenon can also show itself through the mode of *anticipation* or *imagination* (Sokolowski 2000). When the new Halo, *Halo 5:*

Guardians (343 Industries) was to be released, I was reading about it and imagining what this new game might be like.

Phenomenology is not just a positive science: it does not only deal with the *presence* of things, but can also make findings through *absences* (Sokolowski 2000). I can access a specific object while it is present to me in direct perception, but I can also intend the object in its absence. Phenomenologically, I access the identity of the same phenomenon through a manifold of appearances (Sokolowski 2000), for example in the case "Halo the virtual environment".

This is where phenomenology differs from empiricism that explains that our experience of the world that is "out there" is formed by the senses (Sokolowski 2000). Instead, phenomenology describes experience through an intentional act, *noesis*, and its objective correlate, *noema*. Noesis refers to the act, the fact that we always perceive, remember, or judge something. Noema refers to the objective correlate, *what* is experienced (Ihde 2012), something such as the game controller, a virtual environment, or the character 'Master Chief'. Noema should not be taken only as a tangible or a real object, but for example things such as mathematical entities or hallucinations can be considered as noemas (Sokolowski 2000). As Ihde (2012, 92) has described:

> What is seen, the noema, is correlated to the act by which it is seen, the noesis. The noema occurs inside its field and only relation to its field situated in its noematic context. Beliefs, expectations and habits form the correlative noetic context.

This is also where phenomenology differs from sciences that assert to study with objective measures, but also from subjective sciences: phenomenology does not operate with subject-object dualism, but asks how is objectivity constituted to consciousness, or more precisely, "how does consciousness attain to objective knowledge?" (Moran 2002, 61).

Intentionality can be considered as one of the key findings of Husserl, and the question of objective knowledge fascinated him throughout his career (Moran 2002). Although one form of intentionality already existed in the work of Husserl's teacher Brentano in the field of psychology, Husserl took the concept beyond that and made it his own (Moran 2002). Intentionality is the bedrock of phenomenology as it describes how we come to know the objects in the world.

2.4.2 The natural attitude, giveness, and the life-world

The previous descriptions of how we intend the identity of an object shows that during the act of thinking, phenomenologically speaking, *intending* the object, we meet it as it appears without seeing how it appears and what constitutes it (Langdridge 2007). We experience the world immediately; the way the world appears to us is concealed as our focus is attached in the experienced reality (Pulkkinen 2010). As Sokolowski (2000, 50) has aptly put it, "we head directly toward the object; we go right through the object's appearances to the object itself".. For example, my experience of playing Halo is instantly there for me. When I play, I do not consciously construct the playing step by step. I do not actively think how I use the game controller to fire my character's sniper rifle in order to shoot a character of an alien race that is hiding behind an obstacle that looks like a cube. Instead, in the process of playing, I proceed to flank him and shoot him: and the avatar on the screen will do that if my skills to operate it are on the proper level. As Langdridge (2007, 17) has described this, "as a consequence, much is hidden from view".

Phenomenology describes this everyday immediate way of living and the unquestionable acceptance of experience as *the natural attitude* (German: *die natürliche Einstellung*). It is the way we are involved or engaged in the life-world (Moran and Cohen 2012). The world is immediately found and recognized: "the different modes of sensuous perception, corporeal physical things with some spatial distribution or other are *simply there for me, on hand*" (Husserl and Welton 1999, 60). Natural attitude is how we go about our lives in an unreflective state, where we take the world as it is, assuming it appears to us as it really is (Dahlberg 2006). To be in the natural attitude, is to be in the mode of acceptance (Moran and Cohen 2012): I posit things that I experience as real and existing the way they are (Giorgi 2009). Natural attitude is our truth about the world, how the world emerges to us based on our interests and intentions (Moran and Cohen, 2012; Sokolowski 2000).

An important concept of phenomenology that describes how the world appears differently to everyone in the natural attitude is called *giveness* (German: *Gegebenheit*). Moran and Cohen (2012, 139) have recognized three distinctive aspects of giveness: "what is given in intuition has to be accepted precisely in the manner in which it is given", "all experience is experience of something to someone, according to a particular manner of experiencing", and that "there are different modes and

degrees of giveness". A given object is perceived differently whether it is perceived in fantasy, in memory, or in direct bodily contact.

As Giorgi (2009, 90) has argued, "there is a difference between the perception of the objects or persons and the positing of them as real things or real others". Husserl did not deny that things and objects exist in the world or that exact sciences cannot understand them, but that the experience that creates our world is something different (Moran 2002): things exist in the world, but they differ from conscious acts and objects. Being in the world and anticipating the coming moments can posit the odd shadowy shape on the window to be a person when in fact it is a mannequin, or to see a friend at the street when it is only someone who resembles her (Giorgi 2009). Instead of treating these as mere mistakes of the senses and useless for understanding human nature, phenomenology sees also these cases as possibilities to understand how human experience of the world takes place. This is also why phenomenology refrains from truth claims if a phenomenon to be studied is an actual thing in the real world or not: the experience of synchronicity (Hanson and Klimo 1998) or encountering a divine presence during near-death experience (West 1998) are as equally "real" as driving a car (van Lennep 1987). In summary, phenomenology is not interested if an object in the natural attitude is "real" or not, but "it is considered only insofar as it is a "presence" to an act of consciousness" (Giorgi 2011). It is thus these various forms of giveness to which phenomenology needs to focus on (Moran and Cohen 2012) to study *what* is given and *how* it is given (Moustakas 1994).

Another closely related concept of natural attitude that appears in phenomenology is *the life-world* (also sometimes *the lifeworld)* (German: *Lebenswelt*). Life-world is the intuitive, pre-given world of experience, our default position in which "human beings are normally completely absorbed in the world" (Moran and Cohen 2012, 175). It is how the world is to us, as "always already there" (Moran and Cohen 2012, 174). It is the world "concretely lived" (Langdridge 2007, 23). In a broad sense, the life-world describes our surrounding context that affects how the world appears to us, how we are situated "in a living *tradition*" (Zahavi 2003, 108). It includes the commonly held beliefs or common sense, cultural and religious traditions and institutions, the society, and also science. It is the pre-reflective world underpinning our everyday experience (Pulkkinen 2010, 30). As Finlay (2012) has

discussed, life-world is not static. The meanings we give to things change based on the events in our lives (Dahlberg 2006).

The life-world is a later development in Husserl's thought that appeared on the eve of his career (Moran and Cohen 2012). Others, such as Alfred Schutz (1899-1959) and Martin Heidegger (1889–1976) developed the concept further. No single or easy definition for it exists (Zahavi 2003). Zahavi (2003) has explained that one of the core attempts for Husserl with it was to bring to light how the world of science and our immediate everyday life have ceased to correspond to each other. Scientific concepts are considered as exact, impersonal, and proceed to objectivity, while our everyday experience is formed by vagueness, approximated and situated knowledge, relativity and multiple perspectives (Zahavi 2003). In some regards scientific concepts have become detached from the everyday life, but proceed to affect our understanding of it (Zahavi 2003). Furthermore, science is explained to capture and explain the true, objective reality, but it has lost the view to its historical underpinnings: to whom this objective reality would be visible if not the subjective experiencer? To Husserl, the gap between science and our everyday life was becoming too wide, and science, although useful in many ways, was becoming too abstract and too self-conscious of capturing the only true reality (Zahavi 2003, 128). Scientific ideals and abstractions were too strongly imposing their nature on our lived experience where exact scientific ideals actually cannot be observed or do not exist.

Phenomenology is the study of conscious experience. It takes as its field of study the natural attitude where things are directly given to us through different modes of appearing, as existing and as real. For me to proceed to do phenomenology, I need to adopt a specific kind of *phenomenological attitude* that maintains this world as it is, but allows me to describe it without my presuppositions (Pulkkinen 2010).

2.4.3 Phenomenological attitude, epoché, and phenomenological reduction

Phenomenology looks at the process through which the world manifests itself to us and becomes reality (Pulkkinen 2010, 30). It studies and aims to describe the pre-reflective human experience as it is lived in the default position, or in the discussed natural attitude. The way it achieves this is through *the phenomenological attitude*, *the epoché,* and *the phenomenological reduction*.

A phenomenologist adopts a specific kind of thinking called a *phenomenological attitude*. Phenomenological attitude, also called as the *transcendental attitude*, means

suspending our everyday reality and reflecting "the intentionalities that occur within it" (Sokolowski 2000, 42). This creates the possibility for new discoveries, unrestricted by previous frames and biases. Zahavi (2003, 44) has described Husserl's idea of phenomenology as a science without presuppositions as follows:

> Our investigation should turn its attention toward the givenness or appearance of reality, that is, it should focus on the way in which reality is given to us in experience. We should, in other words, not let pre-conceived theories form our experience, but let our experience determine our theories.

The first important step or part of doing phenomenology is the *epoché*. Epoché is adopted from Greek skeptics and signifies not making judgments of state of affairs before the evidence is present and analyzed (Sokolowski 2000, 49). In the natural attitude, we continuously interpret new situations through our previous experiences and make knowledge claims (Giorgi 2009). This is normal for the everyday life, but will inhibit phenomenological analysis and can "diminish the present experience by interpreting it as being identical to the past ones, whereas it is more frequently similar rather than identical" (Giorgi 2009, 91).

Zahavi (2003, 45) has explained the purpose of the epoché as follows:

> We do not effect it in order to deny, doubt, neglect, abandon, or exclude reality from our research, but simply in order to suspend or neutralize a certain dogmatic attitude toward reality, that is, in order to be able to focus more narrowly and directly on the phenomenological given—the objects just as they appear.

When I perform the epoché, I do not try to somehow artificially rethink reality, claim that the world does not exist, or try to get rid of my everyday experience that takes place in the natural attitude (Pulkkinen 2010; Zahavi 2003). Instead, "we keep the attitude (in order to be able to investigate it), but we bracket its validity" (Zahavi 2003, 45). With the world being bracketed, the phenomenologist can investigate it in the form it manifests itself in experience (Pulkkinen 2010). As Sokolowski (2000, 49-50) explains:

> We now consider it precisely as it is intended by intentionality in the natural attitude. We consider it as correlated with whatever intentionality targets it. If it is a perceived object, we examine it as perceived; if it is a remembered

object, we now examine it as remembered; if it is a mathematical object, we consider it as correlated with a mathematical intention… Bracketing retains exactly the modality and the mode of manifestation that the object has for the subject in the natural attitude.

The epoché makes us to step back from our intentionalities as researchers of a specific discipline, as developers, as gamers and so on, and allows us to concentrate on doing a rigorous phenomenological analysis of the things that appear to us as self-evident. What is bracketed in this study are the ways in which VEs appear in the natural attitude. This leaves room for seeing how it appears both in the literature that is reviewed for this study, and also for the research participants, instead of imposing my own views of what is or should be the essence of VEs.

Description of the epoché or bracketing might sound abstract, but some authors have given more pragmatic descriptions on what it might look like in action. In his approach to phenomenology, Moustakas (1994) presented epoché process as the first step in his phenomenological analysis. What he suggested as a process could be considered similar to meditation or slowing down one's knowledge claims, where epoché is performed continuously to meet one's own prejudices and letting them melt away (Moustakas 1994; see also Depraz, Varela, and Vermersch 2003 for meditation and phenomenology). At the same time Moustakas (1994, 90) recognized that although it might be impossible to get rid of all preconceptions, performing the epoché can "significantly reduce the influence of preconceived thoughts, judgments, and biases". For him, the epoché, if given enough time, is a process of personal renewal that can affect how we see the world and the things in it.

In the literature, bracketing has often stayed on a descriptive level. It is often described as a list of things that should be reflected or set aside, such as attitudes, thoughts, hypotheses, biases, emotions, presuppositions, previous theories, and assumptions (Tufford and Newman 2010). At the same time, it has lacked general consensus. Various techniques and vague descriptions have undermined its use, and it has even been used incongruently with studies' philosophical underpinnings (LeVasseur 2003). Some, such as Tufford and Newman (2010), have not considered the absence of a univocal definition for bracketing as its downfall. Instead they suggest the flexibility might be a strength in conducting qualitative research as it sharpens the

researchers to "identify their preconceptions and how best to address these" (Tufford and Newman 2010, 84).

LeVasseur (2003, 415) noted that "[i]n existential and hermeneutic phenomenology, bracketing is considered, ultimately, an untenable project". Existential philosophers who came after Husserl, such as Heidegger and Merleau-Ponty, accused him of idealism. For example van Manen (1990) in hermeneutic phenomenology has reasoned that it is impossible to separate the consciousness from the lived world, and similarly researchers from the text. These always have a relationship, and similar to the world, the text (i.e. research data) is always somehow being interpreted. Such critique in mind, some have refocused bracketing as a more complex process of managing pre-understandings during different phases of the research process to achieve the phenomenological attitude (Finlay 2008). Furthermore, LeVasseur (2003, 413) refocused it as something that is not simply trying to get rid of previous experience of a phenomenon, but a temporal bracketing of the natural attitude:

> The project of bracketing attempts to get beyond the ordinary assumptions of understanding and stay persistently curious about new phenomena. I believe this provides opportunity for fresh experience and the possibility of new horizons of meaning.

As this study uses Giorgi's (2003) phenomenological method, bracketing follows his suggestions. For Giorgi (2003), bracketing, also called as epoché, is a rigorous attitudinal shift that continuously takes place in the analysis process. Most of all, it means maintaining a critical attention to the studied phenomenon for not letting it be defined by similarities of the past:

> Bracketing means that we should not let our past knowledge be *engaged* while we are determining the mode and content of the present experience. (Giorgi 2009, 92)

The way bracketing took place in this study will be discussed in the section that describes Giorgi's (2009) phenomenological approach that structured this study.

Instead of causal explanations, phenomenology aims to describe how the world and things in it appear to us, and to get to the essential structures of things. This is generally described as the *reduction*. Different authors treat the relationship of epoché

and reduction differently, which makes it sometimes confusing to understand them. Some authors have treated epoché to mean the process of the *phenomenological reduction* (Giorgi 2009; Spiegelberg 1975), and some have discussed them more clearly as separate. For example, Moustakas (1994) has described the epoché as the first step of suspending one's beliefs and preconceptions, which is later on followed by the reduction as the task of describing the phenomenon.

In his work, Husserl discussed several reductions, but two are commonly addressed in the literature: the *phenomenological reduction* and the *eidetic reduction*. The phenomenological reduction means to understand phenomena by describing what appears and how it appears in experience. The eidetic reduction goes further in searching for essential invariants that constitute a phenomenon, its essence, without which it could not be what it is. This takes place by distinguishing the essentials that constitute a phenomenon from what is only contingent and contextual in experience (Moustakas 1994; van Manen 2014). Eidetic reduction has sometimes been referred to as *eidetic intuition* (Sokolowski 2000) or *imaginative variation* (Giorgi 2009; Moustakas 1994). Sokolowski (2000) has described eidetic intuition as the "insight into an essence" (177) and imaginative variation as a process to "attempt to imagine changes in the object…[to] see what elements we could remove from the thing before it "shatters" or "explodes" as the kind of thing that it is" (178). The main idea of eidetic reduction is that the phenomenologist will use his or her intuition or imagination to vary aspects of the object or approaches it from different perspectives and angles to find its essential structure or essence (Giorgi 2012). One can also try to compare the phenomenon to another and see if it still stays intact:

> When an imagined, fictive, or empirical variation will destroy or change the phenomenon into something else, then this can be considered an invariant. For example, keeping a secret is not the same as lying because in lying there is deception, but secrecy does not necessarily involve deception. Keeping a secret is not the same as practicing privacy because privacy is essentially a nonrelational experience, while secrets always involve others from whom we keep secrets or with whom we share them. (van Manen 2014, 228–29)

Although these reductions are often discussed as separate entities or tools, some authors in the field of psychology have combined them as part of their particular phenomenological research method (Giorgi 2009; Moustakas 1994). Authors in

philosophy agree that both of these reductions can be considered as useful tools for a phenomenologist to understand phenomena (Schmicking 2010; Sokolowski 2000).

2.5 Phenomenology in the study of technology and HCI

Phenomenology has been applied to the study of technology from its early days. Heidegger's famous analysis of how a hammer as a tool in a use situation is invisible to the user (*ready-to-hand* – German: *Zuhanden*) but in a breakdown situation becomes present in itself as an object (*present-at-hand* – German: *Vorhanden*) has influenced the study and development of HCI and information systems (e.g. Dourish 2001; Svanæs 2013; Winograd and Flores 1988). Understanding the essence of technology was also Heidegger's (1977) project in *The Question Concerning Technology*. Also Merleau-Ponty's (2010) phenomenological analyses of embodied perception and how we assimilate tools to our body schema, with his specific analyses of for example driving a car (see also Van Lennep 1987) and how a blind man uses his cane have influenced contemporary authors in understanding the use of avatars (e.g. Arjoranta 2013; Farrow and Iacovides 2014; Klevjer 2013; Martin 2012) and various other HCI phenomena (e.g. Höök and Löwgren 2012; Larssen, Robertson, and Edwards 2007; Svanæs 2013). What shows the versatility of phenomenology in HCI is that the phenomenological *attitude* has underpinned studies from critically examining the foundations of artificial intelligence (Dreyfus 1992) to understanding the users' interaction with mobile technologies (Fällman 2003), while the phenomenological *paradigm* has been employed to battle implicit Cartesian dualist worldviews in virtual worlds research (Houliez and Gamble 2012).

Don Ihde's postphenomenological analyses of human-technology relationships can be considered as the leading examples in the philosophy of technology. His work has been concentrating on making explicit human-technology relationships in various ways. Most notable are his phenomenological analyses on how technology changes and gives rise to the findings of modern science (Ihde 2012), how technology is part of our everyday lives (Ihde 1990), and the nature of virtual embodiment (Ihde 2002). His work has influenced understanding interaction design (Greiner-Petter and Mareis 2014), avatars and computer games (Farrow and Iacovides 2014; Hammar 2013; Martin 2012), and the use of educational technologies (Adams 2014).

In the field of HCI, phenomenological concepts and earlier analyses have been used to inform HCI concepts and study foci. However, using phenomenology only theoretically might leave unused the potential that Husserl envisioned for it. For Husserl (2012), phenomenology was not to be only a theory or a simple step-by-step methodology to follow. He envisioned it as a radical approach to study phenomena, and as something that would challenge the researcher to see more openly what appears in consciousness the way it appears, without structuring this seeing with existing scientific or personal preconceptions. Instead of following the phenomenological method to conduct research and study HCI phenomena, many contemporary studies merely apply Heidegger's, Merleau-Ponty's and later Ihde's phenomenological analyses as a framework to explain HCI phenomena. This HCI study has a different approach. It aims to perform a thorough phenomenological analysis in order to see VEs afresh, and what constitutes this experience.

As Cilesiz (2011) has suggested, digital technologies have become an embedded part of our everyday lives in leisure, work, and education. Our life-world is increasingly filled with various forms of digital technologies, but we take them for granted and they become invisible to us in use. Therefore phenomenology appears as a promising way to understand and make explicit these user experiences.

2.6 Summary

Phenomenology is the study of intentional structures of lived experience. As Zahavi (2003, 34) has described, "one of the tasks of phenomenology is precisely to overcome and replace the narrow empiristic concept of experience with an enlarged one, and to clarify all of its different forms". It is the study of how things are given or manifest themselves in consciousness. It is the description of noetic acts and their noematic, or objective, correlates. Phenomenology examines how parts and wholes form objects that are manifested through identity in manifolds. Instead of explaining causalities, phenomenology describes what is manifested in natural attitude. This is achieved by acquiring the phenomenological attitude where existing presuppositions of the world are suspended and bracketed for the time of the phenomenological reduction.

As such, phenomenology fits well as an approach to study virtual environments. It is a phenomenon with complex identity that ebbs and flows between what is present

in perception and what is imagined or anticipated. What makes it complex is the fact that VE is a muddle of various intentionalities such as perception, imagination, and anticipation, which are often confused between each other. This can result in imprecise understandings, vagueness, and give a mystical, almost religious aura to VEs. One of the core missions of this study is to understand the essence of VEs by carefully looking and describing various intentionalities that appear both in VE studies and in users' experience of VEs in the context of hazardous environments training.

Chapter 3: Literature Review

3.1 Overview

Carr (2012, 483) proposed that instead of asking what something is, "phenomenology is more likely to ask, of anything that exists or may exist, how it is given, how it enters our experience, and what our experience is like." The aim of this study is to understand the users' experience of VEs. This will begin from the literature review chapter, which takes the first steps to initiate a phenomenological investigation of VEs. The chapter will present how the experience of VEs has manifested itself in the literature, and how the potential of various aspects of VEs has been proposed to transfer to learning and professional development, specifically in hazardous environments context. In parts, these views will be complemented with non-academic sources to add more width to VEs as a phenomenon. VEs are perhaps most widely designed and used in the form of entertainment video games and virtual worlds, but they have also intrigued authors of popular fiction and peoples' imagination in general.

Randolph (2009) proposed the idea of treating a literature review similar to conducting a primary research, by formulating its own research problem and using a primary research method for analysis. He noted the potential of using phenomenology as a method for structuring a literature review, and arriving "at the essence of researchers' empirical experiences with a phenomenon" (Randolph 2009, 10). In such a case, "the unit of analysis is the research report" (Randolph 2009, 10).

The guiding research question of the literature review is: *How has the experience of virtual environments (VEs) presented itself in the research literature?* To guide the review in the next phase more specifically to hazardous environments training, the additional research question is: *How has the usefulness of VEs for hazardous environments training presented itself to the authors?*

The perspective from which a phenomenon is looked at affects what is seen. As Murata (2012, 160) has written:

> Every object of perception appears through various aspects, corresponding to
> the situation of the environment and the perceiver. The object perceived under
> a certain aspect always presents itself as having other hidden aspects, which

would appear in other situations. Especially as the way of appearances of objects is essentially correlated with the way the perceivers realize their bodily movements, the perceptual consciousness included not only a cognitive consciousness of 'I perceive', but also a practical and kinesthetic consciousness of 'I can'. These are the essential characteristics of the intentional structure of perceptual experiences.

The question then is how has the experience of VEs appeared in the literature and under what aspects? At this stage it should be noted that as the interest of the study is phenomenological, 'experience' refers to 'intentionality', the directed nature of consciousness and that consciousness is always about something (Smith 2013). The aim is not to study 'user experience' or 'usability' from a specific human-computer interaction (HCI) perspective.

The chapter will first explore the experience of VEs in general as they have been addressed in the literature. The contextual nature of this study is to examine the experience of VEs in hazardous environments training. Thus the section that follows will first introduce how the potential of VEs for learning has been discussed in general, and then more specifically in hazardous environments training. The literature review chapter will end in a summary that identifies research gaps and justifies the aims and methods of this study.

3.2 Choosing the research literature

The focus of the first stage of the literature review was to synthesize research from various disciplines that describe the experience of virtual environments. The scope was to locate sources that would help to create a broad description of how the experience of VEs presents itself in the literature. The aim was to end up with a representative sample of the research in the field (Randolph 2009). The literature was gathered first with the focus on the most purposeful sources and authors in the field, and then broadened to sources that would add to understanding the VE phenomenon. Sources included both theoretical and empirical publications, including journal and conference articles, and book chapters. The search included online databases such as ACM Digital Library, Elsevier, Emerald, ERIC, IEEE Xplore, JSTOR, ProQuest, PsychINFO, SAGE, ScienceDirect, SpringerLink, Taylor & Francis Online, Web of Science and Google Scholar. Based on the initial search for the research proposal, the

search for the literature review was performed with the following keyword combinations: *virtual environments, virtual worlds, virtual reality, serious game, simulation,* and *video games.* For locating articles discussing VEs in learning and hazardous environments training, the following keywords were used in addition: *safety training, hazardous environment, game-based learning.* References of the located articles were screened to locate other possibly relevant articles (snowball sampling). The inclusion criterion was that the source could present an aspect to the VE experience. Randolph (2009) described how to perform a phenomenological analysis for literature review sources based on Moustakas' (1994) approach to phenomenology. After the relevant sources had been gathered, they were imported to NVivo (qualitative analysis software) in order to first find significant statements that described the VE experience from a specific aspect. After this, the significant statements were compared between the sources in order to find common themes and to create a synthesis of the VE experience in the literature. The literature review process is presented in Table 1.

Search databases:

ACM Digital Library, Elsevier, Emerald, ERIC, IEEE Xplore, JSTOR, ProQuest, PsychINFO, SAGE, ScienceDirect, SpringerLink, Taylor & Francis Online, Web of Science, Google Scholar

Search terms:

1st phase: *serious game, simulation, video game, virtual environment, virtual reality, virtual world*

2nd phase (contextual for learning and safety training): *safety training, hazardous environment, game-based learning*

Inclusion criteria:

(General)

- *Does the source show how the VE phenomenon presents itself to the author(s) or the users – i.e. how it is experienced?*

(Context-specific for hazardous environments and safety training)

- *Does the source describe the use of VEs in hazardous environments training?*

- *Does the source present why and how VEs should be used for hazardous environments training?*

Included sources were imported to NVivo for analysis.

Analysis procedure (based on Moustakas 1994; Randolph 2009):

1. List every expression relevant to the experience of VEs
2. Identifying meaningful statements
   a. Find claims made about the phenomenon (VEs) (Randolph 2009, 11)
   b. Does it contain a moment of the experience that is necessary and sufficient constituent for understanding it? (Moustakas 1994, 121)
   c. Is it possible to abstract and label it? If so, it is a horizon of the experience. Expressions not meeting the above requirements are eliminated. Overlapping, repetitive and vague

expressions are also eliminated or presented in more descriptive terms. The horizons that remain are the invariant constituents of the experience. (Moustakas 1994, 121)

3. Clustering the statements into themes
4. Describing the essence of VEs as seen through the eyes of the authors (Randolph 2009)
5. Review of the literature from the perspective of learning and hazardous environments training
   a. *How do VEs in this context present themselves to the authors?*
   b. *What are VEs useful for, and how do the authors come to these conclusions – what kind of studies and methods can be found?*

Table 1. Summary of the literature review process

3.3 Overview of the literature review results

Studying the experience of VEs has invited various approaches. Some have aimed to formalize the experience first in order to study it, others have aimed to begin with studying the experience – their own or other's. While some have argued that the context of use affects the VE experience, some have aimed to study VEs through more controlled settings with experiments. Despite the approach, all of these perspectives shed more light to how virtual environments are experienced.

When identifying themes, formalized concepts *immersion* and *presence* were identified as something that was commonly used to describe the experience of VEs experience. Different perspectives such as games studies and virtual reality research, in addition to various theoretical underpinnings such as embodied cognition, brought their different emphases on what might create an immersive VE experience. Immersion and presence appeared to be high-level concepts that were used to explain the nature of VE experiences in general. Other themes such as the avatar, narrative and interaction were discussed as more specific aspects of VE experiences, and were often used to explain what immersion and presence are. Furthermore, VEs seemed to naturally raise various questions of the relationship between the virtual and the real.

The literature review begins by presenting the key concepts that have been used in explaining the users' experience of VEs, namely, *immersion* and *presence*. As objects for consciousness, these concepts can be somewhat elusive to deal with: we are never just immersed or feel presence, but we are always immersed in *something* and might feel presence *somewhere* and in *some way*. Therefore phenomenologically, immersion and presence themselves cannot be considered as objects for user's

consciousness, but there needs to be something that gives rise to them in experience. Things that came forth in the literature were the avatar, narrative or story, and interaction with the VE. These will be discussed after immersion and presence. VE experience has also invited contemplations about its relationship to real life and reality in general. Can VE experiences be considered real and to what extent? Table 2 presents the key themes from the first phase of the literature analysis. These themes form the first section of the literature review chapter.

1. Key aspects of VE experience: Immersion and Presence

- Formalization of experience
- Debate between immersion and presence
- Various forms and perspectives to immersion
- Non-mediation

2. An aspect of VE experience: story, narrative and interaction

- Understanding VEs as a new narrative medium
- Relationships between story and interaction

3. An aspect of VE experience: The avatar and virtual embodiment

- The avatar as an access point to the VE
- The avatar as a character is not experienced
- The avatar is a vessel of self-expression and identity
- The avatar affects the sense of self and the body
- The avatar enables social interaction and inhabiting the VE

4. An aspect of VE experience: virtual or real?

- Popular media impacts presuppositions
- Division between virtual and real
- What is virtual and real?

Table 2. Key themes from the first phase of the literature review

The second section of the literature review will focus on VEs in learning and in hazardous environments training. Even though the aim is not to study the effectiveness of VEs for learning as such, the potential of VEs for learning will be briefly touched as many of these arguments have affected the adaptation of VEs, especially video games, for purposes beyond entertainment. The following section this will go deeper

to the more context-specific literature and introduces how VE experience is described from the hazardous environments training perspective. The chapter ends with the conclusion and justification for the current study.

3.4 Key aspects of VE experience: Immersion and Presence

The ability of VEs to *immerse* and elicit a sense of *presence* has been the center of attention especially in virtual reality (VR) research (e.g. Ijsselsteijn and Riva 2003; Slater and Wilbur 1997; Witmer and Singer 1998). VR research and development has been especially interested in how users might come to experience as if a real sense of being in an environment that exists only as a representation (Steuer 1992). The difference to virtual environments in general is that VR approaches its project with various kinds of input and output technologies such as the head-mounted display (HMD), data gloves and other technologies that capture and translate users' movements to the digital environment. In contrast, virtual environment can be considered as a more general term describing environment representations that can be accessed with various kinds of screens and control devices, such as virtual worlds and video games.

The use of immersion and presence varies considerably, and investigation of their formulation would make a study of its own. One thing that different authors seem to agree upon though is that immersion and presence are multifaceted phenomena (Ermi and Mäyrä 2005; Ijsselsteijn et al. 2000; Witmer and Singer 1998). The virtual reality research community, games studies research and general populace have contributed different perspectives to presence and immersion, which makes it difficult to use the terms rigorously and practically (Calleja 2011; Slater 2003). For example Ryan (2003, 14) noted the following about immersion:

> [it] has become so popular in contemporary culture that people tend to use it to describe any kind of intensely pleasurable artistic experience or any absorbing activity. In this usage, we can be immersed in a crossword puzzle as well as a novel, in the writing of a computer program as well as in playing the violin.

A debate has existed especially in VE research whether immersion should be considered as an objectively assessable characteristic of a technology or something that describes individual's subjective experience (more on this debate e.g. in Slater and

Wilbur 1997; Witmer and Singer 1998; see also a critical account in Calleja 2011). The actual root of the debate springs from different views about the role of technology and the human mind in forming the experience.

Defining immersion has been vibrant in the field of games studies. As games are an interactive medium, interaction as a perspective naturally frames this discussion. For example Ermi and Mäyrä (2005) defined immersion as a broad concept that consists of sensory, challenge-based and imaginative immersion, developing a SCI-model that described gameplay experience. Adams (2004) categorized immersion in three distinct aspects, *Tactical*, *Strategic* and *Narrative*. Tactical immersion takes place especially in action games where the user needs to make quick decisions in order to beat the game and follow its goals (cf. Ermi and Mäyrä 2005). In such kind of an immersion, the game's strategy and story become peripheral in the experience: it is action that gives rise to immersion. Strategic immersion on the other hand draws the user in to thinking analytically how to beat the game. Adams (2004) gives chess as an example of a game that can create strategic immersion. Narrative immersion is something Adams (2004) described to be similar to earlier storytelling media such as books.

In addition to explaining different aspects of immersion, many have noted similarities between the users' deep engagement in gameplay and Csikszentmihalyi's (2014) *Flow theory* (Douglas and Hargadon 2000; Lankoski 2011; Nacke and Lindley 2008; Salen and Zimmerman 2004). Csikszentmihalyi (2014, 136) described flow as "the holistic sensation present when we act with total involvement." It is an experience of being in control of one's actions that seem to flow from moment to moment smoothly, and where the self, environment and time become as if one (Csikszentmihalyi 2014). Cairns and Brown (2004) developed a three level definition of immersion where the initial stage was described as *engagement*, followed by *engrossment* and the deepest form, *total immersion*, which they described as *presence*. According to Cairns and Brown (2004), flow seems similar to immersion in the sense that both of these concepts describe an experience where the user is highly focused in performing, and for the duration of that, lose the sense of time and self. Still, the authors felt there is a difference in the sense that the third aspect in their framework, total immersion, is a more unstable experience and more difficult to achieve due to usability: total immersion requires that controls become invisible in experience.

Immersion is related to another concept, *presence*, which has been under a long debate especially in VR research. Witmer and Singer (1998, 227) defined immersion as

> a psychological state characterized by perceiving oneself to be enveloped by, included in, and interacting with an environment that provides a continuous stream of stimuli and experiences. A VE that produces a greater sense of immersion will produce higher levels of presence. Factors that affect immersion include isolation from the physical environment, perception of self-inclusion in the VE, natural modes of interaction and control, and perception of self-movement.

Their work with VR resulted in forming the Immersive Tendency Questionnaire (ITQ) and the Presence Questionnaire (PQ) which have been used in various fields to study for example the fear of heights (Regenbrecht, Schubert, and Friedmann 1998), behavior therapy (Wallach, Safir, and Samana 2010), game-based learning of physics (Schrader and Bastiaens 2012), whether virtual presence can be trained with first person shooter video games (Gamito et al. 2010) and even finding out how athletes perform under high-pressure situations (Wellner, Sigrist, and Riener 2010).

In contrast to Witmer and Singer (1998), Slater and Wilbur (1997, 1) defined immersion as a characteristic of a VR system, and its capability to "deliver an inclusive, extensive, surrounding and vivid illusion of virtual environment to a participant." To the authors, immersion was something that could be quantified and studied as a feature of a VR system. Presence, instead, is a sense of "being there" in the VE (see Heeter 1992) and relies on the conditions of the VR system (Slater et al. 2009).

Although Witmer and Singer have not seemed to agree with Slater on immersion, both of these perspectives seem to agree on *presence*, which has become the other most used concept to discuss the experience of VEs. Witmer and Singer (1998, 225) called presence as "the subjective experience of being in one place or environment, even when one is physically situated in another" and Slater & Wilbur (1997, 4) "as a state of consciousness, the (psychological) sense of being in the virtual environment." The concept of presence is built on the idea that the users either feel, act or react as if actually present in another environment, mediated by the VE system (Draper et al. 1997; Schloerb 1995; Sheridan 1994; Steuer 1992).

Beyond the initial definition that describes presence, authors have tried to make sense of what actually affects this experience. In a special issue of Interacting with Computers, "Presence and Interaction" Waterworth et al. (2012, 190) claimed that although presence has been studied several decades, its essence is still an open question:

> While there is still not a general consensus about what presence actually is, it is fair to say that most investigators agree about what it is not. Presence is not the degree of technological immersion, it is not the same thing as emotional engagement, it is not absorption or attention or action; but all of these and several other factors have a potential role in understanding the experience of presence in interaction.

Slater et al. (2009) argued there were three conditions that underline presence, namely, sensory motor loop, statistical plausibility and behavior-response correlations. For them, presence was

> successful combination of real sensory data and virtually generated sensory data (or in the case of virtual reality, replacement of real sensory data). It is successful when participants respond to the environment and events within it as if they were real. (Slater et al. 2009, 205)

Some have focused attention to presence through *embodiment* and how we interpret and build the realness of an environment holistically with our bodies (Schubert, Friedmann, and Regenbrecht 1999; Schubert, Friedmann, and Regenbrecht 2001; Schubert 2009). Instead of just watching, we gain understanding "when possibilities to act in a spatial environment are perceived or when dramatic events structure the interaction" (Schubert, Friedmann, and Regenbrecht 1999, 277). In this sense, interaction has been proposed to affect the sense of presence (van der Straaten 2000; Zahorik and Jenison 1998).

3.4.1 Criticism of immersion and presence

Some authors have not been entirely satisfied with existing notions of presence and immersion, and the sometimes implicit philosophical underpinnings they are built on. For example Boelstorff (2008) noted that although the concept of immersion has widely been constructed through the idea that a technological system can infuse user's senses as fully as possibly (see also Sheridan 1994), his study on immersion in Second

Life did not support such a view. Instead he noted that "in virtual worlds, "virtuality" refers to sociality, not the senses" (Boelstorff 2008, 113; cf. Villani et al. 2012). He also supported Salen and Zimmerman's (2004, 38) notion of *immersive fallacy*, "the idea that the pleasure of a media experience lies in its ability to sensually transport the participant into an illusory, simulated reality." Salen and Zimmerman (2004) argued that in the core of this idea is a technological deterministic view that presupposes that technology will eventually be able to create more and more life-like simulations. This development will then eventually lead the user to be unable to separate simulation from reality. Bogost (2007, 45–46) criticized this view and its assumptions:

> The values common to virtual reality and computer graphics assume that the closer we get to real experience, the better. This sentiment corresponds directly to the vividness spectrum, with the best interactivity coming closest to real experience. But meaning in videogames is constructed not through a re-creation of the world, but through selectively modeling appropriate elements of that world.

The way technology has become the object of study in such human-technology relations has been highly criticized by some who feel that the experience of a body or how consciousness actually works in such experiences is left in the periphery of such discussions. For example Bayliss (2007) has criticized the view of immersion as something where transporting the player to the video game world creates the sense of as if being present in that world. He proposed that consciousness actually works the other way around and that the game world becomes part of the user's conscious world. Similarly Calleja (2015; 2014; 2011) suggested that the previous terminology of immersion and presence is not adequate to capture human-virtual environment relationships. Calleja's major contribution comes from challenging the ontologically dualistic foundation of presence and immersion and clarifying their use:

> Both assume a unidirectional dive of human subjectivity into a containing vessel, a split between the physical "here" and the virtual "here" that is overcome temporarily when the phenomenon is experienced. (Calleja 2014, 222)

Calleja observed there is confusion especially in the use of the concept of immersion. He points out that the term has actually two meanings that are not well

clarified in use. According to Calleja (2014), this is due to an ontological misconception and unfamiliarity with interactive virtual worlds such as video games. The first way of using the term often denotes *immersion as absorption*. According to Calleja (2014, 228), this definition lends itself to "more general, previrtual environment sense of the word" that can categorize everything under the same label from being immersed in playing Tetris, solving crossword puzzles or reading a book (cf. Ryan 2001). To make a clear distinction to virtual environments where one interacts through an avatar, Calleja (2014, 229) defines immersion that derives from "a sense of inhabiting a virtual environment" as "*immersion as transportation*" (cf. Bayliss 2007).

Calleja (2014) explains that major confusion especially in games studies comes from labeling games simply as immersive, when human-game relationships take place differently in different kinds of games. One might be immersed (absorbed) into playing Tetris, but the experience emerges from playing a captivating and fast-paced puzzle solving game that needs quick decision-making. The player is not, in a sense, "in the game". Instead, for example in role-playing games such as Skyrim or World of Warcraft, the player directly inhabits a virtual world through an avatar and the environment recognizes "the presence of the player within a single location in their environments", and "allows for continuous spatial navigation in an extended geographical space" Calleja (2014, 229).

Calleja (2014, 225) also questioned the technological determinism of VR immersion and presence studies, and asserts that "high fidelity systems…do not themselves create a sense of presence" (cf. Baños et al. 2008; Gordon et al. 2011). He explains that such technological views disregard how user's prior experience and the content itself affect a sense of involvement in a VE. According to the author, new terminology is thus needed for better understanding what takes place in human-VE relationships. Calleja suggests *incorporation* to be a more suitable term. Incorporation is

> an experiential phenomenon that accounts for the simultaneous assimilation into consciousness of the virtual world *and* the systemic acknowledgement of the player's location and existence therein. This turns the concept of a unidirectional plunge into the virtual on its head, and instead posits the virtual as a productive aspect of contemporary reality that is having a profound

impact on notions of identity and sociality exactly because of this more seamless integration of simulated worlds and globally connected minds. (Calleja 2014, 223)

According to Calleja (2014, 232), this better explains the sense of inhabitation users experience in VEs.

3.4.2 The experience of non-mediation

Presence, immersion and VE experience in general have often been approached through the notion of non-mediation. New technologies have been suggested to provide more efficiently more natural and immediate experiences when compared to old media such as radio and television (Lombard and Ditton 1997). Also Murray (2000, 271–72) in her eloquent way anticipated that as a medium becomes transparent to the user, the technology behind the "make-belief" becomes translucent in the experience:

> at some point we will find ourselves looking through the medium instead of at it. Then we will no longer be interested in whether the characters we are interacting with are scripted actors, fellow improvisers, or computer-based chatterbots, nor will we continue to think about whether the place we are occupying exists as a photograph of a theatrical set of as a computer-generated graphic, or about whether it is delivered to us by radio waves or telephone wires. At that point, when the medium itself melts away into transparency, we will be lost in the make-believe and care only about the story.

Grau (2003, 340) explained that in order for us to experience the message of the medium, the medium that gives rise to the experience needs to be concealed "by keeping it beneath the perceptive threshold of the observer." He argued that interactive media does not exist without its user. What to him is too infrequently discussed with interactive experiences is that non-mediation takes place through a process where we ourselves actively build the experience and at the same time its very making becomes invisible to us. In the heart of the matter is that we interact, but we do not consciously experience the interaction mediated, but what we are interacting with. This naturally raises a question, what is it then we are experiencing "in" the VE? These aspects of experience are discussed further in the following sections.

3.5 An aspect of VE experience: story, narrative and interaction

There exists a long and complex discussion concerning VEs and especially video games, pondering if they should be understood through previous narrative media and stories, or as something else (e.g. Aarseth 1997; Hutchison 2007; Juul 2005; Ryan 2015). For example, Murray (2000, 93) discussed new interactive media as a new narrative or storytelling media:

> Writers will be able to develop a better feel for which patterns of human experience can best be captured in digital media. In this way a new narrative art will come into its own expressive form. The process by which this new art form will emerge is already under way and is itself interactive. Each time developers create new genres of digital stories or more immersive games, interactors try them out and grow frustrated or enchanted.

Proponents have argued that narrative or story has an important role in immersive VE experiences (Adams 2004; Calleja 2011). Narrative has been considered as something that connects the user as an actor in the VE context (Frasca 2001; Gorini et al. 2011; Nitsche 2008). Some studies have indicated that having a story affects the enjoyment of games more positively than if there was none (Schneider et al. 2004; cf. Juul 2005). Some have gone even further and proposed that instead of putting development time to reaching increasingly realistic graphics, the focus should be on designing more meaningful narratives and interaction that better immerse the user (Farrow and Iacovides 2014). Adams (2004) proposed that a narrative can immerse the user in the VE when they begin to care about the characters and the unfolding story. This requires good storytelling and it can even make the user forgive other aspects of the experience that might not be on the same level with the story, such as gameplay in video games. Narratives have also been proposed to bring game experiences closer to personal experience, to create affection towards game characters, and even to change real world behavior (Lu et al. 2012).

Others have been skeptical if narrative is an adequate way to describe new interactive media. For some, trying to understand interactive media such as video games from the perspective of previous media might take research astray. Eskelinen (2001) hoped to banish the importance of narrative in interactive media experience by showing that there is no audience in games as such, but the users are interacting with

dynamic elements of the media. To him, the story was more a marketing aspect of video games. Furthermore, he claimed that bad gameplay experiences are due to the fact that developers use too much time to develop narrative and cinematic aspects of games as if they would be the important element of the experience.

Juul (2005; 2001) has discussed if narrative and interaction can co-exist. Still, also he came to the conclusion that "you can't have narration and interactivity at the same time; there is no such thing as a continuously interactive story" (Juul 2001, sec. Conclusion). He also argued that even though a game experience might be linear in a similar way as a story, it should not be the determining factor to call a game experience a narrative. The player is an active agent who can have many different kinds of experiences with the same game. Juul (2005) also remained skeptical if better narratives, whatever they might even be, would even make a game experience more interesting. Results from a study by Lazzaro (2005) support these views. The study, which examined why people play games, indicated that during interactive experiences physical responses and cognitive challenges were more important to players than an existing story.

One reason authors argue for or against narratives might be because it has a wider meaning in contemporary use (Juul 2005). Nitsche (2008, 45) proposed that 'narrative' has a different kind of signification in the context of virtual interactive media:

> The aim of narrative elements like these is not to tell a linear story, but to provide evocative means for the interactor to comprehend the virtual space and the events within it, and generate context and significance in order to make the space and the experience of it more meaningful. While the reader of a novel is limited to the given text, the player of a game interacts with these evocative elements, cocreates them, and changes them. Whatever manifests itself in the shape of this comprehension is of a unique nature. A game's "story" is not a singular entity.

According to Grau (2003, 343), due to the interactive nature of these media, "the quantities of artist, work, and observer begin to converge." While Eskelinen (2001) proposed that the users are not the audience during an interactive experience, there has also been disagreement about who is the author. Some have argued that the real author is the user who creates the story through interpreting the events in the interaction (Gorini et al. 2011). Nitsche (2008) interpreted this personal experience as the plot:

the users do not only take the digital space as it is, but interpret it through their personal preferences. Murray (2000) was against such ideas. She argued that there is still difference between the creator and the one who navigates through the created media product experiencing it. The users might interpret the interactive media in their own way, she argues, but this is not "authorship but agency" (Murray 2000, 153). Another aspect of VE experience has been suggested to connect the user to the VE context even more explicitly, and that is the avatar.

3.6 An aspect of VE experience: the avatar and virtual embodiment

A specific aspect of VE experience manifests itself through the avatar and virtual embodiment. Avatars are virtual representations that the users employ to interact with objects and other users in the VE (Schultze 2010). Users interact with VEs with their body but at the same time they are connected with a body representation, the avatar, in order to act and even feel a sense of dwelling in various forms of VEs. Also virtual embodiment has been studied especially in VR research as an experience where the virtual body is experienced as if the user's own body.

The experience and function of avatars has been described from various perspectives. Some have postulated if avatars are kind of a tool (Martin 2012), even similar to a mouse cursor (Ryan 2003), while others disagree with such simple notions and suggest that avatars connect users to VEs in more complex and meaningful ways (Klevjer 2012; Taylor 2003). Avatars have also been described as something extending the user's body into the VE space, or as user's proxy body in the VE (Klevjer 2012). In her study Doyle (2014, 10) described how different users viewed the avatar experience:

> For some it was like embodying another character or persona entirely, for others the avatar was experienced as a mouse pointer or an aspect of themselves in concurrent time. Conversely, the avatar was described as an unexplored aspect of their own identity.

Martin (2012, 2) examined the avatar through a phenomenological framework, and noted it has an interesting double existence for consciousness: it appears as "a tool through which the player perceives, manipulates and navigates through the game environment, but it is also an object of perception". Still as a tool, it has a slightly different kind of existence to everyday tools:

> Unlike hammers, pens, or other kinds of equipment, the avatar is represented to a greater or lesser extent as a sentient being with its own character, awareness and intelligence and this encourages, or at least provides the possibility of, an empathic as well as a practical relationship for the player. (Martin 2012, 4)

The avatar might be used as a tool, but in some cases it can also have a history, and identity, which give it human characteristics that go beyond it being just a tool. The experience of an avatar can therefore appear from various aspects based on how it is used and how it relates to the VE. At least five aspects, some of them interrelated, could be identified (Sections 3.6.1-3.6.5).

3.6.1 The avatar is an access point to the VE

The avatar is part of the VE gestalt. It appears to the user through its characteristics and informs action in the VE. The in-built "skills" of the avatar both allow and limit the user's actions in the VE, and the design of the environment is often aligned to their use (Gee 2008). Through interaction, the user actualizes the abilities of the avatar in the VE. Lankoski (2011, 306) described the avatar as something that connects the user to the VE and gives rise to both goal-related and empathic engagement:

> In goal-related engagement, players derive their goals from a PC [player character], and this in turn structures the affective experience of a player. Goal-related engagement is fundamentally an ''I'' experience: It is about the players acting to reach their goals. Empathic engagement, on the other hand, is essentially about reacting to the character's actions.

3.6.2 The avatar as a character is not experienced

Another aspect of the avatar is that it does not always hold a constant active place in the user's conscious experience, but is in fact invisible to it. Some have postulated if users might identify more seamlessly with the avatar character and feel more directly involve with the VE if the avatar was in a first-person instead of a third-person perspective (Nacke and Lindley 2008; Taylor 2003). Jennett et al. (2008) argued that such a shift already takes place quite naturally in action games: the experience moves beyond the avatar to the action and the avatar as a character is not explicitly experienced. The authors noted that there are actually two bodies that become absent

in gameplay: both the user's actual body and the avatar's body. In the study by Jennett et al. (2008, 7) instead of reporting their experience as if becoming or being the character in the game, some users explained their experience as becoming highly involved with the game. Although the users take control of the avatar for action, it is not the avatar that gets the attention during the action: in fact it is action that makes the avatar as a character invisible to the users. This confirms with Crick (2010, 267) who described in a similar manner the experience of playing a first-person shooter game: "While playing an FPS, for example, I rarely think about controlling the avatar. There is no reflection or intellectual analysis; I think as the avatar, from the point of view of the avatar."

3.6.3 The avatar is a vessel of self-expression and identity

Avatars have also been described as a means to act one's identity or self in the VE (e.g. Boelstorff 2008; Gottschalk 2010; Murray 2000; Taylor 2002). In such moments, the avatar manifests itself as a vessel to act the self in the VE. Customizing the avatar and controlling its actions and movements allows for self-expression in the VE. Some have noted that creating avatars that resemble the user's real self has made the VE experience feel more immersive (Schultze 2010). Still, the right kind of an avatar body might also allow users to "construct, express, and perform the identity they are seeking" (Taylor 2002, 52; see also Castronova 2005). As Taylor (2002, 51) has aptly put it,

> identity remains one of the most evocative uses of an avatar. Ultimately, digital bodies tell the world something about your self. They are a public signal of who you are. They also shape and help make real how users internally experience their selves.

Avatars can sometime correspond better with users' identity than what is possible to them in their actual world (Boelstorff 2008; Taylor 2002). Some have argued it is not simple projection of the self, but genuine actualization of it (Taylor 2002). It can also work as a means of regained agency for example in case of a disability (Boelstorff 2008).

3.6.4 The avatar affects the sense of self and the body

Some have visioned that taking up a virtual body could affect how users experience their own body and their sense of self. Biocca (1997, 27) went as far as to

call it a "Faustian trade off": "Choose technological embodiment to amplify the body, but beware that your body schema and identity may adapt to this cyborg form." Some have proposed that when people's use of virtual bodies increase, "the distinction between the self and the virtual self loses relevance" (Ratan 2013, 333). For example Gottschalk (2010, 513) described how the avatar experience affected one user who felt she could not entirely be herself in real life:

> She went to Second Life and created an avatar (Nina) as a means of escape until one day, as she put it, "Nina took over." Encouraged by the validating encounters and relations Nina/Karen was experiencing in Second Life, Karen decided to model herself after Nina, assuming she would then enjoy the same pleasurable experiences in her real life. She left her abusive relationship and is "a million times happier now."

In this way, the avatar goes beyond simple representation or exploration of one's "real life" self, but affects it. In addition to naturally occurring user experiences from virtual worlds such as Second Life (Boelstorff 2008), it has also been observed in experimental situations that acting as an avatar has affected for example attitudes towards women and rape victims (Fox, Bailenson, and Tricase 2013) and prosocial behavior (Rosenberg, Baughman, and Bailenson 2013).

Although the avatar could be technically considered as a virtual body, there is another kind of a perspective to VEs that has dealt more directly with the experience of a virtual body, namely, *virtual body ownership*. From this aspect, the users have been reported to experience the virtual body as if their own. The experience of a virtual body has been in the focus of fascination especially in VR research (e.g. Ahn, Le, and Bailenson 2013; Kilteni, Groten, and Slater 2012; Pomés and Slater 2013; Ratan 2013). In virtual body studies users have been reported to feel ownership towards a virtual body even if it was different from their own body; such as a body of a child (Banakou, Groten, and Slater 2013), different gender (Slater et al. 2010) or different ethnicity (Slater and Sanchez-Vives 2014). Some have also reported virtual body-part ownership experiences towards limbs that have been considerably different from the user's normal experience, such as a longer arm (Kilteni et al. 2012) or a larger belly (Normand et al. 2011).

What has given rise to study the experience of a virtual body has been underpinned by questions such as "what does it feel like to own, to control, and to be

inside a body?" and might users "experience the same sensations towards a virtual body…as toward the biological body, and if so, to what extent?" (Kilteni, Groten, and Slater 2012). Some have suggested that the sensory stimulus that VR provides actually allows the user "to embody another person's perceptual experiences" (Ahn, Le, and Bailenson 2013, 7). Also Slater et al. (2010, 7) stated the following about their studies:

> Through an IVR [immersive virtual environment] a person can see through the eyes and hear through the ears of a virtual body that can be seen to substitute for their own body, and our data show that people have some subjective and physiological responses as if it were their own body.

Such experiences have been reported to take place under various conditions. For example, Slater et al. (2010) immersed male users into a virtual representation of a female body with a head-mounted display. They were instructed to look around in the environment to become familiar with it. The head movements of the avatar were mapped on their own body movement, and they could look around in the VE by turning their head. At some point another avatar began to interact with them by touching them, and finally hit them in the face. Based on physiological measures and questionnaire results the authors suggested that users reacted as if to a real threat. The authors noted that in some studies body ownership illusions have been proposed to take place when what the users see on the VE is in sync with what they feel through touch with their physical body (e.g. Kilteni et al. 2012; Normand et al. 2011). Findings by Slater et al. (2010) contradicted these notion and they suggested that such synchrony between touch and visual perception stimulus might not be needed for body ownership illusions to take place (see also Pomés and Slater 2013).

Other authors have been skeptical about virtual embodiment experience. It has been claimed that how we experience our bodies and selves in VEs and real life are blurred with technofantasy, and that such experiences can be explained because they presuppose how we experience our body and technology. For example Ihde (2002) has noted in his extensive analysis on human-technology relations that there are actually three forms of embodiment that we experience: our sense of being a body; our experience of the body through social and cultural constructs; and experiencing the world with our body through a technology (Ihde 2002, xi). The latter he called as an 'embodiment relation'. Embodiment relations denote how we experience the world through technological artifacts that vary from simply seeing through eyeglasses to

more complex virtual reality experiences. For Ihde (2002) the argument that VR could replace real life falls under technofantasy, and to him it is in fact possible only because of our ability to "fantasize ways in which we get beyond our physical limitations or our social problems by means of technologies created in utopian imaginations" (Ihde 2002, xiii). It is actually our inherently technological culture that enables such visions.

To Ihde (2002), the experience of a body is not a simple one in the first place. First of all it is a question if the experience is bound within the skin, or as the author suggests, something that exceeds the physical bounds of the body (Ihde 2002, 6). He used martial artists as an example, and how they can experience a punch before they have actually done it with their body. There are also other complexities in the experience of being a body:

> one can simultaneously experience one's here-body from its inner core while having a partial, but only partial, "external" perception. I can see my hands, feet, part of my frontal visible body rom the focal point of my vision. (Ihde 2002, 6)

As Ihde (2002, 6) noted, "combining these multistable ambiguities, one can begin to appreciate how complex the issues of virtuality may become." He thus differentiated the experience of a physical body as a "here-body" and the virtual as an "over-there body" (Ihde 2002, 6).

According to Ihde (2002), although our bodies are able to adapt to many kinds of technological contexts, they also provide limits to technological developments. Because of this, there are limits to virtual embodiment, as technologies also need to adapt to us. Although technologies might enhance our seeing and acting, they must also work within the limits our body provides.

Farrow and Iacovides (2014) also argued against simple notions of body experience. Theorizing through Merleau-Ponty's (2010) phenomenology of embodied perception, the authors suggested we should understand embodiment as a wider concept in order to study it more accurately in VEs. The authors were skeptical about how far as an experience the avatar or virtual embodiment experience can actually develop:

> We do not relate to bodies in virtual worlds (or in cinema for that matter) in the same way that we relate to our own corporeality. For one thing, we tend

not to care too much about dying and we do not experience pain through our avatar: these phenomena are experienced as representation, not as embodied, subjective experience. (Farrow and Iacovides 2014, 229)

On a physical level, being embodied in a VE is not exactly the same as being in the actual world. What happens to our virtual body in the VE is experienced through representations such as the health bar or other things on the screen, and sometimes through touch where the controller vibration indicates to us our virtual body is taking a hit. It is still us who perceive and feel this with our own body. Because of this, the authors also proposed that the experience of body affects how our actions differ in VEs and real life: in real life, our own physical body is at stake in a different way than the virtual body. Farrow and Iacovides (2014) concluded that although there are bold visions and technofantasies on what virtual embodiment might involve, the field could use more rigorous phenomenological descriptions of how users actually experience virtual embodiment in VEs.

3.6.5 The avatar enables social interaction and inhabiting the VE

The representational aspect of the avatar becomes naturally important in VEs that connect people together. As Biocca (1997, 23) noted, "the social meaning of the avatar, is situationally or environmentally dependent." The representation of an avatar connects users to a context and communicates various things about them: their general presence, identity and intentions, on-going activity, and capabilities (Benford et al. 1995; Birchfield and Johnson-Glenberg 2010; Klevjer 2012). As Benford et al. (1995, 243) summarized, "the primary goal of a body image is to convey someone's presence in a virtual environment." The function of the avatar is thus to represent the users both to others and themselves. In such moments, the avatar has been described to become the "nexus of communication" (Mennecke et al. 2011, 414). Through the avatar, the user becomes connected to other people for social interaction (Taylor 2002). Such experience of social interaction with both digital agents and human agents have been described as immediate and leading to emotional outcomes: "When I get an appropriately placed [online] hug, I really feel the rush of endorphins" (Taylor 2002, 49).

Collaborative environments where users operate with avatars also bring to question the experience of "dwelling" or inhabiting a virtual environment (Boelstorff

2008; Houliez and Gamble 2012). Calleja's (2015, 220) work has brought this together with the sense of self:

> the game environment is absorbed into consciousness as a place inhabited. The significance of this for a contemporary notion of a digitally mediated identity can only be understood fully if we acknowledge how powerful these experiences of habitation can be. Players have an increasingly varied plethora of simulated experiences within settings of their choosing available to them. Inhabiting virtual environments can have lasting effects on the players' sense of self.

As such, avatar bodies are the access point to a digital space (Nitsche 2008) or a "synthetic world" (Castronova 2005) with various action possibilities (Riva and Mantovani 2014). It might be somewhat reduced experience of a world, but it is real in the sense of the experience of embodiment in relation to a digital space (Honey and Morgan 2013).

3.6.6 Summary

Based on the aforementioned aspects that described the avatar experience, we can conclude that avatar experiences can emerge through various aspects (Figure 2).
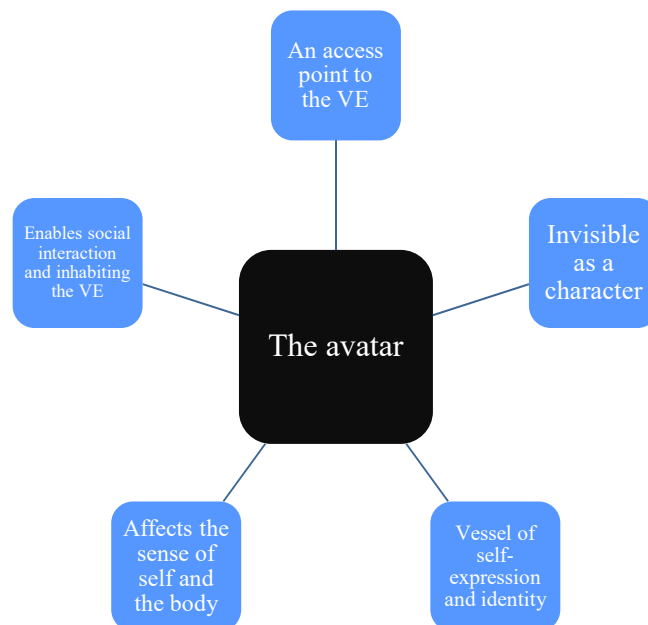
Figure 2. Aspects of the avatar experience

As a character, the avatar can be considered invisible to the users' consciousness, and appearing more as a part of a VE action gestalt. Action and especially social interaction can be experienced as immediate and not mediated as such. This can take place when the users are immersed in action in the VE. In a sense it could be said that the avatar becomes a seamless part of the VE experience through the way it connects the users with VE action possibilities. In some VEs the users concentrate on fast-paced action, when in collaborative virtual environments social interaction might be the focus of attention. In the latter, the avatar affords self-expression, acting or exploring user's identity, and enabling social interaction. During such moments, the avatar can be a vessel of self-expression to the user, but also an object for perception to other users. Furthermore, the avatar experience can affect the experience of the user's self and body.

Honey and Morgan (2013) saw that understanding the way people act through avatars in VEs might help us understand how we construct the reality of our world, both virtual and actual. This could also bring to question how stable these constructions are. It seems that VE experiences naturally raise both critical questions and imaginative accounts about the relationship between virtual and the so-called real life. This aspect to VE experience will be discussed in the next section.

3.7 An aspect of VE experience: virtual or real?

> Normally, especially given how much amazingly rich experience could be crammed into VRs in general and Afterlives in particular, people went with modest and neighbourly growth plans in the Real and an extensive though still ultimately limited expansion program in the Virtual…Deeply immersive and impressive VR was an affectively inevitable adjunct to mind-state transcription technology. (Banks 2010, 126)

Virtual environments and virtual reality have long been the interest of popular fiction such as science fiction literature, movies and video games. Stories similar to the previous quote from the late author of science fiction, Iain M. Banks (2010), have been arousing minds of the public for ages. William Gibson's Neuromancer (1984) in the 1980s, Wachowski brothers' transmedia behemoth The Matrix and the more recent popular seller Ready Player One (2011) by Ernest Cline that synthesized technofantasy of virtual reality with the nostalgia of 80's video games and popular culture all

imagined and represented how virtual reality would rise to the level real life fidelity. Perhaps one of the most representative examples of such fictitious accounts of VR lately to come out arrives from Japan, *Sword Art Online* (2010, ASCII Media Works). The series, both as light novels, manga (Japanese comics) and anime (Japanese animation), describes a future massively multiplayer online role-playing game (MMORPG) where players use a virtual reality helmet to immerse themselves in the game world – when in the game, the players experience it as if real. The story begins with the launch of the game. In order to create drama around VR possibilities, due to evil intentions by game's designer, the players get stuck in the game, unable to log out. With a further twist that emphasizes the reality of the game, if the players get killed in the game, they will also die in real life.

Such examples from pop culture, unaccountable to the eye of scientific rigor, have affected the imagination on what virtual reality could be. Thus some of them have become 'common sense' in contemporary parlance, often as something that does not request a logical definition. This can be seen in metaphors that describe human-interaction with computer-generated virtual environments that might result in something that can be stated for example as "being there" (e.g. Heeter 1992; Ijsselsteijn and Riva 2003). Fictive accounts of technological futures have been recognized oozing in the world of science and the design of new technologies, blurring the lines of prediction of and impact to technological developments. For example Dourish and Bell (2014) contrasted studies in ubiquitous computing against popular science fiction TV series to identify related themes and connections. The authors observed that popular culture and science fiction work as a cultural platform to understand future developments, but also to contrast contemporary situations. This is often more than technological, and reflects important cultural and power issues for example when people have increasingly more devices and interact more in the 'cyberspace' with their own identity. The authors explain that instead of just predicting what future might bring, science fiction "actively shapes technological futures through its effect on the collective imagination" (Dourish and Bell 2014, 769).

As sort of a bridge between popular culture and academia, some authors have imagined the future ways of virtual environment experiences. In her highly cited Hamlet on the Holodeck, a book about how cyberspace is changing storytelling, Murray (1998) used a now popular metaphor of Star Trek's holodeck to describe

immersion as transportation to virtual. Many authors have challenged such notions (e.g. Juul 2005; Salen and Zimmerman 2004). According to Juul (2005, 190), Murray's arguments are too simplistic:

> …this is a misleading account of what is going on in a video game. The player may be completely absorbed by the game *as a real-world activity*, and the player may for the duration of the game or in isolated parts of the game also strongly *imagine* the fictional game world.

As it can be seen from previous studies and examples from popular fiction, there is a strong ontological undertone that places a divide between real and virtual environments claiming that virtual is the opposite of the real. Some authors have considered this as a false dichotomy, and an impractical one (Lévy 1998). Others have directly criticized the alleged newness of concepts such as immersion as mere properties of a virtual reality system (Calleja 2014; Heim 2014; Rudd 2014), while others have traced the history of the virtual to show that as a concept, its properties have existed far before head-mounted displays and computer screens (Shields 2003). Heim (2014) actually dispelled the notion that we should even try to formulate special models to understand virtuality, as our contemporary lives are already full of virtual reality in various forms, ranging from Facebook identities to our increasing augmented reality connection with our smartphones. He suggests that instead of just discussing what virtuality is through constructing theories, there is a need to examine it through our daily activities. In meditations on virtual reality from Lacanian psychoanalysis perspective, also Rudd (2014) asked for a change of mindset on what actually is virtual: not just some head-mounted display-mediated experience, but a phenomenon we have had as long as we as species have had language to name things. Similarly to Heim (2014), (2014, 257) argued that, "we have already left behind the Real, the material "stuff" of the universe; our reality is thus, itself, virtual."

Another aspect when trying to understand VE experience is whether users feel the same emotions in the virtual than they do in real life (Martin 2014). Is there an actual difference between real life and virtual emotions, or do we just pretend to feel real emotions in a virtual environment? This logically gives rise to a question: what indicators do we consider to prove that something is real? Some empirical psychological studies (e.g. Courtney et al. 2010; Mühlberger et al. 2007) have argued based on physical responses to stimuli in VEs that emotions indeed are similar to what

we would show in real world situations: sweating of palms, more rapid eye movement and heart palpitation. Others have observed in experimental conditions people acting as if in real life during virtual reality scenarios. For example Slater et al. (2013) conducted a study on how a bystander (the user) might intervene if there was an avatar showing verbal and physical violence towards another avatar. The main findings of the study suggest that the more connected the research participants felt with the other avatar, the more they tried to intervene. Furthermore, if they felt the victim avatar was asking help by looking at them (a script of code made the avatar look at the participant), they were more eager to step in. Some of the participants also reported that they feared that someone else might come in the situation and make it worse. This indicates how immersing their experience was in the simulated VE scenario.

Additionally, studies in virtual reality exposure therapy (VRET) have revealed positive results for VEs impacting human behavior and eliciting emotions such as fear. These have been used especially in the area of treating phobias such as the fear of heights (Regenbrecht, Schubert, and Friedmann 1998; Krijn et al. 2004), the fear of flying (Hodges et al. 1996; Rothbaum et al. 2000), claustrophobia (Botella et al. 2000), public speaking anxiety (Safir, Wallach, and Bar-Zvi 2012) and arachnophobia (Garcia-Palacios et al. 2002). In such cases, instead of having to confront phobias face to face in an actual real-life situation, participants have been exposed to them in a VE, often presented with some form of a VR system. Although these have been trialed with various examples, study results vary. Some research suggested VEs are efficient and could be used for behavioral therapy when other studies proposed more research is needed to understand how not just technology, but personal variables might affect the experience of VEs (Wallach, Safir, and Samana 2010).

The experience of VEs keeps fascinating both the lay reader and academics. Despite of sometimes mixed debates on how virtual experience should be defined, whether it is real or not, or how these experiences affect users, a widely accepted promise is attached to them: their use holds a significant potential for learning and training. This perspective to VE experience will be examined in the following section.

3.8 A perspective to VE experience: learning and training

The term *virtual environment* (VE) is used in this study to signify all kinds of virtual environments where the user acts as an avatar in an environment where he or

she can navigate and perform various kinds of activities. Still, the terminology in the field lacks unification and has made it difficult to evaluate what makes VEs useful for learning and training (Breuer and Bente 2010; Connolly et al. 2012; Dubbels 2013). For example (Aldrich 2009, xxxii) listed the following terms that have been used: "*virtual experience, games, simulations, social impact games, practiceware, game-based learning or digital game-based learning, immersive learning simulations, educational simulations, serious games, sims*." In addition to these, *persuasive games* (Bogost 2007), *ludic simulation* (Dubbels 2013) and lately *gamification* (Deterding et al. 2011; Huotari and Hamari 2012; Kapp 2012) have tried to capture the power of VEs and games for non-entertainment purposes. What makes the discussion about VEs for learning even more difficult is that the terms often overlap and have various meanings, such as the general term *virtual worlds* (VW), which is sometimes been used to categorize very different kinds of VEs, for example Second Life and World Of Warcraft, under the same label (Aldrich 2009, xxxii). What is common in the discussion of using these media for learning, is the potential that they could be used for other purposes than pure entertainment (Malone 1980; Michael and Chen 2006; Susi, Johannesson, and Backlund 2007). For this, VEs and especially video games look like promising media to instill motivation and fun to learning and training.

The literature review analysis revealed three key themes that penetrate the discussion of the potential of VEs for learning. Firstly, one of the most prevalent aspects is the ability of interactive media such as video games to elicit engagement and capture the users' attention. Furthermore, they seem to be fun. The question then has become, how to translate these elements to other contexts beyond entertainment? Secondly, VEs have been seen as a novel way to realistically capture real world situations and environments for the users to interact with. Thirdly, due to the widespread use of video games and other interactive media, today's learners are suggested to expect more interactive, digital technology-infused learning situations instead of simple content delivery through lectures. This comes forth especially in the discussion about "digital natives", people who have born in the 1980's and later and who have always had video games and other digital media in their disposal. In addition to these key conversations, VEs have also appeared as a cost-effective approach to learning and training, as they could reduce the need of expensive real-life simulations

and promote learning that takes place with learner's own pace and time (Buttussi et al. 2013). In the following, the three key themes are discussed in more detail.

3.8.1 Fun factor and engagement

Games have been suggested to be motivating (Abt 1987), while enjoyment has been noted as the most important aspect of a good game that keeps players engaged (Sweetser and Wyeth 2005). Although for example video games appear as fun, some have noted that fun is not actually an element of games as such but a result of engaging games and other kinds of activities (Calleja 2011; Michael and Chen 2006). Malone (1980, 81) noted that the same things that make entertainment games fun should make educational games fun too. Although he seems to use the terms *fun*, *enjoyment* and *captivating* interchangeably, Malone (1980, 81) proposed that the power of computer games is that they elicit challenge, fantasy and curiosity.

Players of entertainment video games appear as active agents and problem-solvers, and translating such behavior to educational and training contexts has gained a lot of attention (Gee 2008; Petit dit Dariel et al. 2013; Prensky 2003). The holy grail has been how to harness the engaging power of video games, the fact that players can stay hours engaged with video games while students can become disengaged within minutes in the classroom (Michael and Chen 2006, 26). The potential of using VEs and games for learning appears through the idea of combining their motivating, engaging and compelling elements with pedagogy and learning content (Aldrich 2009; Prensky 2003). The aim of engaging VEs would then be to capture learners' attention and ensure they stay engaged for the duration of the learning activities, and that the learning outcomes are achieved (Buckley and Doyle 2016; Dubbels 2013).

Even though engagement has been widely discussed as one of the most promising aspects of games and VEs (Michael and Chen 2006; Reiners et al. 2013), as a term its use is vague (Boyle et al. 2012). Some have suggested engagement to emerge when VEs provide challenges, reward right kind of behavior and are visually pleasing (Caton and Greenhill 2014; Dubbels 2013; Hamari et al. 2016; Malone 1980), and some have used it to signify how involved the learners become with gameplay (Abdul Jabbar and Felicia 2015).

3.8.2 Representation of real world environments

One of the major potentials of using VEs for learning is that VEs could capture complex real world contexts or realistic environments, and thus provide situated learning experiences (Annetta et al. 2014; Dalgarno and Lee 2010; Dede 2009; Gamor 2014; Mouaheb et al. 2012). They can present the learner with scenarios, activities and representations otherwise impossible for them to interact with (Annetta et al. 2014; Buttussi et al. 2013). These can provide powerful problem solving situations that take the learners close to real life situations (Ribeiro et al. 2014; Petit dit Dariel et al. 2013). Dede (1995) contended that virtual environments that are developed based on constructivist learning theories could provide many opportunities to understand the physical and social attributes of real world contexts. Dede (2009) was also hopeful that situated learning can find a new life through VEs, which could simulate real world problems that the users can explore collaboratively with other learners and computer agents.

Gee (2008) argued that all learning is situated and the basis of deeper learning is activity and experience, not decontextualized facts. This is something that formal educational institutions and other learning contexts have not leveraged well. Drawing an example from a commercial game *Full Spectrum Warrior*, Gee synthesizes the potential and affordances of interactive games for learning:

> The player is immersed in activity, values, and ways of seeing, but the player is scaffolded by the knowledge built into the virtual characters and the weapons, equipment, and the environments in the game. The player is also scaffolded by some quite explicit instructions given "just in time", when it can be understood in action and through experiences that make clear what the words really mean *in context.* (Gee 2008, 209 italics added)

Herrington, Reeves and Oliver (2010) discussed that authentic context can be considered as the physical or virtual environment that sets the scene for a situation or a scenario, and simulates the knowledge, skills and attitudes that will be used in real settings. The authors emphasized the importance of cognitive realism and not just visual realism, proposing all-embracing authentic context to be important to provide purpose and motivation for learning.

VEs have been suggested to embody context specific knowledge and skills through virtual characters, objects, processes and environments (Bogost 2007; Michael

and Chen 2006). As Aldrich (2009, 9) expressed this, they are able "to capture and model experiences, including actions, how actions then impact relevant systems, how those systems produce feedback and outcomes, including desired results." Therefore they could be used to construct elaborate context specific experiences. As such, VEs could have the power to make the user feel and act as if another person in a specific context (Puvirajah and Calandra 2015). Interaction with such VEs could thus be more effective than direct communication of the learning topic (Michael and Chen 2006). VE spaces and activities have been suggested to present learners with situated patterns of play from which learned knowledge and skills have proposed to be transferable to real world settings (Dede 2009; de Freitas 2006; McGregor 2007). Furthermore, VEs could provide situations that might be too dangerous for the user or others in real life (Annetta et al. 2014; Backlund et al. 2010; Herrington, Reeves, and Oliver 2010; Petit dit Dariel et al. 2013).

3.8.3 Learners in the digital age

Another argument for using these media for learning is connected to the discussion on 'digital natives' (Prensky 2001) or 'millennials' (Howe and Strauss 2009). The basis of this argument is that the generation of users who have born roughly from 1980 onwards have grown up with digital technologies such as video games and various kinds of gadgets, and thus have a different kind of a relationship with digital technology and skills to use it (Bennett, Maton, and Kervin 2008). These people have been regarded to find their information from other sources than books (Halpern et al. 2012), and furthermore, to actually learn differently (Ribeiro et al. 2014). They have gotten used to learning from video games, and thus are presumed to expect their use in learning (Michael and Chen 2006). Consequently, it is claimed that the way learning gets delivered should live up to their expectations and existing media usage (Halpern et al. 2012). On the other hand, the existence of such a coherent new generation of technology users has been suggested to be a rough generalization without empirical or theoretical evidence (Bennett, Maton, and Kervin 2008). Radical changes in teaching and learning practices just because of such arguments should therefore be approached with caution and more research.

This section has described three potential reasons to use VEs in learning and training, namely, to make learning more engaging and fun, the ability to create realistic representations of actual environments, and to accommodate for contemporary tech-

savvy learners. These are general aspects that appear in the literature to justify the use of VEs in learning and training. Still, the experience of a VE that supports learning physics in a university context might be quite different from an industry hazardous environments training VE. For that, studies that present VE experiences specifically in the context of hazardous environments training are discussed in the next section.

3.9 A perspective to VE experience: hazardous environments training

Many authors have proposed that it is important to expose learners to experiences that would be too dangerous and costly to carry out under real conditions (Filigenzi, Orr, and Ruff 2000; de Freitas 2006; McGregor 2007; Mestre and Vercher 2011; Reiners et al. 2014). For this, various forms of VEs have suggested to hold a great promise to promote new knowledge and practical skills acquisition in a safe surrounding. Growing body of literature in safety training suggests VEs can develop better spatial awareness and problem solving skills (Tichon and Burgess-Limerick 2011), in addition to engage and motivate learners (Reiners et al. 2013). Tichon and Burgess-Limerick (2011) reviewed virtual reality literature for safety training in mining. Promising results from safety training in other contexts such as aviation and health have indicated that VEs can support the development of important skills such as problem solving, motor skills and hazard identification in various contexts. Tichon and Burgess-Limerick (2011) found evidence from various high-risk industries that virtual reality can be effective in training e.g. context-specific spatial awareness and decision making under stress. Also several findings from mining-specific literature propose VEs as a potential alternative for direct instruction (Tichon and Burgess-Limerick 2011).

In their extensive meta-analysis Burke et al. (2011) observed that highly engaging safety training would result in greater knowledge acquisition and higher performance. They found that the more extreme the training events were, resolving possibly in serious injury, illness or even death, the deeper the relationship between knowledge acquisition, safety performance and training engagement was. The authors explained that the VE scenarios made the users to imagine and react emotionally to the potential risks of such life-threatening situations. They also pointed out that as 'risk' is a social construct, social and experiential forms of learning are viable ways of hazardous environments training.

This section will present how VE experience has been reported in various hazardous environments training contexts. This means a context where the real life environment itself or actions in it might pose a risk of injury or even a loss of life. In the literature such contexts have been for example underground mining, traffic, construction work, operating a machine such as driving a car or flying an aircraft, and various military and healthcare situations. The aim of this section is to point out how the potential of VEs has presented itself to the authors and how understanding the VE experience has been approached in these studies in this context. Both empirical and commentary studies that report the use of VEs in hazardous environments training were included. It is not an exhaustive account of the field, but a representative sample of studies that present VEs in a hazardous environments training context (see Appendix B for a table of reviewed studies).

A review of the literature revealed four key learning purposes that VEs have been used for: 1) *hazard identification, assessment and corrective action; 2) self-evacuation in an emergency situation; 3) quick decision-making;* and *4) technical skills and machine operation*. In the following, these will be discussed in further detail in connection with the three key reasons to use VEs for learning and training identified in the previous section.

3.9.1 Hazard identification, assessment and corrective action

Trying to spot possible hazards and choose the right actions to deal with them is the most common use for VEs in safety training. Several authors have reported using VEs for such safety training especially in the mining context (Filigenzi, Orr, and Ruff 2000; Kizil 2003; Mallett and Orr 2008; Stothard and van den Hengel 2010a; Stothard and van den Hengel 2010b; Squelch 2001; van Wyk and de Villiers 2009; van Wyk and de Villiers 2016). In many cases, this has been done by leveraging the capacity of VEs to represent real-world environments and situations. Mallett and Orr (2008) saw the potential of VEs and VR as a safe way to immerse trainees in virtual mining situations to practice various skills such as hazard identification. They argued that with such serious games, trainees could "experience the look and feel of moving through an underground coal mine while in the safety of their classroom" (Mallett and Orr 2008, 83). Various VR prototypes have been used to reconstruct past mining accidents in order to allow trainees to learn experientially from past mistakes (Mallett and Unger

2007). Kizil (2003) reported various uses of virtual reality in the Australian minerals sector, arguing that VR can reduce costs, improve safety training, and decrease injuries. According to the author, VR can transport the user to a hazardous context by "immersing the trainee in an environment as close to the real world as possible" (Kizil 2003, 569). This could reduce the need to take trainees to the real world setting, which might be too costly, dangerous and difficult due to the operation running at the site.

Different strategies and design features have been employed in striving for close representations of real environments. Filigenzi, Orr and Ruff (2000) reported a prototype to train hazard recognition, avoidance and evacuation in a mining context. The virtual mine was made realistic by using real maps to model the virtual environment. Detail was also given to the development of physics and interaction opportunities in the VE. To emulate the harshness of the job, more detail was added to model environmental conditions such as rain, smoke, fog, dust and specific kind of lighting. Consequences of user actions were also considered as an added real life fidelity:

> The user navigates this mine while identifying and avoiding the hazards. If the user fails to avoid a hazard, the user's character in the virtual mine will be severely injured. (Filigenzi, Orr, and Ruff 2000, 467)

Filigenzi et al. (2000, 466) proposed that such VE realism will "allow evacuation routes to be practiced just as they would in an actual mine" and that surface/underground geometry with static, animated and environment objects resulted to a sense of presence.

Stothard and van den Hengel (2010a; 2010b) reported a project between higher education institutions and heavy industry companies to prototype the use of a serious computer game simulation for mining induction. The training environment consisted of five scenarios that presented various risk assessment situations. Simulating actual work scenarios in the VE can thus be regarded as another way of representing real world environments, in addition to physical fidelity. In this prototype, the instructor controlled the VE and the trainees reacted to the scenarios with a questions-answers procedure. The authors noted that this did not seem like an ideal process. This was supported by the feedback from the participants who felt the serious game was interesting, but they would have preferred to use it themselves (Stothard and van den

Hengel 2010a). These findings link back to the concept of engagement and the fun factor: simply observing another person operate the VE and answering questions does not seem to be engaging the participants, even if the environment is a physically accurate representation of a real-world environment.

A third way of creating a representation of a real-world environment found in the literature is having the participants assume an authentic professional role in the VE. Reiners et al. (2014) studied how the users perceive hazardous situation in a virtual cargo terminal. The users act as an occupational health and safety inspector in a container terminal context, going through a simulated scenario from an actual situation with similar challenges to the real world context. Instead of merely hearing a lecture about the environment, the learners adopt a context-specific role in the VE as someone working in that environment. Although the population of this preliminary study especially as a quantitative analysis was small, the results indicated that the participants' experience was intense with strong immersion. The findings suggest that a virtual role-play is an engaging way of conducting safety training in a VE.

In some cases the engagement and fun factor have been addressed by adding game elements and interactivity in the VE training environments. For example, Wyk and de Villiers (2009, 53) tapped into the potential of virtual reality to "simulate real-world and imaginary environments and situations with a high degree of realism and interactiveness". They described an environment developed for teaching safety in the context of platinum and chrome mines. In the environment the trainees identify different hazards and actions to correct them. Wrong answers initiate an animation showing a drastic consequence. The users received feedback on their performance, and the system kept score, adding gaming elements to the VE. Wyk and de Villiers (2009) emphasized maximizing realism in order to achieve a more authentic training experience. They proposed that realism could be increased through motion capture, which can give a more realistic feel to how digital models move. Furthermore, content should be aligned with the real world procedures and environmental features, adding immersion. Also teamwork in VEs was noted as a possibility for higher realism.

Sacks, Perlman and Barak (2013) studied the use of VEs in a construction site safety training. Training with a VE was seen useful for developing skills in stone cladding and concrete work, but strong indications for general safety training could not be identified. However, the authors observed that the VE training was especially

powerful in keeping the trainees interested and engaged. Similar positive accounts for using VEs for hazard identification and assessment in the construction sector have been noted for example in a construction site electrical hazards identification study (Zhao and Lucas 2014) and a metro construction safety management study (Zhou, Ding, and Chen 2013).

3.9.2. Self-evacuation in an emergency situation

In addition to identifying hazards, VEs have also been used for the training of self-evacuation in an emergency situation, for example, in cases of fire emergency taking place in environments such as mines and traffic tunnels (Cha et al. 2012; Kinateder et al. 2013; Kinateder et al. 2014; Orr, Mallett, and Klein 2009; Ronchi et al. 2015; S. Smith and Ericson 2009; Xu et al. 2014). Again, the key motivation for using VEs for this learning purpose is the representation of a real-world environment or situation. Similarly as discussed above, the design strategies employed have included environment design with realistic visuals and audio (Ronchi et al. 2015; Kinateder et al. 2014), as well as constructing realistic training scenarios (Kinateder et al. 2013; Orr, Mallett, and Klein 2009). For example, in Kinateder and colleagues' study (2013), a VE was designed to represent a highway road tunnel with realistic details such as objects required by German safety standards, and the participants assumed the role of a driver who were faced with an emergency scenario. The authors also saw the physical realism of the environment as a potential limitation, as virtual training tunnels and real-world tunnels do not necessarily resemble each other, and thus such training might not work in every situation. This once again highlights how especially representational realism has been perceived as an important element of a VE experience, and that it receives a lot of attention in VE development.

3.9.3 Quick decision-making

The interactive and engaging nature of video games has raised interests for using VEs to train people in quick decision-making in various contexts. For example the military has experimented various ways how to use VEs to make combat training more realistic and cost effective . For example Emond, Fournier and Lapointe (2010) reported a project overview in training soldiers in close quarter combat tactics. In their study, several strategies were employed to reach a realistic representation of a real world environment. Physical fidelity was reinforced by using replicas of actual

firearms as controllers, however, there was a strong emphasis on cognitive realism in the design. Task analysis was performed to map what decisions and actions soldiers need to take in such a context. Cognitive modeling was used to develop more authentic virtual enemies, or agents. Similarly, in a study by Wray and colleagues (2005), intelligent computer characters, or bots, that could act as enemies in a virtual environment were developed. Bot behavior was designed based on background literature and expert advice in urban defense tactics. Although the bots were not modeled to look fully realistic, their actions were to provide a sense of realism in the virtual training environment.

Developing realistic and complex VE scenarios for quick decision-making has also been reported in the healthcare sector. Simple Triage and Rapid Treatment (START) process is a commonly used approach to assess the condition of victims and their need for treatment in mass disasters. In a study by Andreatta et al. (2010), a simulated office building explosion scenario was developed both into a physical space and as a VE. Effort was made so that the both training environments would resemble each other as much as possible in order to compare their effectiveness for training:

> We created a VR environment that was an exact replica of that training context. The VR space included the same office layout, facilities, and furnishings and the same locations, personal characteristics, and injuries of the victims. The VR drill incorporated exactly the same scenario and identical scripts for the virtual patients as those for the SP [standardized patient] drill. In the VR scenario, residents assessed respiratory rate by observing the virtual patients, but were required to verbally request a pulse rate (which was then provided by the faculty evaluator). (Andreatta et al. 2010, 872)

According to the study, the aim was to make both of the environments resemble each other but this aim was clearly towards representational realism. The authors did not discuss in-depth how the users' interaction during the training scenario might affect the experience. In a real world setting people interact directly with tangible objects and move and use their bodies in certain ways. This can often be quite different to interacting with VEs, which is a mediated experience. Therefore trying to find a pulse from a real person or from an avatar representation requires different kinds of bodily actions, and such, could be considered as a different kind of an experience altogether. This raises the question, not only in the study by Andreatta et al. (2010) but also in

some other studies, if the importance of representational realism gets too much focus while cognitive and bodily realism are often ignored or downplayed as variables affecting experience.

3.9.4 Technical skills and machine operation

VEs have also appeared potential for technical skills and machine operation training. One of the earliest and perhaps most widely used contexts is aviation. Although VEs, VR and simulations have been frequently employed and researched in aviation, research results of the effectiveness of using VEs in this area are mixed. Bell and Waag (2009) reviewed literature to determine the effectiveness of training combat pilots with flight simulators. Various limitations from cost to security prevent training pilots in real world settings. There are several tasks and scenarios combat pilots can train with VEs: weapons delivery (dropping bombs), navigation to and from target area, air maneuvering, and offence and defense against various forms of threats in the air and from the ground. Although literature indicates mostly positive results in using flight simulators for flight combat training, Bell and Waag (2009) found the data limited and argued that more robust training models are needed to determine the actual value of combat training simulations.

Flight simulators have also been studied in order to determine what level of realism is important in simulation training. In their meta-analysis, de Winter, Dodou and Mulder (2012, 179) noted that "whole body motion is important when flight-naive subjects need to learn helicopter maneuvering or disturbance tasks; motion might not be important for experts refreshing their maneuvering skills". Also report by Dahlstrom et al. (2009) suggested to consider the effects of simulation fidelity during training. According to the authors, simulators with different levels of realism actually train different kinds of knowledge and skills:

> Lower-fidelity simulation allows the development of generic problem-solving skills, such as sharing knowledge, making and following up on plans, dividing work, stepping back for broader evaluation, borrowing time from the future by current task investments and maximally exploiting a group's available expertise. (Dahlstrom et al. 2009, 312)

The authors proposed that low-fidelity and highly realistic simulators could thus complement each other and give broader training opportunities.

Apart from abundant VE literature in aviation sector, VEs have also been employed for technical skills training in other contexts, such as in the construction sector. Guo et al. (2012) observed a skill gap in this sector: more efficient training methods would be needed for safer operation and better collaboration between team members. Their study described a work scenario where three trainees needed to work together in order to correctly dismantle a tower crane. Each of them was required to complete a different task for successful performance, and to maintain effective communication, collaboration, and correct procedures. The designed VE had several aims. It had to resemble the real environment and deliver safety information effectively. Instead of an instructor led environment, trainees should be able to use it collaboratively on their own, and it should be intelligent by identifying and warning users about wrong procedures that might cause hazards. According to Guo et al. (2012) the VE has proven to be useful in several construction projects, and has improved safety performance with helping the trainees to learn about construction site operation, collaboration with team members, and identifying safety problems. Still, the authors noted that the problems in the field are not always due to knowledge as such:

> Many safety problems were caused by the personal behaviour and attitude of the operative. Although the platform can assist operatives in identifying potential safety problems it is difficult to avoid their occurrence without the operative's commitment. (Guo et al. 2012, 211)

Lucas, Thabet and Worlikar (2008) studied the use of VEs in training conveyor belt safety in mining. They introduced a VR prototype that the trainees could use with similar tasks that can be found in the real work environment. The VE aim was to combine operating the machine and also recognizing possible hazardous situations. The training environment simulated various actions and their consequences:

> At certain stages of the process if the user completes something out of order certain consequences can happen. If the user does not shut down the belt, or lock it out, and removes the guard, it is possible that the employee in real life would be injured. (Lucas, Thabet, and Worlikar 2008, 646)

Although a small population, initial feedback was reported to be mostly positive. Furthermore, as in some of the other studies, the trainees reported to enjoy the practical

hands-on training that the VE provided, and the possibility to test their learning with actual scenarios.

Due to the reducing opportunities and time to practice specific technical skills, the potential of VEs has also been noted in the context of surgical skills training. As new surgical methods and technologies are introduced, there is a need to find new and more efficient ways to training them. For example Lewis et al. (2011) listed several surgical simulations that allow training full surgical scenarios without the need of an actual human body. Although proponents of VR training, they observed that more work needs to be done to determine the cost effectiveness of simulations for them to be more widely accepted in the healthcare sector. Also Sabri et al. (2010) discussed using serious games to learn the skills of performing a knee replacement surgery. The game was designed to be used in conjunction with traditional training methods and focuses on the procedure performance. The aim was to develop a game that the trainees would be able to use in their own time and on their own personal computers. The VE models an operating room where the trainee works as an orthopedic surgeon. The view is from the eyes of the avatar, with the avatar's hands visible. The trainees can select various tools and actions in order to perform the knee operation. Various multiple choice questions work as checkpoints along the way. Furthermore, an in-game avatar gives feedback to the users, and after finishing they will receive a numerical evaluation form of their performance. As a conceptual paper introducing only the first developments of the VE prototype, it did not include any empirical results. Therefore it is difficult to draw any conclusions on for example how the users might experience performing surgical operations in the VE, and how it might connect or help to perform the same actions in the real world.

3.9.5 Summary: VEs in hazardous environments training

VEs have been applauded as a potential new way to train people to perform and survive in various kinds of hazardous environments. The main use of VEs still appears through the possibility to develop realistic representation of real environments. Still, what this realism means and why it is important, is often vague and poorly justified. More often it means graphical realism, when cognitive and bodily realism, the way people might perform tasks in real environments and how it involved their cognition and body, gets less attention. Also, many hazardous environments training studies have been conducted with prototype environments where the users do not often even use

them as part of their everyday work. Research on how VEs appear to real users during a real use situation is therefore scarce. Furthermore, empirical research in this area often relies on quick or short feedback with surveys or questionnaires. Therefore it is clear that the existing research in hazardous environments training would benefit from more in-depth qualitative studies performed with real users. Such research could make the users' experience of VEs more explicit, and thus affect future VE developments. This is important as it can make VE development more coherent and also result in more effective hazardous environments training with VEs.

3.10 Conclusion

The experience of VEs has manifested itself through various aspects, moments and perspectives. Their engaging nature has invited development of formalized concepts such as immersion and presence that could capture the nature of the experience (Chapter 3.4). Still, immersion is immersion to something. Therefore many aspects such as narrative, interaction, avatars and virtual embodiment have been explained as what define or give rise to VE experience. Using entertainment video games, collaborative virtual worlds or virtual reality systems in various kinds of real life and experimental situations provide different moments to these aspects. Furthermore, earlier theoretical constructions, implicit worldviews and even science fiction have affected how VEs have been approached in research (Chapter 3.7). In many cases it has led to formalization of concepts and study methods in order to make research results easier to compare.

As described in Chapter 3.8. and its subchapters, the engaging nature of VEs in leisure contexts has led to explore their use in non-entertainment contexts such as learning and training. VEs have been applauded as something that have the potential to engage contemporary learners who are increasingly used to interactive media, and might even expect them in learning situations. VEs have also been regarded as something that could capture various aspects of real life situations for the users to interact with in a safe surrounding (Chapter 3.8.2). This aspect has naturally captured attention in hazardous environments training.

While aiming to determine how VEs could be used in hazardous environments training, many studies follow certain common strands of inquiry that show the need for further research in the field. These are 1) the emphasis on representational realism

or "fidelity", 2) studying prototype environments and experimental situations, and 3) using quantified or predefined and short qualitative feedback from the users.

Firstly, in many studies, visual or representational realism gets high priority in research and development. Oftentimes this does not seem to be grounded in earlier research, but is based on assumptions of the importance or the suggested potential of VEs to simulate reality. Thus many studies take representational fidelity, or visual life-likeness, as the starting point of research and development, without holding its importance under scrutiny. Still, there are views that have challenged its importance. For example Caird (1996) was especially critical towards the concept of fidelity. While it is often stated that more fidelity is good, Caird (1996) noted that what it means in the first place is regularly poorly defined. According to Caird (1996, 128), it would be "more important to understand which aspects of an overall task need to be supported in the simulated environment, rather than the overall fidelity of the simulation system." In addition, some studies have even suggested that higher fidelity might actually affect learning results negatively, and that lower fidelity could sometimes be better for training certain skills (Dahlstrom et al. 2009).

Secondly, several studies researched the use of prototype environments and experimental situations while there were few studies on how users might experience VEs during actual hazardous environment training situations. There are compelling arguments both in human-computer interaction in general (e.g. Moran 1994; Moran and Dourish 2001) and games studies (Deterding 2016; Mäyrä 2007) that propose that contexts affect the users' experience.

Thirdly, the data in the studies were often gathered with quantitative measures or short predefined qualitative questionnaires. The users were often asked if they enjoyed the VE or how real it felt to them, which already guides the research towards certain direction and findings. The replies were often quantified ("rate from 1-5") or consist of short comments such as "I really enjoyed it". Such studies could be complemented with rich qualitative data and analysis that would describe more in-depth what the VE experience was like, and that could rigorously describe *what* the users experienced, *how* they experienced it, and *why* they experienced it. Therefore to conclude, the field of HCI could benefit from research that gathers rich data to analyze more in-depth the experience of VEs during actual hazardous environments training situations, without presupposing or emphasizing the importance of any individual VE

element prior analysis. Rigorous analysis and description of how users experience VEs could show what aspects of VEs are important for the experience, and therefore direct research and development. Phenomenology as an approach to study the intentional nature of experience from the user's perspective appears as a viable option that can give an important contribution to the existing research both in HCI and hazardous environments training.

Chapter 4: Research Design

4.1 Overview

This chapter presents the chosen research design and methodology. It will discuss the philosophical paradigm and interpretive framework of this study to justify the chosen qualitative research approach, namely, phenomenology. This includes research objectives, sampling strategy, data collection and analysis method, with validity and ethical considerations. The overall research design is illustrated below in Table 3.

Research Topic Development

- Review of personal experience and research literature
- Developing research question, objectives and choosing the appropriate methodology (phenomenology)
- Understanding the phenomenological research approach and methods
- Bracketing my own presuppositions of the research topic (continuing throughout the study)
- Ethics application

Phenomenological literature review of the literature

- Research question: What is the experience of VEs described to be like in existing literature?
- Phenomenological analysis of the literature based on Randolph' (2009) approach to perform a phenomenological literature review
- Describing the key aspects and the essence of VEs as seen through the eyes of the authors

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Selection of research participants for the study

- Developing selection criteria: "Employees who have experienced using VEs for hazardous environments safety training"
- Creating the sampling strategy and the consent form

Data Collection

- Choosing the data collection method: Semi-structured in-depth interview to collect rich data
- Developing the interview question
- Managing data storing

Data Analysis

- Employing Giorgi's Descriptive Phenomenological Method

	• Finding the key constituents of the experience and developing the description of the essence of the experience
Discussing the research findings to the literature review findings	
	• Relating the phenomenological structure of the experience from the research participants to the one developed in the literature review
Implications and Conclusions for future research	
	• Recommendations for practice and for future research opportunities

Table 3. Research design

As presented in the literature review chapter, existing studies reveal a gap in studying VEs through user experience, especially analyzing the life-world of users in a safety training context. Many studies focus on technology instead of the users' experience, and are either experimental or quasi-experimental. They often choose a specific aspect of a VE as their focus, such as the effect of graphical realism or the use of avatars. Furthermore, they often gather quick feedback from prototype environments with predefined data collection instruments such as surveys. Such studies are naturally valuable for the development of more efficient virtual training environments. Still, research that does not begin from existing theoretical stances and hypotheses but from studying the experience of real users in their context can more clearly shed light to the structure of VE experience and how this experience is formed. Such perspective will bring an additional valuable contribution to existing studies of VE user experience. With its rigorous empirical approach to study experience, the descriptive phenomenological method developed by Giorgi (2009; 1985) was chosen to structure the present research.

4.1.1 Research questions and objectives

Phenomenological research questions are deliberately broad to maintain openness with the researched phenomenon. The aim of this study is to understand how the users experience a VE while they use it in their work-related health and safety training session. The aim is guided by the following main research question: *How users experience virtual environments in a hazardous environments training context?* Instead of focusing in a predetermined aspect of VE experience, the study examines

from an open position how VE experience emerges for the users in a safety training setting.

The objectives of this study follow the phenomenological method and are as follows:

- To understand the constituents that form the experience of VEs
- To construct a general description or the essence of the VE experience
- To critically compare the study findings to existing theories and previous research in the area of VE experience

Findings of this study are expected to lead to a better understanding of *what* users experience when they use a VE and *how* they experience it. This understanding can lead to better design in safety training and thus safer practices in hazardous environments. This has the potential to reduce significant injuries and unnecessary deaths. Furthermore, as the study aims to reveal how the users' experience is formed and structured, the findings can also result in new development ideas on how to support the user experience throughout the training situation and where to focus VE design efforts. As such, the study can benefit professional groups who are involved in designing virtual environments for other contexts as well. These groups might include user experience, instructional and learning designers who work to develop VEs, but also those who plan to acquire VEs as part of their training. This study also aims to reflect its findings with VE research outside safety training context to determine the findings correspond to them. This could support theory building in the area of VE experience in general. When studying VEs, phenomenology has more often been used as a research paradigm or a theoretical frame instead of a research approach. Therefore employing phenomenology in this study as a research method can also give a valuable contribution to the field of phenomenology, and how to use it to study VEs.

4.2 Research methodology

This section will present the methodological framework of this study. It will outline the research design and discuss the epistemological and ontological underpinnings of the qualitative research approach. It will also connect the chosen research method, phenomenology, to these underpinnings.

4.2.1 Research design

Creswell (2014, 12) has described research design as "types of inquiry within qualitative, quantitative and mixed methods approaches that provide specific direction for procedures in a research design." As this study aims to understand the experience of VEs through the user meanings, it follows the qualitative approach under which Creswell (2014) places phenomenology. After comparing several qualitative approaches, such as narrative inquiry and grounded theory, phenomenology as an approach to study "the lived experience of individuals about a phenomenon as described by participants" (Creswell 2014, 14), was chosen as a suitable but underused approach to study users' experience in the context of VEs. Its approach to hold the researcher's personal and theoretical views about the phenomenon in abeyance for the duration of the analysis was also seen as an important factor as the researcher has a history as a gamer and an interaction and instructional designer (see Section 1.2).

4.2.2 Epistemological and ontological underpinnings of this study

According to Gray (2014), the research methodology advises data gathering methods, but underlying everything are the researcher's epistemological and ontological perspectives. Our worldview affects our beliefs of truth, objectivity, and subjectivity, and if we as researchers should and could stay neutral during a research study (Marshall and Rossman 1999).

Existing philosophical paradigms impact epistemological positions (Langdridge 2007). Guba and Lincoln (1994, 105) defined a paradigm as "the basic belief system or worldview that guides the investigator, not only in choices of method but in ontologically and epistemologically fundamental ways". Epistemology has been described as the limits of knowledge and how we come to know. It is the theory of knowledge (Sokolowski 2000), but also "the relationship between the knower and the known" (Langdridge 2007, 3). According to Gray (2014, 19), it is taking a stance in "what it means to know" and "what kinds of knowledge are legitimate and adequate". Ontology has been described as the study of being, existence, what is, and the nature of reality (Creswell 2013; Gray 2014).

Epistemological and ontological positions affect the accepted theoretical stance:

…for positivists the world is independent of our knowledge of it – it exists 'out there' while for relativists and others, there are multiple realities and ways of accessing them. (Gray 2014, 19)

Different paradigms have been explained in various ways. Willis (2007) described that generally accepted major paradigms include postpositivism, critical theory, and interpretivism. At the same time, Gray (2014) introduced a non-exhaustive list of theoretical perspectives as positivism, interpretivism, critical inquiry, postmodernism, and feminism. Denzin and Lincoln (2011) described four major research paradigms that underline research: positivistic/postpositivistic, constructivist/interpretive, critical and feminist/poststructural. Also Creswell (2014) identified four slightly different major views: the postpositivist, constructivist, transformative, and pragmatic. Postpositivist worldview relies on reduction, empirical measurements and verification of theory. Constructivist aims to understand his or her objective of research through multiple views or meanings, and possibly generate theory from research. Transformative worldview is political and action oriented to change the world better, especially through giving a voice to marginalized people. Pragmatists use whatever in their grasp, be it philosophy or mixing different research methods and modes of analysis, in order to get the job done. They are interested in problems and how the research can help real-world practice. For them, "truth is what works at the time" (Creswell 2014, 11). In addition to these, arguments affected by postmodernism have reasoned that all research is inherently interpretive as it is always affected by existing worldviews and power relationships: there are no purely neutral views.

Willis (2007) underlined that paradigms should not be taken lightly as they have actual effects on what gets published as real research and the evolution of research approaches. As many authors (Gray 2014; Rota 2008; Ryle 1949) have long discussed, the widely accepted classical mechanics paradigm deals with comparisons and dualism (e.g. if A is A and B is B, then A cannot be B). Sokolowski (2000, 201) has examined such developments as follows:

In regard to human knowledge, reason takes possession of itself and rules over its own experiences by generating methods of inquiry and carrying out a critique of its own powers. The mind establishes itself as reason. The mind rules over itself and its power to know.

Historical epistemological developments direct and restrict alternative worldviews, which in the end affects what is considered as possible to report research:

> The "define your terms" imperative is flawed in more than one way. (…) The theorems of mathematics motivate the definitions as much as the definitions motivate the theorems. A good definition is "justified" by the theorems that can be proved with it, just as the proof of the theorem is "justified" by appealing to a previously given definition … The theorems are proved starting with definitions; but the definitions themselves are motivated by theorems that we have previously decided ought to be correct. (Rota 2008, 97)

As Rota (2008) has noted, the state of the field where the researcher enters forms the boundaries of "useful", "practical" and "acceptable". Still, as it can be seen from the development of postpositivism, paradigms are always negotiated and changing, affected by both social and hard sciences (Gray 2014; Rota 2008). For example, Rogers (1980) described developments in theoretical physics, mathematics, and chemistry that dispel the traditional notion of stable objects of reality and how knowledge can be achieved. Also results from experiments in quantum mechanics have recently indicated that an atom is not matter or light before it is measured (Manning et al. 2015). Interestingly, this account holds similarities with phenomenology, and how far we can explain "real" reality. Spiegelberg (1975, 134) observed that this is not a simple question of dichotomy:

> Reality and phenomenology do not explode each other, either conceptually or structurally. What is real exists in and of itself and may, though it need not, be real at the same time. The phenomenal world is a group of entities characterised and set apart by their special structure; rather it is held together merely extrinsically by the fact that the spotlight of observation catches them temporarily.

4.2.3 Qualitative research and interpretivism

Qualitative research consists of various research genres (Marshall and Rossman 1999) or approaches (Creswell 2014; Gray 2014) that have been defined and redefined over time. Terminology makes it sometimes difficult to grasp what is an approach and what is a design. For example, Creswell (2014) recognized five qualitative approaches: narrative research, phenomenology, grounded theory, ethnography, and case study. At

the same time, he described these as designs of inquiry. Gray (2014) discussed symbolic interactionism, phenomenology, realism, hermeneutics, and naturalistic inquiry approaches as part of the interpretivist theoretical perspective.

Qualitative researchers obtain the view that reality is socially constructed and that different people hold different views of reality (Creswell 2013). Rossman and Rallis (as cited in Marshall and Rossman 1999) stated that qualitative researchers have a holistic view on phenomena, acknowledge and make their personal views explicit during the study, and use iterative reasoning. It is vital for the investigator to make his or her philosophical worldview already explicit in the beginning of the research as it affects everything from the overall research design to the chosen research methods (Creswell 2014; Gray 2014). If one does not believe that multiple human accounts of a phenomenon can result in a useful research outcome, one simply cannot employ open-ended interviews followed by a qualitative research design such as narrative research or phenomenology.

For an interpretivist, the world and objects in it are interpreted through the mind (Gray 2014). This notion challenges that the methods of natural sciences studying natural phenomena would be useful in human sciences: atoms and particles do not have a consciousness through which they interpret their surroundings and make decisions, but people do. Naturally also this view has its critics (e.g. Bogost 2012; Latour 1993).

4.2.4 Phenomenology as qualitative research

Various authors have categorized phenomenology under qualitative research approaches or genres (Creswell 2013; Guba and Lincoln 1994; Marshall and Rossman 2011), and under an interpretivist perspective (Creswell 2013; Gray 2014). Some authors have discussed that in reality the boundaries are less precise, and some such as Racher and Robinson (2002) have even suggested phenomenology to have similarities with postpositivism. Still, several authors (Flick 2007; Gray 2014; Marshall and Rossman 1999) have shown how the phenomenological paradigm differs from positivism in several distinctive ways: phenomenology considers the world as socially constructed and not just external and objective; the researcher is part of the research and not a neutral outsider; it recognizes that science has implicit meanings instead of being value-free; it focuses on meanings instead of objective facts; it aims to understand phenomena instead of testing pre-defined variables and proving

hypotheses; it is inductive instead of deductive; it uses a small sample instead of a large; and its methods of data collection and analysis are qualitative, for example interviews, instead of quantitative, such as questionnaires.

4.2.5 Phenomenology and epistemology

Spiegelberg (1975, 131) asked a crucial question, "how far can the phenomenon of reality tell anything about 'real' reality?" Does it not just answer what "we take to be real" and what guarantees that "the supposedly real is actually real" (Spiegelberg 1975, 130)? Phenomenology's answer to this challenges epistemological notions:

> Our cognition consists of the immediately perceived objects, i.e., of the perceptual phenomena. The examination of their relation to reality must therefore be a major task of every epistemology. (Spiegelberg 1975, 131)

Spiegelberg (1975, 131) explained that if reality exists beyond "phenomena as presented to us and the 'real' reality apart from such presentation", it would require comparison, which is impossible as it is always a new phenomenon to us through our cognitive acts. It would never be "free from any relation to us" (131), or to put it in other words, "objective". Spiegelberg (1975) noted this to be the central limitation of every epistemology.

Complexity and possibility for misunderstanding exists with phenomenology, especially with Husserl's widely cited phenomenological maxim "Back to the things themselves". Sokolowski (2000) has noted that existing Cartesian views of epistemology and ontology have affected how Husserl's phenomenology has sometimes been misinterpreted. As Racher and Robinson (2002) have shown, concepts of subjective and objective are differently present in phenomenology. Based on, for example, Guba and Lincoln's (1994) description of the epistemology of positivism being "dualist/objectivist", Husserl's position might appear slightly similar (more on Husserl's relationship to Cartesianism; e.g. in Sokolowski (1999)). Phenomenology regards at the same time that people can perceive various phenomena differently, but that there exists common essences that can be described. Still, these essences are not necessarily stable.

Phenomenology has been acknowledged to be able to answer epistemological questions (Spiegelberg 1975), but it is not just "an exercise in the theory of knowledge" (Sokolowski 2000, 61). Phenomenology studies the essential structures of phenomena,

as "there is at least the possibility that in their very structure they already refer to something beyond themselves" (Spiegelberg 1975, 131). It invites a thorough examination of how phenomena present themselves, the "what and how" (Spiegelberg 1975, 131).

Phenomenology considers humans as intentional action-oriented embodied beings who are affecting and are affected by different physical and social contexts (Gallagher 2014). It also recognizes that the human mental world is not fully private and unreachable, but can be made public (Husserl 2012; Sokolowski 2000). This is why human experience should be understood through its context and life-world (see more on *life-world* in Section 2.4.2).

4.3 Data analysis with Giorgi's descriptive phenomenological method

Phenomenology has similar characteristics to other qualitative studies, and it has been discussed as an approach to qualitative research (Creswell 2013). Still, the way phenomenology operates from the adaptation of the phenomenological attitude to epoché and the search for meaning also differs from other qualitative approaches. The following will present Giorgi's (2009) modified Husserlian approach of a phenomenological analysis that is used in this study. It was developed in psychology but has been employed in many other fields such as nursing (Giorgi 2000), business (Russell 2006), professional development (Webster-Wright 2010) and even in law enforcement in studying police officer's experience of using deadly force (Broomé 2014).

Giorgi (2000) has discussed philosophical phenomenology and scientific phenomenology as different things, and that it should be made explicit what one is doing. Giorgi (2000, 13) has argued that the researcher should be familiar with the philosophical underpinnings of phenomenology, but that his "method is legitimately phenomenological, but scientific rather than philosophical". Giorgi (1997) has described several ways the scientific phenomenology differs from philosophical phenomenology. First, instead of studying the phenomenologist's own consciousness, the researcher obtains everyday lived descriptions from others and studies them to describe the phenomenon. Second, the phenomenologist adopts the phenomenological attitude in order to "withhold past knowledge about the phenomenon he or she is researching in order to be fully present to the concrete instance of the phenomenon as

presented by the subject's description" (Giorgi 1997, 244). This means the researcher will put aside any theories or personal experiences that might explain the subject's experience of the phenomenon. Third, the researcher does not take the subject's account to be describing an objective truth, but something that describes what was present to the subject. Fourth, the researcher needs to analyze the obtained description with a special sensitivity to the perspective of the discipline and the phenomenon being researched (Giorgi 1997, 244). In the case of this study, the discipline is human-computer interaction, and the phenomenon is virtual environments. Finally, fifth, the scientific phenomenology aims to find more narrow "scientific" essences instead of universal philosophical ones. As Giorgi (1997) has explained, every discipline needs to determine how contextual or discipline specific the found essences are; in the case of this study, could the essential invariants of using a virtual environment transcend the use of VEs in safety training context to other VE use situations, and even other technology use situations?

The following section will introduce the stages of Giorgi's (2009) phenomenological method that was used to analyze the interview data. It should be noted that even though the steps are introduced here in a linear fashion, the analysis process was experienced more as a zigzag between these steps (cf. Webster-Wright 2010).

4.3.1 Reading for sense of the whole

The researcher assumes the phenomenological attitude and begins to read the whole transcript of the interview to get a sense of the whole. Most likely the participant's account will have meanings that come out in different phases of the interview, but making them explicit is not important at this stage, but are done during the following steps of the analysis (Giorgi 2009). The researcher is merely trying to get a sense of the whole, and what the general themes are about.

As Giorgi (2009) points out, this stage of reading the whole is common to many qualitative approaches, and so are some other steps of the analysis. The difference between phenomenology and other qualitative approaches is that the reading is done from within the phenomenological psychological reduction, and the aim is to note the "intentional objects of the lifeworld description provided by the participant" (Giorgi 2009, 129). The other difference is that descriptive phenomenology aims to maintain

the open attitude through its analysis, and not to structure the experience with predefinitions.

In this study, the transcripts were thoroughly read at this stage.

4.3.2 Determination of meaning units

According to Giorgi (2009), all qualitative analysis processes require the step of establishing parts of the whole data in one way or another. This helps focusing more fully in the analysis, as the transcripts are usually too long to be analyzed as a whole. In phenomenology, in contrast to some qualitative analysis methods that employ predefined labels for coding, no pre-established criteria are used. The distinctive way of achieving partitioning in phenomenology comes from its goal to understand the meaning of experience (Giorgi 2009). Instead of treating single sentences as parts of the whole, "the constitution of parts in the method are based upon the dimension most sensitive to the ultimate goal of the task" (Giorgi 2009, 129). This means the researcher's perspective and research objective plays a role here.

The process of determining meaning units takes place as follows. After reading the transcript fully, the researcher goes back to the beginning and begins to read it again. The phenomenological psychological attitude is maintained with being "mindful of the specific phenomenon being investigated" (Giorgi 2009, 130). Whenever the researcher experiences a shift in meaning, he or she makes a mark.

Giorgi (2009, 130) emphasized that "there are no objective meaning units in the description as such", but determining them is based on the attitude and sensitivity of the researcher. Different researchers could get different meaning units, but it does not matter in the end: different meaning units can lead to the same results. Establishing meaning units does not have theoretical value, but the process merely makes them more manageable for the more in-depth analysis (Giorgi 2009), which takes place in the more difficult next phase.

In this phase, a new meaning unit document was established for each of the participants. All the transcripts were read through from the beginning, and divided into meaning units. An individual meaning unit was established when it was sensed that a change of meaning took place in the transcript. A table was created in the new document in order to place the emerging meaning units into their own cells. Sections of the transcript were pasted into the left column of the table. Sections of the transcripts that were judged as irrelevant for the research question were omitted. All the meaning

units in the table were given a running number (see Table 4 for an example of a meaning unit). In the end, the total of all meaning units from all the participants was 192.

4.3.3 Transforming of participant's natural attitude expressions into phenomenologically sensitive expressions

After the meaning units have been established, the participants' expressions are transformed to a more discipline-specific language and made more general (Giorgi 1997). Giorgi (2009) describes this as the most laborious and difficult phase in the analysis process. He gives three advices for the researcher at this phase. First, the researcher needs to maintain the phenomenological attitude during the analysis. This means not structuring the analysis with existing knowledge of the studied phenomenon (Giorgi 1997). In the case of this study it means not using the researcher's own knowledge about interaction and game design principles or personal video game history to structure the descriptions. Second, the researcher needs to abstain from making claims if the things in the participant's account are true or not, or if they exist, but continue to describe them as "how the subject construed the situation" (Giorgi 1997, 244). Third, "the researcher has to analyze the description with a special sensitivity to the perspective of his or her discipline…and with a sensitivity to the phenomenon being researched" (Giorgi 1997, 244). Furthermore, Giorgi (2009) warns that although the phenomenon is described with bringing forth discipline-specific aspects of the experience, great care should be taken to avoid discipline-specific jargon. Great care was taken to describe the participant accounts with special relevance to the human-computer interaction perspective, but as Webster-Wright (2010, 96) describes, "retaining all other features of the experience in the background".

Giorgi (2009) recommends beginning this stage by changing the language in the participant account from the first-person perspective to the third-person. This small change will make it more explicit that the focus of the analysis is another person's experience, and prevents the researcher identifying too strongly with the viewpoint of the other (Giorgi 2009). This also supports rigorous analysis where the researcher will not project his or her personal ideas that are not found in the data from the participant.

Another aim of this phase is to express the meaning units on a more universal level by reducing the specific details of the experience but at the same time maintaining their meaning. For example, an expression from one participant of this study, *"I was*

too busy working really hard to notice the first time that he was fitting" was expressed as, *"During an intense concentration to her activity she did not notice the other character's changed bodily condition the first time it took place."* This will refocus the reader's attention from a specific activity (working hard) to the fact that the participant was concentrating to perform a VE activity in an intense manner. It also describes more clearly that the participant did not notice the virtual character's changed bodily condition, originally expressed by the participant more specifically as "he was fitting". This retains the meaning in the meaning units, but brings them closer to HCI and makes them more generalizable between different accounts in order to develop the general structure of the phenomenon.

After determining the meaning units, a second column was established in the meaning unit table. In this column, the participants' verbatim expressions were changed from the first-person to the third. In many cases, the participants went in and out from describing things from their perspective and from the more passive "you" perspective, as in *"you just pick options and they do it for you"*. In such cases, "you" was maintained in the first transformation.

Next a new column for the discipline-specific transformations was added. As Giorgi (2009) has proposed, there are no set amounts of transformations, but the researcher needs to determine when a transformation fulfills the meaning of the unit. For this, the process of free imaginative variation is employed (Giorgi 2009). As it was explained in the key concepts of phenomenology, imaginative variation signifies a mental experimentation of trying to vary the meaning in the data by imagining aspects of the object to be different or varying their appearance.

For this, Webster-Wright's (2010) approach was adopted where a specific column was added to the table for notes and reflection. The specific function of this column was also to make explicit the researcher's video game and interaction design related meanings that might come to mind during transforming the meaning units. If the meaning unit prompted personal examples from video game experiences or how to employ imaginative variation to determine the invariants of the experience, it was written in the column. This makes the analysis process more rigorous and transparent. In addition to keeping the researcher's views about the studied phenomenon in abeyance, the process of continuous writing greatly supported finding the proper expression of the meaning units. An example of a meaning unit from one of the

participants can be found in Table 4. The discriminated meaning unit from the original verbatim transcript is located on the left column. The first transformation that changes it to the third-person and aims to make it more coherent is in the second column. The next columns present transformations that aim to fulfill the meaning of the meaning unit and also to express it more directly in HCI-specific language. The last column on the right is reserved for reflection and notes.

Original transcript *(Discriminated meaning units in their original form – passages clearly unrelated to the experience of VE were removed)*	Transformation 1 *(Discriminated meaning units expressed as much as possible in the subject's language and based upon perspective that description was an example of the experience of a virtual environment)*	T2 *(Discriminated meaning units expressed more directly in HCI language and with respect to relevance for the phenomenon of virtual environment. Also the nickname is changed to 'the user' for easier analysis with the other accounts.)*	T3	Reflection/notes
1. User BD: Umm… It was pretty, some, I think some of the instructions were little… vague. So I had to, I killed a guy. 'Cause I didn't give him enough water, 'cause I didn't… the instructions weren't very clear. So I think… More common sense was expected from people than what… information was provided I guess.	BD thinks some of the instructions were little vague. She killed a guy because she didn't give him enough water. The instructions weren't very clear. She thinks more common sense was expected from people than what information was provided.	The user thought some of the instructions were vague. She blames them for killing the virtual character in the training environment, as she did not give him enough water. The user estimates that more common sense was expected from users, instead of giving more information.	The user experienced the instructions were imprecise. She gives an example where her inaction caused a poor outcome to take place [*she killed a guy*]. She felt that the users were expected to recognize a situation and act on it based on common sense, and without correct level of information.	*There are several things here, but most importantly that she feels there was not enough instructions on what would happen, and that the user should recognize situations and be able to act on them based on universal, day to day experience, or 'common sense'. To her, nothing signified or made her anticipate that she would have to act specifically in such a situation when it occurred. It was not totally without instructions, but instead of making it explicit, it was implied with 'vague'/'unclear' instructions.*

Table 4. A meaning unit example with transformations and notes.

4.3.4 Writing the general structure of the phenomenon

In the final stage, the researcher writes the general structure of the phenomenon. The aim is to illustrate how the studied phenomenon manifests itself through the lived experience. It can represent things of which the participants are both aware and unaware of during the experience. As Giorgi (2009, 166) has written, the structure "is not a definition of the phenomenon". The aim of the structure is to provide insight into the lived experience and ground for communicating the research findings. With the structure, the lived experience gets expressed more generally (eidetically), which means it can be relevant to other individuals outside the context of the study (Giorgi 2009). Based on the obtained data, more than one general structure might emerge. According to Giorgi (1997), if a study is done for example with five subjects, anything between one to five structures is a possibility.

The general structure consists of constituents of the phenomenon and the "description of the intentional objects… essential for the structure" (Giorgi 2009, 199). As Giorgi (2009, 166) has pointed out, "the relationship among the meanings is the structure". The structure is written with the support of the participants' discriminated meaning units and using imaginative variation to determine "which ones are truly essential for the phenomenon to present itself to a consciousness" (Giorgi 2009, 200). The structure can be based on one subject, but Giorgi (1997) has recommended using several. The researcher compares and contrasts meaning units in order to locate the constituents. Instead of just being a process of collating key meaning units, the researcher employs imaginative variation to determine which are the essential constituents and how to describe the structure "from the perspective of the discipline" (Giorgi 1997, 247). What is important is that the structure is also tested with imaginative variation if it holds when potential constituents are removed. The researcher needs to find the suitable way to express the structure, and not to let the language of the meaning units dominate; as partial analyses, language used in them might not always work for the general structure (Giorgi 2009).

At this stage the meaning unit tables were imported to qualitative data analysis software NVivo to make the participants' meaning units more easily comparable. The aim was not to code them similarly to, for example, a grounded theory study. The aim was to use NVivo to make the comparison of meaning units and determination of the constituents more systematic. Below are three meaning units from two participants that were compared and contrasted, and which were determined in the analysis to belong to the same constituent (see more details of the analysis in the Results section).

12.	I: About taking the samples, do you think it felt the same, doing that in the… with the computer and doing in… B: Nah, no, you… Because it is a hazardous material, it is getting kitted up in the… the chemical gear and respirators [word missing] gloves and goggles and all that sort of. With the computer [laugh], you're just [in close?]. [laugh] It becomes uncomfortable actually to do the testing.	When asked if taking samples felt the same with the computer and doing it in real, B say no. The reason for this is that it is hazardous material: it is getting kitted up in the chemical gear and respirators, gloves and goggles. With the computer, you're just too close. It becomes uncomfortable actually to do the testing.	When asked to compare between the virtual and the actual work environment if doing a specific task felt the same, the user says no, because the material you operate with gets kitted up with your safety gear and it can affect your level comfort when doing it. With the computer, you are just too close.	The user explains there is a difference between doing the same task in the virtual and the actual plant. In the actual environment the materials you are working with build up on your safety gear and can make you feel uncomfortable to do the task: with the VE, you are just too close.	Cf. to the "cut and dried" MU. Also, again 'virtual'. Is conveying the process that seems to matter in the virtual?

Table 5. MU12 from user B.

17.	B: But it would tend to lend itself to that. Umm… I don't think there's too many other… I: But let's say that, you could… like, you could use your hands more or. B: Yeah aa, yeah-yeah, but it's not that it's the fact that it's pretty "cut and dried". Umm… what you are looking for and what you do. Where a lot of the other processing… especially aa solids and material handling [between ?]. It has a lot to do with other senses as well, like hearing and you know. Feeling [stuff?] drop on ya. I: In the real? B: Yeah, in the real world. Yeah, I don't know how you you'd equate that… virtual stuff and do anything more with it [in the plain?]. For… the process that was set up for… was absolutely [ideal?].	But to B, it would tend to lend itself to that. B is asked what if he could use his hands more, but he replies it is not that it's the fact that it's pretty cut and dried, what you are looking for and what you do. Where a lot of the other processing, especially solids and material handling [between?], it has a lot to do with other senses as well, like hearing. Feeling [stuff?] drop on ya. When asked, in the real, he confirms, in the real world. He does not know how you would equate that virtual stuff and do anything more with it [in the plain]. For the process that was set up for, was absolutely [ideal?].	To the user, the VE would tend to lend itself to performing in it. When the interviewer asks if the possibility of using his hands more would change it, the user says it is not about that, but the fact that it is pretty much set in stone what you are looking for and what you do. He compares this to handling materials in the real world, which has a lot to do with other senses as well such as hearing and feeling stuff drop on you. He felt the VE was ideal for what it was set up for, but he cannot think how it could go beyond that.		Although asked if it changed it if hands were visible in the VE, B takes the thought further to the direction he wants, explaining the experience of the environment "tending to lend itself" to the objective, and how it felt "cut and dried". It is a reduced version of the real, with less for the senses.

Table 6. MU17 from user B.

14.	I: Mm. Can you be even more specific, like, if you went to the, your, where you work here. Was it, like the sound, or what you saw, or the process or what…? L: I think it was… It's quite funny being a process tech, because you can feel quite isolated. You're wearing Monogoggles [certain brand of safety glasses]. You're wearing gloves. You're wearing hearing protection. You're wearing everything. And you're very reliant on the visual… umm, for just about everything. Umm… [coughing] In some instances, especially on that plant, umm, you'll have all of the above, and you'll have BA. So… really, you shouldn't able to smell anything, hear and[br] hear very little. Umm… You shouldn't be able to taste anything unless you are in terrible trouble, you can't feel anything… So you're ve[br] You're heavily reliant on your sense of sight. Umm, and I think it heightens that,	When asked to be more specific, she begins by explaining it is quite funny being a process tech, because you can feel quite isolated. You're wearing Monogoggles [certain brand of safety glasses], you're wearing gloves, you're wearing hearing protection, you're wearing everything. And you're very reliant on the visual for just about everything. In some instances, especially on that plant, you'll have all of the above, and you'll have BA. So really, you shouldn't able to smell anything, and hear very little. You shouldn't be able to taste anything unless you are in terrible trouble, you can't feel anything. So you're heavily reliant on your sense of sight, and she thinks it heightens that, you're always looking about to make sure that something hasn't failed or something isn't broken. You can hear to a degree. But really, in certain environments if you're hearing something, it'll be because it's failed. So, you've got to react quite quickly. So she thinks, when she talks about the specifics of the environment, coming out of the virtual into the real, she thinks it would have to do with the placement of things, and where they were. And she thinks that was explained quite well in the virtual: the valves, the main part of the suction, the discharge of the press, where the lab sampling is connected from and things like that.	When asked to be more specific what created that experience, the user begins by explaining that in her job you can feel quite isolated based on all the gear you wear. This means that almost all aspects of the work depend on visual and your sense of sight: this heightens that you are always actively looking that nothing has failed or broken. When she reflects this to coming out of the virtual into the real, she thinks it is to do how the VE presented and explained the location of objects.	When asked to be more specific what created the experience of familiarity, the user explains that in her job you can feel quite isolated with all the equipment you wear. This means that almost all aspects of the work depend on visual perception: this heightens that you are always actively looking that nothing has failed or broken. If something triggers your other senses, you know something is wrong and you have to react fast. So when the user compares between the VE and the real environment, she thinks the placement of things in the VE had an important role.	She says 'visual'. How might other jobs compare to this? It's also interesting how she says that it heightens seeing, basically communicating the need for an active process of seeing. It does not matter if we have the sense of sight if we do not exercise it actively. The difference between VE and the real.

you're always looking about to make sure that something hasn't failed or something isn't broken. You can hear to a degree. Umm… But really, in certain environments if you're hearing something, it'll be because it's failed. Umm… So, you've got to react quite quickly. Umm… L: So… I think… When I talk about the specifics of the [lp]… umm, environment: coming out of the virtual into the real. I think it would have to do with the placement of things, and were they were. And I think that was explained quite well in the… umm, virtual. I: Mm. L: You know, the valves and the main part of the umm… the suction and the discharge of the press, and… where the lab sampling, umm, is connected from and things like that.				

Table 7. MU14 from user L.

4.4 Sampling and selection of participants

4.4.1 Sampling strategy

In a phenomenological study, it is necessary that all participants have experienced the phenomenon (Creswell, 2013; Moustakas 1994). Thus, purposeful criterion sampling (Creswell 2013; Patton 1990) was employed to identify suitable individuals. Moustakas' (1994, 107) has described criterion sampling in phenomenology as follows:

> Essential criteria include: the research participant has experienced the phenomenon, is intensely interested in understanding its nature and meanings, is willing to participate in a lengthy interview and (perhaps a follow-up interview), grants the investigator the right to tape-record, possibly videotape the interview, and publish the data in a dissertation and other publications.

Creswell (2013, 156) noted that specific individuals are identified "because they can purposefully inform an understanding of the research problem and central phenomenon in the study". As the purpose of this study is to learn how users

experience virtual environments during a hazardous environments training, it is more useful to study a carefully selected sample instead of a large random sample. This is also often used procedure in applied research in the area of user experience design to understand user needs and how they use a product in their context (Garrett 2010). Miles and Huberman (1994, 30) explained that sampling decisions should not only be advised by individual characteristics, but also "settings, events and social processes". There are several ways people might be connected to a phenomenon, but different roles and actions affect their perspective of it. Managers, training developers and coders might all possess a certain experience of the phenomenon, but their lived experience differs from the employees who need the training in their immediate work.

Based on the aforementioned sampling strategy suggestions, the research sample for this study consists of users who have experienced virtual environments as they appear to them during hazardous environments training. In summary, the participants were chosen based on the following criteria:

1. The participant has used a virtual environment for hazardous environments training

2. The virtual environment models a hazardous environment where the user navigates and performs various activities

3. The participant works in a company that operates in hazardous environments, environments where potential for injury or death is present. Such contexts might include the minerals sector such as mining, the chemical industry, but also using potentially hazardous machinery

4. The participant is willing to describe his or her experience in spoken or written English, allows the data to be recorded and the results to be published as part of the dissertation and other publications

Snowball sampling was employed to locate participants for the study. Company representatives were contacted to recommend and inquire for possible individuals. The representatives were informed about the topic of the study and the suggested sample population with a study poster and consent form. When searching for the participants and informing them about the research, the term "co-researcher" was used in the consent form in order to reduce the "researcher-research subject" division. Previous phenomenological studies indicate this could make the interview situation more informal or dialogical, and therefore help the interviewee feel they can describe the

experience as it appeared to them instead of trying to accommodate the researcher's presuppositions of the topic (see Moustakas 1994; Webster-Wright 2010). In addition, the consent form described the topic of the study, the interview process, the ethics, the possibility to withdraw from the study at any time, and other important university contacts (Appendix A). After inquiries, two promising organization were identified.

4.4.2 Sample size

Several matters beyond generalizability affect qualitative study sample size. There are no definite general rules beyond "it depends" (Patton 1990, 184) and "so many subjects that you find out what you need to know" (Kvale 1994). Qualitative studies have received criticism for the generalizability of results from small samples. Several authors have discussed the general misconception that amount would result in a worthy sample and thus more worthy research (e.g. Bar-Hillel 1979; Kvale 1994). For example Patton (1990, 185) described the following:

> Piaget contributed a major breakthrough to our understanding of how children think by observing his own two children at length and in great depth. Freud established the field of psychoanalysis based on fewer than ten client cases. Bandler and Grinder (1975a, 1975b) founded neurolinguistic programming (NLP) by studying three renowned and highly effective therapists: Milton Erickson, Fritz Perls, and Virginia Satin Peters and Waterman (1982) formulated their widely followed eight principles for organizational excellence by studying 62 companies, a very small sample of the thousands of companies one might study.

Other aspects than large size should therefore advise the sample. Patton (1990) identified the purpose of the study, the research question and objective, and available time and resources as the criteria for the sample size. Also redundancy (Patton 1990) and saturation (Bryant and Charmaz 2007) have been used to describe a situation when data collection reaches a point where no significant new information is emerging or the existing themes start to appear during the data collection. This is perhaps an ideal process for a qualitative study, but as Patton (1990) explains, studying to this point might not always be possible due to time, budget and other various constraints.

The focus of a phenomenological study is to understand the common meaning individuals give to a phenomenon they have lived and experienced (Boland 1986; Creswell 2013; Moustakas 1994). Rich results can often be achieved with few subjects.

Reported sample sizes in phenomenological studies vary, and have been observed to be from 3 to 10 (Creswell 2014), 5 to 25 (Creswell 2013; Smith, Flowers, and Larkin 2009), and even 3 (Giorgi 2008). For his phenomenological dissertation on expat managers' lived experience of another culture, Russell (2006) reviewed 26 studies that were using Giorgi's descriptive phenomenological method and found the average sample size in them to be 8.3.

The sample size of this study was determined with the availability of participants, saturation, and the richness of the data for analysis, the ability to maintain the timeline of the study, and what was suggested by the descriptive analysis method. The study follows Giorgi's (2009) advice to use at least three participants to better triangulate the responses and to reach "a sufficient number of variations" (Giorgi 2008, 37) to form the essential description of the phenomenon. The study also notes Smith, Flowers and Larkin's (2009) warning, although from interpretive phenomenological analysis (IPA), that because of the difficult and laborious nature of a phenomenological analysis, students and first-timers should begin with a small sample as otherwise the analysis may become too large to handle. Based on these criteria, the sample size for this study is five.

4.4.3 The research participants

Based on the inclusion criteria, five participants from Western Australia participated in the study. All the participants worked in companies who used virtual environments for hazardous environments training. Two of the participants had used a VE for heat stress training (group 1), when three had used a VE to train for a specific work process in order to use specific machinery in the chemical sector (group 2). In both of the cases, the VE was a representation of their actual work environment. They assumed the role of a professional in that environment, and performed tasks by using the VE themselves. Group 1 consisted of one man and one woman, and group 2 included two men and one woman. All the participants were interviewed.

4.5 Data collection with interviews

Mishler (1986), among others, has criticized the validity of stimulus-response model of research interviewing. He suggested that this kind of interviewing is actually ignoring that an interview is a form of discourse, "hidden from view by a dense screen of technical procedures" (Mishler 1986, 7). According to Mishler, treating interview

events this way can force ad hoc hypotheses and procedures into analysis and interpretation, and can lead to poor research validity.

According to Mishler (1986, 138), "requirement for reliable and valid analysis and interpretation depends of tape recordings and careful transcription of interviews". Also Silverman (2000) has lined several benefits of using recorded interviews. With them it is easier to remember conversations, but also note possibly important "pauses, overlaps and inbreaths" (Silverman 2000, 829). With recordings one can also focus on details, and in contrast to field notes, they can serve as a public record, available for other researchers. They can also be replayed and transcriptions be improved.

As Englander (2012) has noted, there is not one specific qualitative research method. Although several authors who have written about qualitative research provide useful information on interviewing and forming research questions, data collection should be rigorously aligned with rest of the research design. The aim of phenomenology is to collect rich descriptive data about a phenomenon (Colaizzi 1978). The most commonly used method for this is the interview (Moustakas 1994). In order to gather rich data, often semi-structured interviews are conducted with few individuals. Moustakas (1994) suggested that the interview event should be informal, and that the researcher should aim to create a comfortable environment and an atmosphere of trust. The interview process should be organic with open-ended questions and comments (Moustakas 1994). According to Colaizzi (1978, 58), "success of…all phenomenological research questions, depends on the extent that they tap the subjects' experiences of the phenomenon as distinct from their theoretical knowledge of it". Instead of simple yes or no answers, research questions should elicit broad answers resulting in a rich account of the experienced phenomenon (Moustakas 1994).

Phenomenologist enters the life-world through rich descriptions of people's experiences (Finlay 2012). The interview should be constructed according to the phenomenological analysis (Bevan 2014). It is the role of the researcher to support the research participants to describe their experiences with their own words, but not to affect the content of these descriptions. As Finlay (2012, 181) has suggested, "phenomenologists seek down-to-earth, richly detailed description of the lived experience rather than abstract intellectualizations or empirical generalities that try to analyze, explain, or theorize". Phenomenology describes the essences of different

experiences, the way they are experienced without theorizing them. Such essences already exists and are not created by the research as such: "they belong ''already'' to the life-world and the everyday manner of which we live our lives, being researchers or not" (Dahlberg 2006, 12).

4.5.1 Developing the interview questions

Colaizzi (1978) proposed forming research questions from the researcher's presuppositions about the phenomenon. He gives an example phenomenon of being-impressed-by-reading-some-thing-to-the-point-of-modifying-one's-existence, or existential change occasioned by reading. Some example research questions for his study were, "*Please try to recall something which you read that made an impression on you, or which in some way affected or influenced you; try to describe the impressions that it made on you*, *What were you experiencing before you were reading it? During? Afterwards?*, and *What differences can you detect within yourself after reading it?*" (Colaizzi 1978, 58). Also Moustakas (1994) described that phenomenological study rises from the researcher's personal history, curiosity and interest in the topic.

For the researcher, studying the experience of VEs was an evolution of his professional history, standing in the crossroads of interaction or user experience design and instructional design. The original research question drafts were related to how users might experience various aspects of VEs, most importantly, how VEs might simulate a context. Based on researchers' professional experience and background literature, modeling space, agency such as movement and interaction with objects, and background such as sounds and graphics was regarded as important aspects of VE experiences. Based on the researcher's history as an instructional designer and his work with the authentic e-learning theory (Herrington, Reeves, and Oliver 2010), he was also asking, cannot VEs be more than just a setting or a "stage"? Cannot there be more interaction, similar to the agency people might experience in real work settings? These were parts of the researcher's personal epoché process where he tried to set aside his professional history and theories from the literature review in order to create an interview guide that would not direct the content of the interviews, but elicited rich descriptions of experience.

The original interview questions were as follows:

1. Try to remember a training situation where you used a virtual environment. Can you describe how you felt? What thoughts stood out for you?

2. How did you experience the setting?

3. How did you experience the actions that you were able to take in the setting, and how did you feel about that?

4. How did you feel the background story, instructions or tasks contributed to the authentic context?

5. Was there something that you feel contributed in building the authenticity of the VE setting? Anything that you feel inhibited it or was missing?

6. In what ways did you feel the environment reminded you or did not remind you of the real world work setting?

7. Anything you would like to add?

These preliminary questions were created several months before beginning the data collection. After growing more accustomed with phenomenology and the data collection phase coming nearer, it became clear that the research questions needed to be redeveloped. The questions appeared as too leading, and too structured to allow the participants to describe their experience openly in their own terms. Especially questions three and four presuppose that certain aspects would be important to the research participants. Still, they might not even find these meaningful in their VE experience. This made the researcher search better ways to stay true to the phenomenological process. This was found from Giorgi (2009; 1985) and (Valle 1998) where the approach is to ask a broad question that would elicit rich descriptions of the experienced phenomenon. The form of the interview question was developed based on how several researchers have used it in (Valle 1998) and is as follows:

> Please go back to the time when you were using the virtual environment for hazardous environments training. Describe as vividly as possible how you felt during that time, so that someone reading or hearing your report would know exactly what the experience was like for you. You might want to start from the beginning, or from a single moment / particular incident during the training. Keep your focus on the experience, not just the situation itself. Please do not stop until you feel that you have described your experience as completely as possible. Take as long as you would like to complete your

description below. Please note that I haven't developed, used or seen the virtual environment myself.

Additional questions were asked when the need for them naturally occurred during the interview. The questions were primarily used to lead the participants to describe their experience more explicitly, or to direct them to describe the way it took place instead of reflecting or judging the experience. Also imaginative variation questions were asked, where the users were asked to imagine if something in the VE experience was different than what it was. As such, the interviews were treated more as a dialogue than a mechanical question-response process (see Mishler 1986).

4.5.2 The interview process

As suggested for example by Creswell (2013), interviews began with a brief description of the research project (see Appendix A, 'Information and Consent' letter). The aim of the project, that it investigates how users experience VEs during a hazardous environments training, was described briefly. The participants were given the information letter and consent form to sign if they had not done so before the interview. It was also made explicit that the aim was not to study them, but to understand VEs based on their experience.

All the participants were interviewed and the interviews were audio recorded. These recording were transcribed verbatim for further analysis.

4.6 Ethical considerations

As the participants were located from actual companies with snowball sampling, special care was taken to protect the identity of the participants. All were given a pseudonym, which was also shortened when reporting the results (e.g. "user BD" or "user C"). All other names that might refer to their colleagues or places were also removed or expressed with a pseudonym. Also the fact the participants were from different companies makes their identification more difficult.

Only the researcher and his supervisor had access to the data, which was kept on a password-protected computer for the duration of the analysis, and its backup on a secure drive in the supervisor's locked cabinet and on the secured Curtin University cloud drive. The data will be archived for seven years in a locked cabin after the research is finished.

Ethical considerations and research integrity were ensured in several ways. The researcher undertook Curtin University's Research Integrity Training prior to conducting the study. Furthermore, the study was conducted according to Curtin University research procedures and the *National Statement on Ethical Conduct in Human Research* (2007; updated March 2014):

- Research proposal and ethics application was submitted to and approved by the Curtin University ethics and research committees.

- *Information and consent form* (Appendix A) was given to the participants before the research. They were asked to read it through, and if they were willing to participate, to sign the form. The participants were further explained that they could withdraw from the research at anytime without questions asked.

All located participants were willing to participate in the study, and maintained their participation until the end.

Chapter 5: Results

5.1 Introduction

This chapter will present the findings of the phenomenological analysis that were derived from the user interviews. It is achieved with two sections. First, the general structure of the VE experience is presented. The aim of the written general structure in the phenomenological method is to communicate "the most general and essential meaning of the phenomenon" (Castro 2003, 54). As Giorgi (2009, 166) has written, "the structure usually consists of several key constituent meanings and the relationship among the meanings is the structure". Thus the structure section is followed by a detailed presentation of the key constituents of the VE experience. The general structure has been derived through interrogating all the meaning units and tested if removing any of the constituents breaks the structure. The constituents that are essential for the structure are the ones that remain. (Giorgi 2009)

5.2 The general structure of the VE experience

The phenomenological analysis of the interviews suggest that the cornerstone of the VE experience is the users' ability to adopt the mode of technologically mediated bodily perception through which the VE can be interpreted. How to control the VE is chosen based on the users' preferences, and the mode of acting in the VE, described here as acting-through-the-controller, is learned in order to fully concentrate on VE action. When this learning takes place successfully, the control device as an object withdraws to the periphery of consciousness, but does not become entirely absent.

Acting-through-the-controller enables the users to adopt an action-oriented awareness to interpret signs and other cues in the VE that lead to more specific and complex action possibilities. The users actively construct action possibilities: objects, such as sounds or other avatars, which are not judged to correspond to action possibilities, in addition to specifics of interaction and how it exactly takes place, fall in the periphery of awareness.

Even if the VE explicitly highlights the topic of the training several times, it is the users who judge how this guides their actions: objects might directly signify

something for action, or they might be regarded as background. Other characters in the VE that address the user can make the user feel as if in the context, but their communication might not have relevance for the users' actions. Explicit instructions in the VE can guide the users to concentrate to an aspect of an activity and conceal another aspect of it. This can lead the users to become more aware of objects that are not even thematically relevant to the training topic, while objects that are relevant to the training become concealed from perception.

The users construct the logic of the VE, and aim to maintain and realize it through perpetual action. This means they can also misinterpret VE signs and the order and parts in which to perform activities. The users become aware of this when the logic of the VE seems to break: the users might get a message that does not seem to fit the current logical sequence, or they might need to redo an activity. Such a situation leads the users to actively try to identify the reason for this by retracing the VE logic to a section where it was still intact, or trying to get more information with other means available during that moment, for example with options available in the user interface. VEs can have various problems, but the users' relation to them is active in the form of trying to solve them by doing or trying to understand the logic behind what caused them. If the problem is something the user cannot solve by doing or thinking, for example in the actual design, the problem can maintain an open status in the users' thinking. It might even become a well-remembered open mystery. Despite of problems, users generally respond positively to VEs.

The logic of the VE is learned through use, and becomes clear in retrospect. The logic consists of what activities needed to be performed and in what sequence. This can sometimes include awareness of what needed to be done with the control device. The logic of the VE comes together as if the user has found individual sections of a musical score and has finally been able to put them together through play.

Various aspects of the VE experience invite comparison and fulfillment with real life experiences. The users might for example judge an event in the VE by comparing its logical possibility to something that has taken place in real life. Furthermore, if the users have not been in a similar kind of a real life context that the VE simulates, the VE experience can lead the users to imagine what it might be like in real life. To those who have been in a similar real life situation, VE appears as a reduced process and a reduced bodily experience. At the same time, these reduced processes can make the

real context appear more approachable and give confidence to the users that they can perform the job in real life. The VE experience can make the future work place seem more familiar. This sense of familiarity is activated when the user accesses the real life environment: it is as if he or she has been there before. As such, the real fulfills the virtual.

5.3 The constituents of the VE experience

This section presents the constituents of the experience of VE in more detail. Constituents are the essential parts to have the experience of the phenomenon (Giorgi 2003). A constituent is not an individual factor, but "a part that is mindful of its role in the whole" (Giorgi 2003, 102). The reader should note that the clear-cut division into constituents is simplified; it is a decision taken to support a more approachable presentation of the experience. In reality, the different constituents are more entwined, which becomes evident in the users' comments: in some cases the same user comment could represent several constituents. The interrelatedness and partial overlapping of the constituents is illustrated in Figure 3.
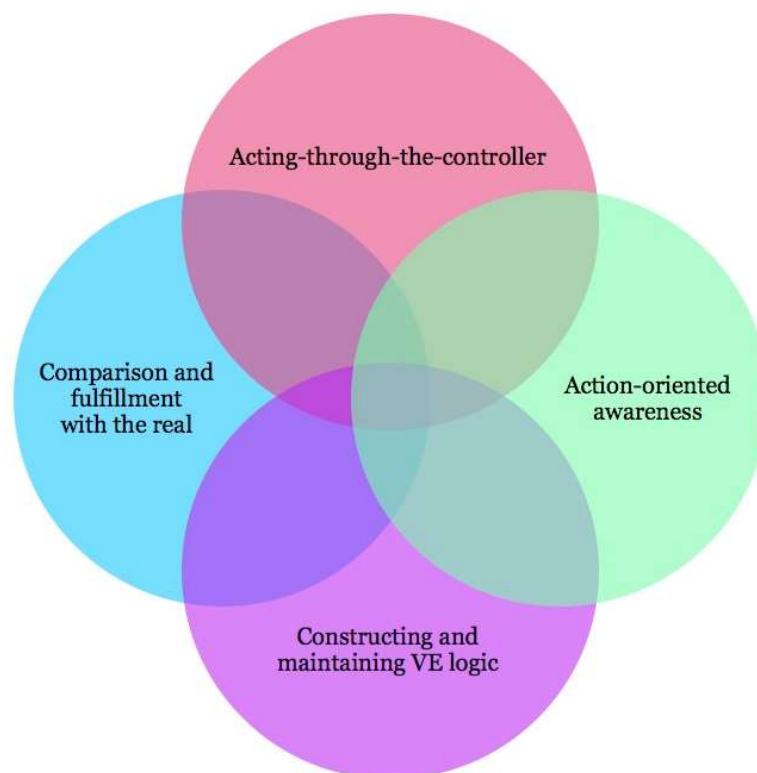
Figure 3. Four interrelated constituents of the VE experience.

Four interrelated constituents were identified from the data, namely: acting-through-the-controller, action-oriented awareness, constructing and maintaining VE logic, and comparison and fulfillment with the real. The four constituents are discussed in detail in the following paragraphs, illustrated with quotes from the interviews.

The user quotes in this section are edited from the original transcripts and are not in the third person form as in the transformed meaning units that supported the phenomenological analysis. These quotes are in the first person the way the users expressed them in the interview, but with original pauses and breaks removed. Some user quotes are edited from several sentences because their meaning was expressed several times during different sections of the interview. The aim was to maintain the originally expressed meaning, but edit the text for more seamless readability. This was chosen in the hope it might better evoke the users' experience as it was lived through (van Manen 2014).

5.3.1 Constituent 1: Acting-through-the-controller

Before the user can fully adopt the active mode through which the VE appears, the user needs to become comfortable with the control device in the present context of use. In the case of the users of this study, the controls consisted of a keyboard and a mouse; devices many of us use every day with the computer. When using a controller for the first time, one needs to learn physically where certain buttons are and what they do. Thus perception is directed towards the control device. If the control device itself (for example a keyboard and a mouse) is familiar as an object for the body, the controller as such is not what is learned, but acting with it on the screen, which becomes acting in the VE. This gestalt where the user bodily employs the controller to act in the VE is defined here as 'acting-through-the-controller'. When this takes place, the controller itself as an object becomes peripheral in consciousness.

The users proceeded to learn and adopt acting-though-the-controller in the present context of use (using the VE). This seemingly self-evident aspect is an important one. As the case of user BD illustrates, one can use a keyboard as a part of daily work, but taking action with this same physical device is another kind of an act in the VE context:

I think you could choose between using the keyboard, which I didn't because that would probably frustrate me too much. I could choose between using my keypads to walk around the room to the wardrobe or I could just click the button to go straight there. So I clicked the button 'cause I don't play video games. (BD)

The user chose to use the mouse option because that way she could concentrate on unfolding the thematic "story" of the VE instead of having to make a conscious effort to navigate through the VE. As BD explained, "You just pick options, and they do it for you." As mentioned, after the control device itself is learned, it as an object falls in the periphery of consciousness. In the case of BD, the absence did not mean it only perceptually (control device as an object to perception), but also on the signifying level of consciousness (what is a control device). When BD was asked how the interaction was like using the controllers, she replied, "I just clicked around. I didn't use the controllers". Interestingly user C chose the other option available option for navigation (keyboard and mouse) based on the same judgment of it being "easier":

I think you could move backwards and forwards with the mouse, but I found it easy with the key to move around and just select with the mouse. (C)

In C's case it should also be noted that acting with the controller might be adopted the way the user sees fit in order to proceed to use the VE:

I'm not sure if both arrow keys worked but I just used one. I used the forward arrow key and the left one. And if I had to go around the circle that's what I did but that sort of got me where I wanted to… (C)

In the context of the VE, "gamers" seem to have a special status in relation to controls and acting-through-the-controller. What partially affected BD's choice of controls, was that to her, the option that she did not pick signified a video game (she communicated in several ways that she was "not a gamer"). BD also judged based on her own VE performance that she was not sure if the employees in her context would take VE training approach as "a way forward", because she judged it took her "a bit long to figure out". Still, she was not sure about her comment about her colleagues, because "they might be gamers". Another example from user L conveyed the special status of gamers in relation to acting in the VE: "Some people play a lot of video games. And my general impression was that they found it very easy."

This brings forth an important aspect in the VE experience, the fact that the users proceeded to "get used to" (user C) the mode of acting-through-the-controller. Otherwise, the controller or trying to act in the VE filled the users' consciousness and inhibited them from proceeding further in the VE:

> The main things that I heard about the virtual training's feedback was that, in some instances it made people feel ill. Like, they were a bit seasick because they were having trouble perceiving and walking it through. Others said they had hard time coordinating the movement through the world and they were getting a little bit frustrated with it. Then it would take them longer and then they would kind of get even more annoyed. (L)

For user L who expressed that the VE was a novel experience, navigation itself became the object for consciousness that she struggled to get over in order to focus on the "content" of the training:

> There was the novelty of actually moving yourself about in it, which took a little bit of practice. It was quite fascinating moving myself through the virtual environment and I was little bit worried that my brain would be more interested in the actual function of the training rather than the information. (L)

Also situations that occur during acting in the VE, such as problems, can bring either the controller or the acting-through-the-controller back to presence for consciousness. For example in the following passage from user B, acting-through-the-controller is the object of the conscious act of remembering and holds the key to solving a problem he encountered in the VE:

> There was a bug in the program that when you tried coming out of a lab door, if you turned slightly sideways as you're coming out of the door, you ended up on the roof. [laughing]. Three times I was on the roof [laughing] until I worked out "No, don't touch the…" Because it was [gesturing like pressing a keyboard]… So you could go forward and sideways at the same time, but if you did that coming out of the door, you ended up on the roof. [laughing] (B)

In this case, the controller and acting-through-the-controller both manifest user B's judgment of the situation and the perceptually vivid memory: he even bodily acts his agency in the situation [*gesturing like pressing a keyboard*]. As a matter of fact,

the key aspect through which the memory of this situation appears is *movement* itself: "forward and sideways" and "coming out of the door".

While it was expressed earlier that the controller became absent for consciousness, it did not mean total absence. User stories revealed that reflecting upon situational uses could bring the controller and acting-through-the-controller to presence. In the following, user C describes a section that was part of a more complex activity he was performing in the VE. This conscious act is past-oriented and brings forth a moment which is a gestalt of pressed buttons and activity, and where the controller plays a part to explain the use situation:

> Part of what you're supposed to do is to stay hydrated as well. And you stay
> hydrated by... I think it's pressing the 'Escape' key. So, "press the Escape
> key", you can have a drink; "press the Escape key", have another drink. (C)

This example illustrates how acting (staying hydrated) through the controller (pressing the Escape key) could still be made visible through the conscious act of remembering, even if consciousness was not fully directed towards the controller during the activities. The next section will discuss the mode the users actively maintained that had an important role in constituting how VE was given to the users.

5.3.2 Constituent 2: Action-oriented awareness

When the phase of acting-through-the-controller was adopted at least to an extent, the users proceeded to act in the VE based on signifying conscious acts (interpreting signs):

> Initially I felt a bit confused with it, you know, getting used to how to navigate
> my way through it. But once I got through that part, it was just trying to
> identify where I was going. (C)

In a similar way a guitar player is not conscious about the fingers on the fret board but the melody, the users' awareness became directed to the action on the screen. The users adopted a mode of action-oriented awareness through which the VE manifested itself as a system of signs leading to action:

> I knew I had to follow the green arrows, or the green spots on the screen. When
> I got to that arrow I did whatever I needed to do there. (C)

Similarly, in another example user G described how the VE took him through a step-by-step process of how exactly to do the job:

> So starting from, in the control room, going through the permit system. Getting on to a permit to get everybody a PPE [Personal Protective Equipment], working your way out, and then opening certain valves and stuff like that. (G)

As G described the unfolding action, it was "as if you were out there on the equipment, doing it". Related to this is also BD's comment on why the VE engaged her: "Because you had to do everything. You had to do the instructions and follow each part to get to the next level."

The users learn the signs and objects of the VE in order to actively seek and use them for action. For example when user B was casually asked if his character could get hurt in the VE, he expressed there was no specific object such as "a health bar" to indicate he had done something wrong or that he was down a certain percentage of health. This indicates that also VE objects are learned, after which they can be employed for action-oriented awareness. This directly affects how users navigate, explore and perform with action opportunities in VEs:

> Once you realised there were active locations, that the mouse would activate, you could just scroll over the page and find where there were active locations. Say you wanted to operate the valve; you went to get to the valve handle. Soon as you clicked the mouse over the valve handle "operate valves" would come up. You basically knew what valves and in what sequence you had to go to. But if you had problems the next valve or the sequence was the one highlighted not the other ones around it. (B)

The core of this constituent is that the users' awareness is actively directed towards action opportunities, and it is active in discriminating what objects belong to action and what do not. This affects the mode in which the users approach the VE and objects in it. For example when C was asked if he could think of something that was wrong in the VE, he replied as follows:

> I wasn't even thinking down that line, you know. It's just, I knew it was animated the start with. I guess if I was doing the training to criticize the training I guess I could've found plenty of things wrong with it, but I wasn't.

Because I know it's some sort of training program. It's just go with the flow, you know. Go with what, what's trying to be taught. (C)

When the users are truly directed towards the VE action opportunities, objects such as sounds or other characters, or even full events that are determined not to belong to the action opportunities fall in the periphery of consciousness. Another illustrative example of this from user C is a certain scene where his character rides a bus from one location to another in the VE. He does not recall anything specific taking place during that scene. When inquired what he saw, he generally just remembered seeing things passing by. He felt "going through the program, thinking, 'what's the next task'?" He was directed towards action possibilities, and the bus scene as a whole appeared only as background.

Parts of VE remaining concealed from the users' consciousness is also revealed in other statements that show how the users did not remember well elements that were not judged relevant for action. For this group, sounds were one such object: user L noted only vaguely "I think there was sound in it" while C explained "There might've been a sound on the bus but I can't remember anything…" Objects can also include other characters, as it is presented by the example from BD, who did not recall what character of a particular scene were doing:

Maybe there were people walking around. There might have been people walking around. Like, in the background. I can't remember. [laughter] (BD)

At the same time, she did not have any trouble of describing another scene where avatars were more clearly part of the activity:

When it comes to the supervisor coming over and saying "Well done", they actually pause the little scenario and group them all together and the supervisor's speaking to you. (BD)

The users' action-oriented awareness also affected how the activities were performed. Examples from BD and C show how in the VE they were communicated the theme of the training several times, but then instructions for the actual activity they were expected to perform was something else. The "real" objective of the task was to manage another character's hydration, but this became a "concealed" task inside another activity where they needed to move objects from location A to B. The

instructions explicitly described the task, which was not directly relevant to the theme of the training, but still guided their actions more than the generally communicated training theme:

> At each stage they're talking about heat stress, 'cause that's what it's topic is. And then, you got the designated job, which is moving scaffold poles. And that's the point where moving the poles and keeping an eye on your work colleague I wasn't aware that, that was my task. (C)

The users aimed to perform the task given to them with the relevant objects *for that task* becoming present for awareness. Furthermore, the users realized the task only partially, and took the part to be the whole activity. The reaction from BD shows how even the visible signs such as the virtual character's bodily expression did not have the power to affect her actions but remained on peripheral for consciousness:

> Well they say, "You're off to work now. Make sure you keep an eye out on your co-workers" or something like that. I mean, I was watching him but I didn't know that he was dying. [laughter] (BD)

When comparing this to the earlier example where B was operating valves, in both C's and BD's case the other virtual character's body was not initially perceived as an object for the activity. As BD explained, "I was too busy working really hard to notice the first time that he was fitting." Only after it was clear that the other character was part of the action, did it become actively present object for perception. As BD described, she realized after a specific moment that she was supposed to observe the other character: "And that's when I realized I was supposed to be watching him, so then when I looked at for the symptoms I saw them." Similarly C judged that unless you were aware of what was going to happen, it was questionable if you could succeed the first time you were doing it. This yet again shows how certain objects were first identified as being part of the activity before they became objects present for action.

The action-oriented awareness locates objects in the VE that correspond to action. In this study, the participants rarely mentioned graphical objects of the user interface (UI) itself. Only when they explicitly needed the UI for action, did it become present for the action-oriented awareness. An example of this was C describing a moment where the UI was crucial for successful performance of the task: "there's a little bar to say that you're not hydrated." Also when C failed an activity and he was

not sure if it was because he completed or failed it, he tried to find more information with the options available in the UI ("then you press 'talk' again and get the same spiel"). Generally, as with the controller, the users' awareness was towards the action itself, beyond the UI. The specific UI elements that supported user actions appeared contingent and vague in the users' accounts. As BD explained, "It gave you options so umm… I can't remember, I think maybe a box was on the side and said 'Do you want to…' or you go over to him and offer him water." Another example for this is from C who did not remember how he actually interacted with another character in the VE:

> I think it must highlight him… I can't remember how you grab him anyway,
> but there's something on the screen to show that you can take him and then
> move him over to the shaded area. (C)

What is also important to notice about action-oriented awareness temporally is that when everything worked as expected and the users were able to interpret the signs and perform the activities, the awareness was directed towards future, or as C earlier expressed it, "what's the next task?" In contrast, when problems emerged and the users tried to solve them, their awareness became past-oriented. This will be described in more detail in the next constituent, *constructing and maintaining VE logic*.

5.3.3 Constituent 3: Constructing and maintaining VE logic

Action-oriented awareness proceeds to establish and maintain VE logic that is experienced sequentially. This is an act of correspondence between how the users construct the logic and how the logic was designed. When the users were able to follow the designed logic successfully, they navigated the VE in a future-oriented mode of signifying perception that searched for coming action possibilities. When the logic broke, the users took up a mode of intentionality that moved more closely between present perception and past-oriented remembering in order to retrace and build the logic. If the logic could not be built through acting in the VE, the users proceeded to do that with thinking. If the logic was impossible to rebuild, for example if the logic broke on a level that the users could not rebuild through either action or thinking (on a design level), the reason became an open mystery to some. Furthermore, the logic of the VE was learned by going through the logic, and appeared through both correct and incorrect actions.

The users described the VE with an impersonal *it* that *made* them do things. The VE logic appeared to the users as a *step-by-step* process, which they were required to *follow through*. This came forth as a cycle where the users interpreted various forms of VE cues and followed them with actions. User G explained "it just basically takes you through step-by-step process of how exactly you would do the job" while B summarized that "They would step through it and then you had to go on [to perform different parts of the task]." Similarly BD expressed how the VE made her perform an activity, while user L described, "We went through the task in segments." Also user C described that the aim of the VE was to follow through a specific step-by-step process. On the level of the whole, parts of the VE appeared to C also as individual "scenes". His description embodies the cycle of VE control and user action. When C was asked how he got to a specific location in the VE, he explained that after doing each scene, the VE loaded in another one and you complete that scene and then you move on to the next one.

When moving from the general form to more specific aspects through which the VE logic appeared, different activities that the users met initiated different kinds of intentional acts. Some activities relied more on simple memorization while others required complex gestalts of bodily, perceptual and signifying acts. In more simple activities, the users merely needed to choose right options based on previously given information, or as BD explained this:

> Then it [VE] explained, went into detail, signs of heat stress and it made us, it quizzed us on what… so related back to the information that they told us and got us to do a quiz on what heat stress symptoms are. (BD)

Such activities brought past objects of perception into presence to be remembered and judged accordingly, in addition to acting-through-the-controller to select and use their representations on the screen. As BD described it,

> It said, "what safety gear do you think you should be wearing today and what equipment do you think you should be taking?" So it gave me a whole offer of footwear, eyewear, and we had to go through and select each one. (BD)

Also the example from user C illustrates this cycle of prompts and action:

> 'Cause they gave you a list of what to be aware of for heat stroke, you know. Like clammy or hot or sweaty. And you had to select what were these

symptoms of heat stroke. There was maybe a selection of five, and three of them were the correct answers. So you just dragged the three correct answers into a box. (C)

An example from B describes a seemingly more complex activity:

They would step through it and then you had to go on to get a sample. So you had to go out to sample valve, click on the sample valve, and get the sample with a beaker. Take it back in, get the pipet, fill it up with the solution, and then put the additives in to it and all that, so yeah, that was that side of it, which got you into the routine of doing it. (B)

Intentionally speaking, the process in user B's case is not that much more complex but similar to the ones described earlier by user BD and user C. The similarity comes from the fact that there are objects for perception that are first presented to the users. The users need to remember them, and later acting upon them, to maintain the correct logic of the VE. In BD's case these objects were various safety wear, in C's case 'clammy' and 'sweaty', and in B's case 'beaker' and 'pipet'. In all of these cases the users were required to act upon them in the correct order. With more complex activities, the VE UI gave them both perceptual and temporal support. B noted this as follows:

But if you had problems, the next valve or the sequence was the one highlighted, not the other ones around it. (B)

Also C explained the following:

I think as you get to the site the scaffold pole goes green. And I think you select it with your mouse, it says something like, "pick up" or it might be green and then you just select with your mouse key.

Some VE activities required more complex intentional acts and introduced temporality as an important element of the VE logic. These activities required identifying and acting upon objects at a certain moment. Both users BD and C performed an activity where the key object for consciousness was another virtual character's bodily condition. BD described this as follows:

We had to manage the person working with us and ensuring that they'd stayed hydrated as well and if they didn't, what we would do in case of an emergency,

drag them into the shade or call first aid or give them water, just things like that. So it was more like you making sure that the person you are working with didn't dehydrate and have a fit. (BD)

Sometimes the designed logic and the users' logic did not correspond, and the users' logic departed from the designed one. The users acted to maintain the VE logic, but it also broke for various reasons. Two main reasons emerged in this study; one was due to the fact that the users actively construct the VE logic which is not always successful, and the second was due to design problems. Still what is important is that the users aimed to retrace and rebuild the logic when it broke. This took place through acting in the VE and supplementing the broken logic with thinking. Also both successful and unsuccessful actions were able to reveal the designed VE logic.

For example with user C, green arrows guided him to find different activities in the VE, but for some reason the VE did not appear to guide him in what order to do them. That is why, while seeking for cues what to do next, C went to an activity location in the wrong order. When he left the location, an event occurred that did not fit the logical sequence in his experience. This made C realize he had done the activities in the wrong order, and actually one activity twice. When he realized this, he traced his way back to a section where the logic still seemed to be intact to find how to get back on track. This way he realized the correct order in which the activities should have been performed.

In a more serious case that might even affect the training outcome, both users BD and C initially failed a key VE activity. When it took place, it came as a total surprise to both of them as they were certain they were going through the designed logic as required. As C described it:

> 'Cause it, it just stops. But you don't know has it stopped because I failed or has it stopped because it's complete? (C)

BD explained that described this as follows:

> I think some of the instructions were little vague. I killed a guy. 'Cause I didn't give him enough water, 'cause I didn't… the instructions weren't very clear. So I think more common sense was expected from people than what information was provided I guess. (BD)

In both of these cases performing the activity in a way that resulted in a poor outcome made the users realize what the actual objective was, or as BD summarized it, "once I sort of picked it up I realized once I killed him that my intentions were to keep him alive [laughter]."

The failed performance could also occur because the users' logic was different from the designed logic on the level of parts and wholes. Both users BD and C explained that they thought their task consisted of parts A and B when the full task actually consisted of parts A, B and C. They eventually realized the full designed logic of the task because they failed it, which as one example of many captures how the full logic of VE was learned through use. C described this:

> After a couple of goes I realized what the task was, which was move the scaffold poles and keep an eye on your work colleague. It took me two goes I think to figure that out, that's what I was supposed to do, but then, like I say, once I had figured that out it was just a matter of, take two scaffold tubes, take him over and put him in the shade, give him a drink. Yeah, and just stay hydrated myself and that was it. (C)

Both users experienced this task as slightly unfair. This was due to the fact that they both judged the available information for performing the task too vague. BD explained that the instructions were imprecise and relied too much on common sense when C contemplated "I don't think you can do it the first go, unless you are aware of what's happening. Or what your task was." As was described in the previous constituent, the direct instructions of the task (carry scaffold poles) guided their actions towards the logic more than general communication (remember to keep an eye on your colleague). In the next constituent, an aspect from real life that might have affected this will be discussed in more detail.

The logic also broke because of something inherent in the VE design. User B experienced a "glitch" which took him to a location in the VE where he was not purposefully aiming to navigate (to a roof of a building from which he was coming out). Also in this case, the user was actively trying to work out the logic of what caused this problem. It took place three times before he learned there was a certain way of moving with the controls at a certain location that made it happen. This made him realize the proper way of acting-through-the-controller at that moment in order to still maintain the logic.

In some cases the problem in the logic remained vague. Although in B's case it was clearly a design problem and not something that should take place through what the user does, he was able to maintain the logic both through action and through thinking, or as he described, "it needed a jump function so I could jump off the roof. [laughing]." With user G, a problem he experienced was more vaguely described as "freezing":

> I sure remember it tend to freeze up quite a bit. I think other people had issues with it freezing up. Again, I don't know whether that was the software or what was with it, so… We got there in the end [laughter]. (G)

Throughout the interview this "freezing up" came forth as something user G was still wondering why it took place. The reasons for this could be postulated by comparing his problem to the previously described: perhaps because there was no resolution to why it took place either through acting upon it in the VE or fulfilling it through thinking. Thus the reason for the "freeze" became and still was an open mystery to him.

As mentioned, the designed logic of the VE was learned through use. Furthermore, following through the VE process was experienced as uncovering the logic of the work process itself. As G noted, "it just basically takes you through a step-by-step process of how exactly you would do the job." The VE experience has various implications on how the users will perceive the actual work context, but actual also affects how the users constructed aspects of the VE experience. These will be discussed in more detail in the following constituent, *VE is compared and fulfilled with the real*.

5.3.4 Constituent 4: VE is compared and fulfilled with the real

It might seem self-evident that users' life in the "real" world impacts their experience of VEs. The question is *how* does the VE experience involve the users' real world? It is impossible to experience a VE without having the experience of the actual world to underpin it. This came forth in various intentional acts that the users performed, through which the VE experience became fulfilled with real world experiences.

Phenomenologically speaking, 'real' is a slightly difficult term. For phenomenology, VE is considered real because as a phenomenon it appears to the

users' consciousness. The question for phenomenology is then more about *how* it is given to consciousness. In the context of this study, 'real world' does not signify an objective world apart from the users, but real as the world outside the VE experience has been given to them. When in this constituent the term 'real' is used, it indicates the users involving their world in the VE experience.

This constituent is closely connected to action-oriented awareness and VE logic constituents. It presents how VE was given through similarities and differences to the real world; similarities appeared through perceptual and procedural nuances, which took place through judging conscious acts. This constituent aims to elicit these intentional acts and their objects that involve the real in the VE experience.

An illustrative example of how VE was given in relation to real world comes from user C (Figure 4).
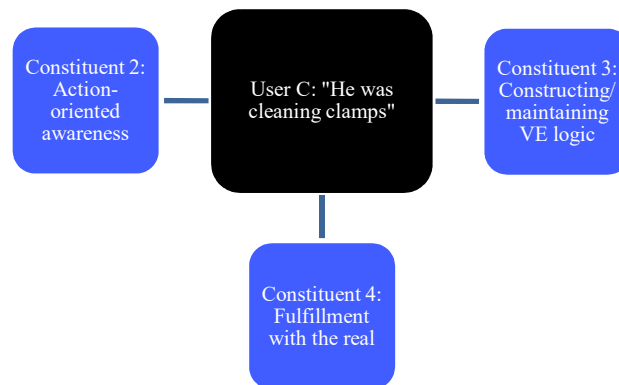
Figure 4. User C's example that connects three constituents.

User C described a moment during the VE experience where he saw a virtual character (Constituent 2) doing not just something but a specific task (Constituent 3). This appeared through a perspective of a person who has been in a similar kind of a situation in real life (Constituent 4). Although the passage is quite long, the description of the moment in the VE illustrates well how this particular aspect of the VE was grasped by user C:

> He's cleaning up the… well it looks like he's cleaning up the scaffold clamps. 'Cause he's standing next to a bench. You know, it's animated. So you're not exactly sure what he's doing but… I've seen scaffolders offshore and that's what they… you know, there's several blokes loading poles and then there's

always a couple of blokes cleaning up the clamps. So I'm guessing that's what this guy was doing: cleaning out the clamps out in the sun. (C)

Due to the fact that the character was located next to certain objects and his body moved in a certain way, this event was grasped as a whole through an earlier event in the user's life. In a couple of other sections in the interview, user C also gave the virtual characters specific titles such as the 'leading hand' (the data do not tell if the characters actually had such titles). Furthermore, the virtual hotel room was not just a hotel room, but a 'donga' (transportable building) or an 'ATCO hut'. As such, the VE brought absent perceptual objects present to the user with signifying labels.

Real life also affected how the users' awareness of the logic emerged during the VE experience. VE appeared as similar to the real, but real life also made the VE experience more specific. The way VE was grasped through real life naturally had an effect in the users' performance. The significance of certain objects and the truth-value of the logical process were evaluated through the real. For example, BD explained the following:

That was a part that I struggled 'cause it didn't… I don't think it was clear enough to say that you need to watch that person. Because in a real work, well, you'd probably looked after yourself first and you wouldn't really constantly check up on somebody else. But so that's probably the bit that confused me the most. That's when I killed a guy [an avatar]. (BD)

Also C judged the logic of this same task as a bit corny, but was more willing to suspend his disbelief:

So you know, I guess it's a little bit corny but, I mean, the reality of it is that if you don't keep an eye on who you're working with, well, maybe they can collapse. [laughter] (C)

These previous evaluations of how the VE might match real world logic could have affected the users' performance. Other VE events that were compared with the real might have been too far apart from its logic to directly impact the performance of the VE design logic. In the case where user B ended up on the roof in the VE without trying to do so (Figure 5, see Constituent 2 for more details), it required him to learn the control logic behind this in order to continue to act in the VE. This was different from judging the general logic of the VE through the real world in order to perform in

the VE: the occurring event was logically too far apart from anything that might take place in the real world. Or as B described, "I can't walk out the door and end up on the roof over me [laughing]".
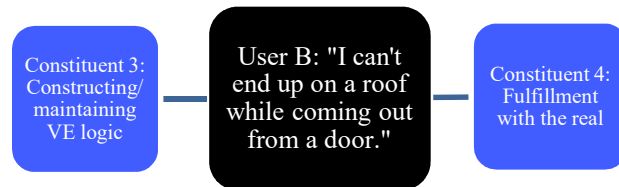
Figure 5. User B's fulfillment of the VE logic with the real.

To go deeper in to the specifics of the fourth constituent, it could be said that on many levels the VE experience appeared to the users through similarities with the real world. In addition to similarities with objects that appeared to the users' action-oriented awareness, the *general* logic of the VE was evaluated in contrast to the real world logic. User L's comment on her activity captures these both: "The training environment was very similar. They had you going in to a shed, and they had a desk with things on it." On the level of logic, C described VE as "an induction process that simulates every step of the process of getting to work" while B explained the process was similar to "how you would train a new guy":

> You take him; show him the valves. You know, they would not necessarily touch them, but you would show them the valves, you would go and show them how to do the test. And you do your slow walkthrough first and then explain what's going on. Which is what happened in the virtual. (B)

In an example used earlier in Constituent 3, user B described an activity in the VE:

> They would step through it and then you had to go on to get a sample. So you had to go out to sample valve, click on the sample valve, and get the sample with a beaker. Take it back in, get the pipet, fill it up with the solution, and

then put the additives in to it and all that, so yeah, that was that side of it. Which got you into the routine of doing it. (B)

If one was to analyze this directly as it was expressed as a logical process, one might perhaps proceed to claim that VE captures the real. Still, imaginative variation questions during the interview brought more details into this. VE might appear to capture the general process of work, but other aspects of the VE experience still appeared as reduced when compared to the real world. What is reduced in the VE experience manifests itself in the relation the user's body has to the work environment. For example B compared the VE performance to the real world as follows:

> Because it is a hazardous material it is getting kitted up in the chemical gear and respirators, gloves and goggles and all that sort of. With the computer, you're just too close. [laughter] It becomes uncomfortable actually to do the testing.
> There was a slow walkthrough and then you had to demonstrate on the virtual environment, how to do it. But it would tend to lend itself to that. It's the fact that it's pretty "cut and dried" what you are looking for and what you do. Where a lot of the other processing, especially solids and material handling, it has a lot to do with other senses as well, like hearing and you know, feeling stuff drop on ya. (B)

The user's body and its relation to the situation bring more nuances to the logic of the work in the real world.

Another example from user L further illustrates this:

> You're in your gear, you are isolated because you're wearing acid gear and it can be extremely hot. You know how your glasses fog up? Your Monogoggles fog up. You got your suit on, your helmet on, your Monogoggles, your BA, your gloves on… (L)

The user explained how wearing safety gear affects the senses: everything seems more reduced and the senses are used differently in the job than in everyday life. Also to L, feeling or evaluating the state of things with the body had a role in being aware of the specific machine in her work. Interestingly, she did not think such things could be implemented in a VE, as to her, they were something one learns to pay attention to

through experience. This might indicate that temporarily, longer time is needed to learn this than what the users had with the VE.

In addition to similarities, the VE experience appeared in various ways different to the real. This difference came forth in details: real life nuanced made the VE experience appear as a reduced experience. This took place both on the level of perception and logic. C explained the following about what he saw in the VE:

> I guess it could kind of resemble the onshore gas plant you know. Just with some of the structures there, that it… I wouldn't recognize anything only just because of the… I just know what the onshore gas plant structure looks like, and this structure kind of looked similar, but I wouldn't say it was exactly… (C)

The "truth" of the VE logic was also judged against the real. For example user C reflected his problem in the VE where he went through the VE induction in the wrong order that it would be impossible in the real world: there would be someone who knew how many people were coming in the training, and would be welcoming them and directing them to the activities. Also user L explained that the VE was quite authentic in the sense that it captured the individual nature of the job:

> We generally exclude people from the area when we're pressing acid. So, no, there shouldn't really be a lot of people coming back and forth. (L)

Furthermore, judging the VE logic with the real world affected especially how parts and their sequence were perceived. L contemplated the following:

> I think I found, I don't know if this is absolutely correct, but I think I found the order on the virtual was a little bit out. (L)

In her comment user L referred to a specific section in the work process. She was not sure if the VE training took into consideration a certain evaluation stage in the process: she was not sure if VE presented in detail what different actions you might take that depend on situational variables. Also an example from user G described a VE activity that did not seem to match the logic of the real work as it emphasized the importance of using earplugs. He experienced that a section about safety instructions was not right, as they do not correspond to the classification of the actual space of work [not a high-level noise area] nor the work procedure that takes place there:

following these guidelines could actually inhibit perception (communication through the radio with colleagues) that is part of the everyday work situation.

What enabled these perspectives that judged the logic of the VE, was that they were derived from the real world of these users. This constituent presented the important role of the users' real world as a constituent in the VE experience. VE directed the users to act upon the formalized logic of the real. As BD explained it, "Because they put you in a scenario. They get you to do things and it's as though I would assume that a normal day at work would be." Real world penetrates the VE experience and affects the way objects and the logic in the VE are grasped. This also seemed to work the other way around: the virtual affected the experience of the real, but even in that moment, the users' relationship to the real still underpinned how the post-training experience of the real world was given. User BD described the VE experience after the training: "the training sort of gave me a bit of an idea what would be going on in the actual." In contrast to BD's description, which expressed how "VE gave her an idea of the actual", user L explained that when she walked out in the actual plant, it did not seem foreign to her. It seemed like she had walked through it before. User L felt the virtual world consolidated itself once she got out into the real world. When she got into the real world, she felt familiar there.

5.4 Conclusion

This chapter presented the findings of a phenomenological analysis of the experience of virtual environments. The general structure of the experience illustrated how VE manifested itself to the users through four interrelated constituents. The constituents are interrelated, and with some of the users, they were experienced in a linear fashion, one constituent of the experience leading to another.

The constituents were, 1) acting-through-the-controller, 2) action-oriented awareness, 3) constructing and maintaining VE logic, and 4) comparison and fulfillment with the real. The first constituent revealed how even controllers such as the mouse and the keyboard that are familiar objects in other contexts of use were relearned for the context of the VE. Furthermore, this did not only mean learning the controller as an object, but learning it as part of a gestalt that enabled the users to act with and thus through the controller on the screen or "in the VE". The second constituent showed how the users adopted a mode of action-oriented awareness that

established the VE as a system of signs that led to more specific and complex action possibilities. The third constituent illustrated how throughout the experience, the users constructed VE logic while aiming to maintain its designed logic. Finally, the fourth constituent showed how aspects of VE became compared and fulfilled with aspects of the real world that were both general and also context-specific to the area of hazardous environments.

The next chapter will discuss these results and connects them to the literature in the field.

Chapter 6: Discussion

6.1 Introduction

This study began with the research question, "How users experience the use of virtual environments in a hazardous training context"? The aim was to understand what might be the invariant constituents and essential in such an experience. Instead of beginning from a specific predefined aspect of VEs, such as the experience of an avatar, or from previous theories or concepts, such as *presence* research, the aim was to begin by understanding VEs through users' experience. Phenomenological analysis was employed to understand what appeared in the users' experience and how it appeared. Furthermore, adopting the phenomenological approach guided the researcher to bracket his presuppositions, previous theories and professional history about VEs in order to allow the users' experience to emerge.

What appeared to the users' consciousness does not provide the definition of VEs, but gives insights about how the users' lived experience of VE might take place in hazardous environments training. Furthermore, as the phenomenological analysis aims for eidetic results, seeking for invariant constituents instead of what is contingent in the experience, the results could be generalizable to other contexts (Giorgi 2009). This has many kinds of implications. Firstly, it has practical implications for hazardous environments training, and to various strands of research that study the use of VEs. Furthermore, it also gives new perspectives to earlier studies that have used phenomenology as a theory or a paradigm in the study of VEs and in HCI research in general.

The four constituents that emerged from the phenomenological analysis and form the general structure of the VE phenomenon embody the key findings of this study. As it was presented in the results chapter with Constituent 1, *acting-through-the-controller,* when the users start using the VE, they first learn the controls for that specific context of use. This is more than learning to press the right buttons with fingers on the physical controller, but they adopt the use of the controller so that they can successfully act "in the VE". This action, described in Constituent 2 as *action-oriented awareness*, grasps the VE as a system of signs that lead to various kinds of activities.

As Constituent 3, *constructing and maintaining VE logic*, communicated, the users actively aim to maintain the designed VE logic but construct and learn it while they go through it. As presented in Constituent 4, the users *compare and fulfill VE logic with the real*. What the users perceive and how the logic is judged find their partial constituent in this. Also similarities and differences between the VE and the "real" play an important part: the users' experience gives indications on how the VE and the real might be different and similar to consciousness. On a further note, especially the first three constituents seemed to appear to the users in a linear fashion: first they needed to adopt acting-through-the-controller before becoming fully concentrated on action-oriented awareness, and constructing and maintaining VE logic.

Often in research, VE experience is studied through separate aspects (the controller, the VE, the avatar, and so on). This study indicates that the VE was experienced as a gestalt in which certain aspects such as signs that lead to further activities that together create the VE logic became highlighted as important parts of the conscious experience. Such findings will be discussed more in-depth in the following.

6.2 Context and embodied perception in the VE experience

Findings of this study show that even though most of the users had used a mouse and a keyboard in other HCI contexts, such as when using a word processor or playing a video game, using the VE still required them to learn how to act with these devices in this particular HCI context. This seemingly self-obvious but an important aspect indicates that it is not the controller that is learned as such, but acting with it and eventually, *through* it – therefore defined in this study as 'acting-through-the-controller'. To adopt acting-through-the-controller allows the users to better concentrate on other levels of experience in the VE use, such as action-oriented awareness and constructing and maintaining VE logic.

Our relationship with objects of the world has also been discussed in phenomenology and extended to HCI literature. Merleau-Ponty's (2010) phenomenological analyses could help to explain some of the aforementioned aspects of the VE experience. Merleau-Ponty (2010) described how perception can extend through objects: when a blind person uses his cane, s/he learns to perceive the world through the cane, while the cane as an object, when learned, becomes transparent for

perception. For Merleau-Ponty, perception is always *embodied*, which means that the whole body is participating in making meaning of the world: for example when examining an object, our hands move the object and participate in the perceptual act (Svanæs 2014). For example with an interactive artifact, the users "feel" how it works through interaction, and the artifact would appear to them differently through only looking at it (Svanæs 2014). When interacting with an artifact has been learned, the body becomes as if an automated part of perceptual acts with the artifact. This means that for example with computer software, action possibilities on the screen become available for the user who has adopted the required embodied perception (Svanæs 2014). As an example from the current study, user C explained that at first he was a bit confused how to navigate his way through the VE but once he got *through* that part it was just trying to identify where he was going. Also user L described how she was afraid that the novelty of the VE navigation would take too much attention from learning the actual VE content. Comments such as these indicate that at those moments the users had not yet adopted the mode of acting-through-the-controller, or the embodied perception required by the VE, at least not yet to a point where it would have become a more seamless part of acting in the VE. These comments sound very similar to how Merleau-Ponty (2010, 166) described getting used to tools in the world:

> If I want to get used to a stick, I try it by touching a few things with it, and eventually I have it 'well in hand'… To get used to a hat, a car or a stick is to be transplanted into them, or conversely, to incorporate them into the bulk of our own body.

Merleau-Ponty (2010, 164 italics added) discussed this as "the acquisition of *habit* as a rearrangement and renewal of the corporeal schema", and as something that "is forthcoming only when bodily effort is made, and cannot be formulated in detachment from that effort" (2010, 166). This means that the object is learned and becomes part of the activities that are performed. In a similar way in this study, the users described how they learned the controls in use for action. When they had learned the controls for action, they could adopt more fully the mode of action-oriented awareness where consciousness became directed towards interpreting signs on the screen for navigation and doing the activities: acting with the controller was adopted for use, "acting-through-it", and not consciously experienced when everything worked well. Indication for this is that generally in the descriptions the users rarely described

acting-through-the-controller, but concentrated on describing what took place with the VE activities.

For example some results from 'presence' research have indicated that prolonged action with a VE could promote increased levels of immersion and presence (Gamito et al. 2010). Still, it seems that acting-through-the-controller has not received much space in hazardous environments training research. It even seems that the use of control devices has sometimes been taken for granted, or that the "habit" of using a controller is something that is easily transferrable from one context to another. For example Guo et al. (2012, 207) simply noted with using Wii controllers in a construction safety training VE that "Wii controllers are commonly used by game players and it is likely that the trainees will be familiar with their operation". The results of the current study indicate that acting-through-the-controller always takes at least some conscious effort to learn for a new HCI context – even if they were "gamers" and learning it would be easier to them than to some others. As such, it will take attention away from other aspects of the VE experience. As discussed, when the users were faced with a situation where they explicitly needed to concentrate on acting-through-the-controller, it took away their attention from performing the activities in the VE. A logical implication for VE design would be to ensure that the users could become well familiar with acting-through-the-controller before performing the actual VE activities, and that there would not be any problems during the use that would take their attention away from the activities, and back to the controller or the navigation.

6.3 Action-oriented nature of the VE experience

Another angle to reflect the way VEs appeared to the users comes from Heidegger's phenomenological analysis of tool use. Heidegger proposed that we always approach the world through our pragmatic engagement with it (Gallagher 2014). Things become differently relevant to us when we use them for action. When we authentically use objects around us for our tasks, they "appear as "ready-to-hand" (Zuhanden)" (Gallagher 2014). The famous Heideggerian example describes how a carpenter uses a hammer and how the hammer in use becomes equipment or a tool that supports the carpenter's project. In the project, the tool "becomes experientially transparent" (Gallagher 2014, sec. 28.4).

When Heidegger proposed that tools are used authentically for action they appear as "ready-to-hand" and are not itself the focus of consciousness, he also described what takes place in consciousness when a tool breaks. In contrast, when the object breaks or does not work seamlessly as part of the current project and its goals, the status of the object for the user changes and it becomes "present-at-hand" (Vorhanden), "a problem to be fixed" (Gallagher 2014, sec. 28.4). Macann (1993, 75) described this as follows:

> Finally, our ability to make use of equipment ready-to-hand may be impeded by something else which, as it were, stands in the way. Had the thing in question not stood in the way, it would hardly have been noticed. But because it stands in the way of our using the piece of equipment in the manner intended, we are obliged to take note of it. Thus the presence of what stands in the way becomes obtrusive by virtue of the fact that it obstructs our instrumental dealings.

Instead of being something practical, the tool becomes an entity in itself to be theorized about as it is preventing us to continue with our project as intended (Macann 1993). Some have discussed this in HCI as a *breakdown situation* (Winograd and Flores 1988), and it might help to understand the users' experience of problems during the VE use. If novelty in the beginning of the VE use kept controls and more specifically acting with them in the users' conscious focus, after adopting this well enough, only conditions such as software problems made the controller and the VE as an object in itself present for consciousness. For example user B experienced how he lost the control over his avatar due to a software problem: every time this happened, he had to restart the software. In relation to Heidegger's 'present-at-hand' status of the tool use situation, user B's awareness became directed towards solving his problem with the VE – he solved this unfortunate additional "project" by learning that he should not press specific controller buttons which would make his avatar move sideways at a certain location in the VE. Interestingly, which perhaps reflects Merleau-Ponty's proposition on embodied nature of perception, during the interview user B even re-enacted with his body how he was able to refrain from pressing the keyboard buttons at the last moment.

The Heideggerian example of tool use has often been used also in HCI (e.g. Farrow and Iacovides 2014; Houliez and Gamble 2012; Svanæs 2013). Instead of

taking Heidegger's tool as given, the users' experience in this study invites to ask, but what is this Heideggerian 'entity' or 'tool' in HCI? Winograd and Flores (1988) described a software in the computer, such as a text editor, to be such a tool. Others have proposed it to be the virtual world (Houliez and Gamble 2012), the avatar (Martin 2012), or the control device itself (Farrow and Iacovides 2014). A hammer is just one tangible object, but when using a VE there are many elements or tools that support the users' "project", which in this HCI context was to learn to perform safely in hazardous environments. One could perhaps propose that the primary tool was the controller, as it was the access to the VE and allows interaction. Without it, the users could not have navigated the VE and performed various activities – therefore the VE would not have appeared *the way* it did to the users. Still, there was always a purpose why the users were acting with the controller: what appeared to the users' perception and how the logic was maintained during activities were important parts of the VE experience. In relation to Heidegger's hammer example, Svanæs (2014) described how the hammer is part of an 'equipmental nexus' in relation to nails, wood and the shared cultural practice of the project at hand, and that "the elements form a whole, and each element gets its significance from its role in this whole" (Svanæs 2014, sec. 11.5). In HCI, also the term 'interaction gestalt' has been used to describe the whole that emerges when people interact with digital artifacts (e.g. Lim et al. 2007; Svanæs 2000). Treating the VE experience as an 'equipmental nexus' corresponds to the findings of this study better that treating an individual element of a VE as a tool to be studied independently. The results of this study show how the constituents of the VE experience were interrelated in various ways. The whole VE was an 'equipmental nexus' that in this HCI context served the "project" of training to act in hazardous environments.

The action-oriented nature of the VE experience also requires discussion in relation to the role of story and narrative in interactive media (Chapter 3.6). It has been suggested that story and narrative can be important aspects of immersive VEs that bring the experience closer to the user's personal experience (Adams 2004; Calleja 2011). Others have been more critical and pointed out that it is interaction that is in the focus, and as such, VE experiences are somewhat different from previous storytelling media (e.g. Eskelinen 2001). To an extent it could be said that the findings of this study support the latter view. Based on the users' accounts, their consciousness seemed to be directed more towards action, and not so much the "story" of the VEs (if it could

be even said there was one). Even during times when there were more room for something that could be defined as story, for example a moment where one of the user's avatar was just riding on a bus to another location and there was nothing to do as such but to watch out from the window and listen to a non-player character talking, the user's consciousness was directed towards expecting the next chance of interaction. This brings forth a question that for example Juul (2005; 2001) has posed: can narrative and interaction co-exist? Perhaps the situation with consciousness is similar to Merleau-Ponty's (2010) example of the double image where one can see either the face of an old lady or the portrait of a young lady, depending on what one is currently seeing, but never them both at the same time. On the other hand, one of the participants remembered being slightly shocked when she killed her avatar, which really focused her on the task when she tried again. Perhaps this could be taken as "learning from the moral of the story", when working in a hazardous environment ("if you do not proceed with the safety instruction, you might get killed or injured"). However, it is difficult to make broad claims about the relationship between interaction and story based on this study due to the fact that this topic was not the sole focus of the research. Therefore, focusing in future phenomenological analyses on how interaction and story might appear to consciousness could give more details to this.

6.4 Immersion and absence of technology in the VE experience

The discussion with the Heideggerian and Merleau-Pontian examples might give an expression that the tool becomes somehow entirely absent in the lived experience, and only the goal or the activity with the tool remains present for the user. Interestingly, the interviews of this study showed that, although the users clearly do not focus their conscious effort on acting-through-the-controller during the VE use, they were still able to recall how they used the controller at a certain moment. The data gave mixed indications about this though: the same users were sometimes able and sometime unable to describe their control use in the VE. On one hand, they could describe what buttons they used in the beginning, most likely because they were still making a conscious effort on how to control the VE. On the other hand, some could describe at least vaguely even more complex VE activities and how pressing certain buttons on the controller were part of it ("press the Escape key to have a drink" (user C)). This could indicate that the controller does not become entirely absent for consciousness,

but still remains somewhat present in the periphery and as such, part of the VE experience. Unfortunately there was not enough data that would describe this part in more detail, and as such, could open up further research opportunities.

Making mediating technologies as intuitive and inconspicuous as possible could be said to be common sense of good user experience design. HCI literature has discussed this as a sense of non-mediation, transparency of the controller or controller naturalness, and as something that has also been suggested to better immerse players in VEs and to feel as if "being there". Some have suggested that to make VE controls easier to learn and the experience richer, the controllers should aim to simulate real physical movements with the user's own body (Arjoranta 2013). It has also been proposed to make the VE experience appear closer to "real" life. Others have been skeptical if trying to get rid of the controller from experience or to involve the users' whole body would make the HCI experience somehow better or more engaging (Farrow and Iacovides 2014). The results of this study indicate that the users indeed became "immersed" in the VE experience and enjoyed it with just a mouse and a keyboard. Naturally controls that are working well are part of making the experience engaging, but it would appear that the immersion or engagement was due to the fact that the users became engaged through action-oriented awareness and constructing and maintaining VE logic, i.e. performing the activities.

6.5 Presence and absence of VE objects for consciousness

When acting-through-the-controller fell in the periphery of consciousness, the users focused on grasping the VE as a system of signs that lead to activities of various kinds. The users employed signs and objects of the VE for action. The users' awareness was actively directed towards action opportunities and actively discriminating what objects belonged to action and what did not. This made certain objects present for consciousness and others absent, and in some cases it also determined the parts and wholes of a VE activity.

In one of the VE activities two users of this study were instructed to carry specific objects from one location to another, and at the same time to maintain a positive (hydrated) state for their avatar. What came as a surprise to both of the users was that all of a sudden the activity ended in failure. The failure was due to that the users neither saw nor reacted to another virtual character's changed bodily condition

that was simulating a heat stroke. The data do not tell if the virtual character's changed bodily condition was easy to spot or not. What it tells though is that the users failed to notice what happened to the virtual character even when they were instructed by another virtual character to "look after their colleague". This was perhaps because they were so involved in performing the task that was more directly given to them – even if the activity as such was not directly related to the VE topic of heat stress training. This particular activity and its objects filled their action-oriented awareness.

In phenomenology, Sokolowski (2000, 18) discussed *presences* and *absences*, or *filled* and *empty intentions*, as an important part of the way things appear to us. He illustrated it with an example on how we might perceive a cube:

> At a given moment, only certain sides of the cube are presented to me, and the others are absent. But I know that I can either walk around the cube or turn the cube around and the absent sides will come into view, while the present sides go out of view. My perception is dynamic, not static; even if I just look at one side of the cube, the saccadic motion of my eyes introduces a kind of searching mobility that I am not even aware of. As I turn the cube or walk around it, the potentially perceived becomes the actually perceived, and the actually perceived slips into absence…

When looking at the failed activity, one could say that the instructions that were given to the users attuned them to the task, and as such, were judged as the activity towards their awareness was directed at. The users anticipated certain things to take place, which were fulfilled in experience. At the same time, "watch your colleague", in its vagueness and openness, was not present in this anticipation.

6.6 Parts and wholes in the VE experience

In addition to presence and absences, Sokolowski (2000) illustrated how things appear to us also through the structure of *parts and wholes*. Sokolowski (2000, 25) proposed that, "whenever we think about something, we articulate parts and wholes within it." This activity is the basis of human understanding. Wholes can be divided into parts, which can be divided into *pieces* and *moments* (Sokolowski 2000). A piece can exist as an individual part from the whole – such as a leaf is part of a tree, but a leaf can also appear as an independent whole. A moment, such as *color*, on the other hand, cannot exist independently as such, but needs for example a surface to appear.

For this study and the described failed activity, parts and wholes might give another frame to understand how the users' experience of the activity was given and why they might have failed the activity. First of all, their action-oriented awareness anticipated the objects that could belong to the activity that they were instructed before the activity by one of the virtual characters in the VE. In addition to that, as the users explained in the interview, they took the explicitly given task (carrying scaffold poles) to be the whole activity, when in fact it was only a part of a whole activity. For the users, this part easily existed as a whole as long as they were able to maintain the activity – until the heat stroke of the virtual character ended it. Interestingly, the users were vaguely aware that this character was standing close to where they performed their partial activity ("I had to drag poles from, or click to get poles from here to there, and he was in the middle of doing something else." (user BD)). Now only after this surprise and trying again, the users' action-oriented awareness took the virtual character and the possibility of a heat stroke as part of their activity. As user BD's comment well summarizes it, "And that's when I realized I was supposed to be watching him, so then when I looked at for the symptoms I saw them."

6.7 The avatar in the VE experience

The literature has discussed various ways the avatar might be part of the VE experience. Avatar has been described to be an access or reference point to VEs, an enabler of social interaction and inhabitation in the VE, an invisible character part of the VE action, or a vessel for acting the self and identity. It has also been explained to affect users real self and experience of the body. The way the avatar was part of the VE experience in this study seems to fit more closely with what some have discussed as the avatar becoming invisible in action (e.g. Jennett, Cox, and Cairns 2008; Nacke and Lindley 2008). The way one of the users explained the first-person perspective of this experience, was that it is "as if you're someone's eyes" (user G). During the interviews the users mostly described the activities they were performing in the VE. As such, their avatar did not manifest itself as a character nor did the users describe its specific aspects. This could be due to the case that the VE interaction was quite straightforward, consisting of navigation and choosing right options during the activities (for example doing a quiz), and the avatar was not part of the activities as an object. Some have proposed that, with its abilities, the avatar is a mediator that

connects the user to the VE context (Gee 2008; Lankoski 2011). It might be interesting to compare the hazardous environments VE experience to experiences with contemporary first-person shooter games such as Halo or Call of Duty series (Infinity Ward) where the characters possess various complex abilities from jet packs to x-ray visions. In such games these abilities are often a vital part for successful performance of the games' objectives. As such, they could also be more important for the users' action-oriented awareness, and make acting-through-the-controller appear more complex.

The avatar has also been discussed as some kind of a vessel for acting the self in the VE. The only description that would relate to this came from user BD, who hoped there could have been a female avatar option. Her comment relates directly to the logic of the real context that the VE aims to simulate: there are female workers in the field and it would be only logical that a female user could choose a female avatar. Another activity that could be proposed to resemble "acting the self" proposition is a VE activity where the users needed to choose the right kind of safety equipment for their avatar. This was something the users experienced as an activity where they merely "had to select the right stuff" (user BD). This sounds very different from complex experiences in virtual worlds such as Second Life (Linden Lab) where people sometime strongly connect with their avatars and often use considerable amount of time to choose and develop their avatar representations (Boelstorff 2008). In doing this, their motivation can be to immerse themselves as a customized character to a fictional world such as the World of Warcraft (Blizzard Entertainment) in order to interact in specific contexts with other users (Billieux et al. 2013). Looking at the VE experience from the action-oriented awareness perspective, the difference to these VEs seems obvious: the aim of the users in the hazardous environments context is to learn about that particular context and to be able to perform there. In this context, the reason to use the VE is not usually due to self-presentation, social interaction or leisure, but for work. As some have proposed, although the potential of VEs has often presented itself in an entertainment HCI context (i.e. playing videogames and using virtual worlds), what makes using VEs compelling in one context, might not be directly relevant to another (Deterding 2016; Mäyrä 2007).

6.8 VE logic and temporal structure of consciousness

Important part of the VE experience appeared to the users through actively seeking action possibilities in the VE by using various signs to reach activities. The users followed VE design logic by going through it but while doing it, were actively constructing it for themselves – in this, the mode of action-oriented awareness made certain objects present and other absent. Several users described the VE experience as something that took place in sequence or steps. When the users were able to follow the sequence of the designed logic successfully, navigating and performing the activities in the VE took place as they anticipated – also the activities in themselves had their own logic. When the logic broke either in navigation or within the activities, the users referred more closely to the past VE experience they had just lived through – which brought past into presence again to be used for action. For example the case with user C showed how he thought he had followed the navigational logic correctly, but at some point he realized based on the messages he got that he had actually gone through it in the wrong order. This made him to try to rebuild the navigational logic of the VE by retracing his steps to a point where he considered it to be still intact. Also in the activity where the users BD and C were required to move scaffold poles and to identify another virtual character's bodily condition, the logic suddenly broke: both of the users who did this activity were surprised when they failed it, as they had thought they were performing it correctly. (see also Sections 6.5 and 6.6).

Although the earlier examples of tool use from Heidegger and Merleau-Ponty in relation to acting-through-the-controller have often been used to explain HCI experiences, another potentially useful development from Husserl's phenomenology has received less attention: the proposition that consciousness has a temporal structure. The temporal structure of consciousness has been explained as something that gives continuity, coherence and stability to our experience of the world (Gallagher 2014). We are always anticipating the future and holding the past, which ties us in the present moment. This gives us a sense of continuity:

> Consciousness, on Husserl's account, has a three-fold structure of retention, primal impression, and protention. The retentional aspect at any moment of consciousness provides a sense of what I have just experienced; primal impression is directed at the present moment; and protention is oriented towards what may happen in the next moment. (Gallagher 2014, sec. 28.3)

When we are listening to a melody, we do not just hear parts or just the present part of it, but we retain the history of the melody changing. As Gallagher (2014, sec. 28.3) has argued, "without this kind of retentional temporal structure, which is built into the perceptual act, we would not be able to perceive melodies at all." This would mean that we heard only one note at a time. Gallagher (2014) proposed that also in protention the consciousness anticipates that the experience will continue and that the experiential object such as a melody continues to appear as anticipated. If it does not, and the conscious act is not fulfilled as anticipated, it can lead to a surprise (Gallagher 2014).

Gallaher (2014) explained that this three-fold structure of retention, primal impression, and protention takes place both with temporally changing objects such as a melody or more stable physical objects. As such, it could support understanding how to design more coherent VE activities. Garrett (2010) proposed that testing with users or conducting a field study can yield results that reveal how the users interact with the product. The way the temporal structure of consciousness shows itself in the results of the current study indicates why testing VE interaction with the actual end-users beyond simple usability might be useful for design: authentic use might reveal the gaps in the VE logic, and how they appear. The users make meaning (Dourish 2001), and construct the VE logic in use.

6.9 VE experience is compared and fulfilled with the real

As described in the results chapter, the users compared and fulfilled various aspects of the VE experience with the real. For example the acting-through-the-controller constituent presented how user BD explained how she chose the control layout because "she is not a gamer", while user C explained he chose it as he thought it was easier to use. Also when in the mode of action-oriented awareness, the real had a constitutive quality in infusing meaning to the things the users encountered. For example when perceiving a building or a room, user C perceived a "gas plant" and "a donga" (a transportable building) instead of just some graphics empty of meaning. This same process made virtual character animation appear as "cleaning scaffold clamps" instead of just shapes moving. The real also affected how VE logic got constructed and maintained. The task which two of the users failed when they did not recognize a virtual character acting strange and getting a heat stroke was compared to real life

which made its logic appeared improbable. As user BD expressed it, "Because in a real work, well, you'd probably looked after yourself first and you wouldn't really constantly check up on somebody else." and user C, "I guess it's a little bit corny but, I mean, the reality of it is that if you don't keep an eye on who you're working with, well, maybe they can collapse." These appeared to affect how the users' awareness was directed, or better yet *not directed*, towards the VE action.

Making it as easy as possible for users to adopt control devices and technologies could be considered as basic interaction design: the users have various levels of skills that affect how they learn the use of control devices and games. Also user BD's comment, "I'm not a gamer", might be discussed in the light of the Technology Acceptance Model (e.g. Davis 1989; Mathieson 2016; Venkatesh and Davis 2000). Still, it is the relationship of the real with action-oriented awareness and constructing and maintaining VE logic that brings more details to presence that could be taken to be specific to the VE experience. The relationship of the real to other aspects of user experience in VEs might be more intertwined than what has been discussed for example in 'presence' research. These results show that the real is part of the VE experience and affects it.

But what is this "real"? As for example Houliez and Gamble (2012) have argued, the often implicit Cartesian worldview in the research of VEs allows and even forces a common sense split between the virtual and the real world. This is due to the fact that, a Cartesian perspective considers an independent world to exist "out there", and that truth about it can be achieved with analytical methods. Based on this worldview, one could interpret the results from the perspective that it is this "world" that the users are referring to when acting in the VE. The phenomenological concepts of the *life-world* (see more extensive discussion on this concept in 2.4.2) and *being-in-the-world* challenge the notion of correspondence to some kind of a stable world, and in contrast refer to the "world" as it appears to the users (Dourish 2001; Svanæs 2014). This has been employed in HCI as a frame to discuss the users' relationship with the technologies they are using. For example Svanæs (2014, sec. 11.5) wrote that

> …to be able to understand how an interaction is meaningful for a specific user, we would have to understand the *lifeworld* of that user, i.e. the cultural and personal background that serves as a frame of reference and context for every experience of that person.

Also Merleau-Ponty proposed that we are always "subjects already existing in the world and becoming aware of ourselves through interaction" (Svanæs 2014, sec. 11.6).

The basics of user experience design show that design should help users to navigate and use the interactive artifact (Garrett 2010). This can be designed by using known conventions, grouping similar things together and making sure that things which help users to perform their tasks and goals are in place. Similarly the users of this study navigated and followed signs, and in the same way as in other HCI contexts, they sometimes got lost. For example user C explained how he "had to follow the green arrows, or the green spots on the screen." Still, he did this in the wrong sequence, which broke the designed VE logic and the user needed to search his way back. From one angle, the users' life-world could be said to affect how they experience control devices and the conventions of using icons, menu items, logical flow and so on.

From another angle, results from using VEs for hazardous environments training showed the complex ways the life-world became a constituent in the VE experience. It became present in how the users' perceptual objects and events from the real world played a part in forming the VE experience. The VE was given and made meaningful through complex manifold of present perceptual VE action and objects, and past "real world" objects and events. Instead of the use of the VE being just about perceiving and following a logical flow of certain graphics, although that also took place when the users were searching for action opportunities, the users perceived and followed the logical flow based on the "real world". Dourish (2001, 17) noted the following about the role of the everyday world in HCI:

> This role of the everyday world here is more than simply the metaphorical approach used in traditional graphical interface design. It's not simply a new way of using ideas like desktops, windows, and buttons to make computation accessible. Instead of drawing on artifacts in the everyday world, it draws on *the way the everyday world works* or, perhaps more accurately, *the ways we experience the everyday world*.

The focus of writing this for Dourish (2001) was perhaps more the desktop user interface in mind, but especially the final sentence appears to resonate with the findings of the current study. As Dourish (2001, 137) expressed, users make meaning, and "action and meaning are inherently inseparable". Perhaps due to the aim of the VEs to

simulate the everyday world, meaning during the VE use emerged when the users corresponded their action-oriented awareness and constructing and maintaining VE logic to *their* "real" world. While the VE experience appeared as a phenomenon of VE use and the "real" world, the VE experience also made present the differences between the experience of the VE and the "real" world.

6.9.1 Differences of the VE and the "real" world experience

An important result of the phenomenological analysis is that the users' experience made explicit not only how the users involved their life-world in the VE experience, but also exactly how the VE experience was different to the "real" world. The earlier comments from the two users who failed the heat stress activity show how logic was judged as something that might not even take place in real life. The work logic was also something that appeared as reduced when reflected to the real world. For example user B said that doing the work in the VE felt "cut and dried": performing the tasks took place in a way that seemed more or less set in stone. Likewise some users explained that some work sequences or details were slightly off or missing. The VE experience also appeared reduced as a bodily experience: users B and L described how doing the job in the real can feel difficult due to the hazardous material and how it gets kitted up in the safety gear. This can sometimes make doing the job to feel uncomfortable. This aspect does not come through the same way in the VE experience. As user B summed it, "with the computer, you're just too close."

These results show how the intentional acts and their objects in the VE can be considered both similar to the "real" world, but still different, as in relation to the reduced bodily and logical complexity. These results resonate with Merleau-Ponty's (2010) contribution to understanding the experience of ones' body, and how it is part of ones perceptual acts. He stated that, "the body is our general medium for having a world" (Merleau-Ponty 2010, 169). We are embodied agents who encounter others and objects in the world. Furthermore, as Gallagher (2014, sec. 28.6) described it,

> Our bodies are not primarily objects — either for ourselves or for others — but agentive bodies that express their subjectivity in their postures, movements, gestures, actions, and expressions.

The way we experience our body and feel and experience things around it forms our experience of the world. As Svanæs (2013, 8:11) aptly summed it:

> The lived body manifests itself mainly as its possibilities of acting in the world. We have a world insofar as we have the capacity to act in that world. The lived body is an active body.

When user B was describing the VE activities as "cut and dried", he was referring to the reduced action, and therefore reduced meaningful possibilities in the VE. The possibilities for unpredictable encounters and ways to do things are more diverse in the real world. When the users were describing the difference between doing the job in the VE and doing it in the real world, they were referring to how the body is differently involved in the real world. When working with hazardous materials particularly, the status of the body is naturally in focus, as the possibility of an injury is ever present. In the real environment, the users coordinate and move their bodies differently. With the VEs of this study, the users acted through mediating control devices and the status of their real bodies was not really at stake: they were "too close". Farrow and Iacovides (2014) argued that one of the main reasons why fantasizing about digital and real life embodiment becoming the same is futile, is that we really do not risk our lived body in virtual experiences. Therefore total immersion to VEs is an impossible idea as it is clearly different from the real world, which sets limits to virtual embodiment. The authors proposed that phenomenological descriptions of virtual experiences would help to make these experiences more explicit, and thus show how they compare to "real" experiences that VEs aim to simulate. Based on the results of the current study, the authors' claims seem plausible. Still, more similar kind of research would be useful in this area.

By default, VEs seem to invite comparisons between the "real" and the virtual. Underpinned by a often implicit but widely accepted Cartesian worldview, it presupposes a "real" world existing "out there", and therefore forces an unnecessary juxtaposition between the "real" and virtual worlds, making their comparison possible (Boelstorff 2008; Houliez and Gamble 2012). This justifies studies that measure if VEs are able to elicit similar responses than what the real physical environment would: if they do, the VE experience can be considered similar to real. Some have even claimed VEs to be more real than real. At least in the present HCI context, the findings of this study seem to make irrelevant the question if the VE experience could be considered as "real"? First of all, as discussed earlier, the perceptual and embodied aspects of the VE experience and life outside the VE experience have both similarities and

differences: there are similarities on the level of perception and logic, but differences in logic how the body is involved. Therefore it is not a question of either one of them being more "real" than the other, but how these experiences are similar or different based on the users' intentional acts and objects. The role that the user's body plays in this should not be forgotten.

What appeared for perception and how VE logic got maintained was affected by the "real" world. Interestingly, this comparison and fulfillment with the "real" also seemed to become reversed after the training event: the VE experience was attuned the users to the "real" world of work and was enmeshed as part of the real world experience. For example user L felt that after she went to the real environment, she felt familiar: to her, the VE experience "consolidated" itself when she got there. User G explained that the VE experience gave him confidence to do the job, while user BD who had not worked in the actual hazardous context after the VE training, the training gave an idea what it might be like. For different users, the VE experience appeared enmeshed differently in their post-VE training "real" life. As the initial research focus of this study was not to study how exactly the VE experience might become part of the "real" world experience, the data and analysis in this are insufficient to make any further claims. As such, this area can be considered as an opening for future research.

6.9.2 Procedurality, and graphical vs. cognitive realism

The way the VE experience appeared to the users of this study was described primarily through VE activities. For example user BD's comment captures how VE made her feel as if being in the actual environment. She explained that it took place because she had to *do* everything and follow each part to proceed to the next level. Furthermore, she was as if part of the VE: "they had you still in the environment, and they had the people grouped around you, and you were seeing all of their faces, and they were speaking to you as the virtual person" (BD). Although some of the users referred to objects of perception, the VE appeared primarily through the users' interaction with the VEs.

The intentional structure that describes the users' VE experience resonates with arguments that the primary potential of VEs does not lie in their ability to simulate realism and to produce graphical "life-likeness" or 'fidelity' (Caird 1996; Herrington, Reeves, and Oliver 2010; Herrington, Reeves, and Oliver 2007). It has been suggested also in HCI literature that instead of trying to capture the visible reality of the world

with increasingly life-like graphics misses the potential of VEs: the potential is in capturing the procedural logic of the real world. For example Bogost (2007, 5; see also Murray 2000; Salen and Zimmerman 2004) proposed the following:

> …computer processes are representational, and thus procedurality is fundamental to computational expression. Because computers function procedurally, they are particularly adept at representing real or imagined systems that themselves function in some particular way—that is, that operate according to a set of processes. The computer magnifies the ability to create representations of processes. The type of procedures that interest me here are those that present or comment on processes inherent to human experience.

Naturally Bogost did not claim that the actual human experience could be captured one on one for representation, but that "software and videogames are capable of generating moving images in accordance with complex rules that simulate real or imagined physical and cultural processes" (Bogost 2007, 35). We have failed to understand what could truly give the expression of a world: aiming for life-like immersion is a dead end, and procedural rhetoric, "the art of persuasion through rule-based representations and interactions rather than the spoken word, writing, images, or moving pictures" (Bogost 2007, ix), is the key. According to Bogost (2007, 45–46):

> Greater interactivity is often considered especially engaging, or "immersive." The interactivity of (good) videogames might locate those games higher on the "vividness spectrum" discussed earlier, producing more vivid experience thanks to the player's active involvement. But I want to suggest that vividness comes not from immersion, but from abstraction. The values common to virtual reality and computer graphics assume that the closer we get to real experience, the better. (…) But meaning in videogames is constructed not through a re-creation of the world, but through selectively modeling appropriate elements of that world.

Bogost (2007) also criticized the field of 'serious games' focusing too much on content, and that the potential of VEs lies much deeper procedural rhetorics. He also noted its potential for learning:

> …procedural literacy entails the ability to reconfigure concepts and rules to understand and processes, not just on the computer, but in general. The high

degree of procedural representation in videogames suggests them as a natural medium for procedural learning. (Bogost 2007, 245)

The question that might first comes to mind is, can VEs somehow genuinely represent the actual world? Better yet the question is, how and on what extent could they achieve this? If as Bogost and others seem to argue that instead of simple graphical realism it could take place on a procedural level, how might it come through in the users' experience? Could going through VE logic somehow be considered as going through the real world logic of work, and what might prove that this is or is not taking place?

Herrington, Reeves and, Oliver (2010; 2007) also criticized the aim for realism in designing virtual learning environments. They proposed that to create effective learning environments, cognitive realism is more important than highly realistic simulations, and that "the task itself is the key element of immersion and engagement in higher order learning" (Herrington, Reeves, and Oliver 2007, 79). The "authenticity" of the task and the learning environment should be supported with creating an authentic context. In this, a background story or a scenario could be developed that includes "conditions, characters, circumstances and parameters are drawn to simulate a real-life context for learning" that "simulate a real-life context for learning" (Herrington, Reeves, and Oliver 2010, 88).

The way these come through in this study, is that the users' awareness was directed towards the activities and VE logic, and perceptual objects appeared as a supportive background in the experience: based on the users' experience, realism as elicited by graphics, did not appear to play the major part for awareness. Engagement took place due to performing activities, which naturally required perceptual acts, but still realistic graphics were not the main focus of the experience. Therefore the results connect with what Herrington, Reeves, and Oliver (2010, 86) proposed based on their research that, "the physical reality of the learning situation is of less importance than the characteristics of the task design." Herrington, Reeves, and Oliver (2010, 76) also suggested that an authentic context should be "a physical/virtual environment that reflects the way the knowledge will ultimately be used" that would maintain the complexity of the real-life setting instead of a linear learning design. Although the results of the current study show that the VEs in this study were quite linear, and as such perhaps not as "authentic", the VEs were still able to elicit the sense of "real" life.

Some of the users actually called the VE training "hands-on", or as something that gave them an idea about what the real context might be like. This, with comments that communicated that the VEs made the users feel confident and familiar with the job, indicate that although the VE experience appeared somewhat linear, the experience still had a positive impact for becoming familiar with the work context.

6.10 Summary of the primary implications of the findings

Beginning from the users' experience appears to provide an interesting open perspective to understand VEs in different contexts. This can help to reveal aspects of user experience, which might be concealed if the study was predefined with existing theories and concepts. Implications of the findings of the current study are discussed below. The results propose practical implications for VE design. Experience from this research also shows that although phenomenology has not been widely employed in the study of VEs, it shows promise for this task.

6.10.1 Practical implications for VE design

The study results have several practical implications for VE design, which might be helpful in and outside the hazardous environments training context. As discussed in this chapter, HCI is embodied and contextual. One cannot simply expect that even if the users have used similar control devices in other HCI context that they would be familiar with them in another – although the results indicated that it might help if you are a "gamer. Still, the users need time to learn to act with the controller so that they become familiar with it, and it becomes acting-through-it "in the VE". Otherwise their awareness can be drawn away from the main reason to use the VE, which in the context of this study was to learn safe working procedures in hazardous environments.

This study shows that the users were oriented towards the activities: perceptual objects that were judged to correspond to this aim became present to awareness. Graphics have their role in creating the environment that tunes the user in the context and supports doing the activities: objects, such as in the context of hazardous environments training for example a pipet or a pole clamp need to appear as what they are. Still, it is difficult to determine what is enough detail. For example studies that have reported the use of VEs for identification of hazards have not explicitly touched this subject. The results of this study indicate that if the graphics support the activity, they are "realistic" enough. When looking back to VEs and VR, research reports often

describe them as realistic but as something that always seem to have room for more development. This has been discussed in commercial video games, where some designers have jokingly said that they use a lot of time for environmental details, but the players merely run through the game without seeing them. VE designers need to balance if they want to use time, effort and cost for increased graphical realism even if the users largely do not even concentrate on that. It might be that more graphical details are useful when the users need them for in the VE activity – for example if trying to identify hazards requires it. It is obvious that poor graphics affect users' performance, if they cannot really see what is on the screen. Most likely this is something that can be balanced with relevant user testing.

The way the users involved their real world with the VE is an important contextual aspect of the experience. When playing a commercial first-person shooter, most likely the users are not involving their real world as it is so far apart from some of the themes used in such games. Still, in the hazardous environments training context, it was apparent how the users judged especially the logic of the VE activities, and how it affected their performance. As Dourish (2001, 162) argued. "Users, not designers, create and communicate meaning; Users, not designers, manage coupling…and embodied interaction turns action into meaning." It is the users who operate in the mode of action-oriented awareness and construct VE logic. Finding out how this might take place in the real use for training, requires testing VEs "with real users, in real settings, doing real work" (Dourish 2001, 19) to make it appear. When imaginative variation questions were asked in the interview to guide the users to imagine how the VE could have been better or different, the users reflected their real work to the VE activities. Such data could provide useful information when designing the logic of VE activities and scenarios. Naturally not everything can or should be implemented what users can think of, but hearing from the users never hurt designing user experience.

6.10.2 Implications of this study for phenomenological research of VEs

Phenomenology has shown promise as a research approach for understanding the experience of human-computer interaction and information systems phenomena (e.g. Adams 2006; Boland 1986; Cilesiz 2011; Dourish 2001; Farrow and Iacovides 2014; Ihde 2002; Svanæs 2013). Acknowledging that HCI is contextual, embodied and meaning*ful*, it provides a way to understand the users' experience as a whole beyond

mere usability (Svanæs 2013). But the potential of phenomenology lies beyond treating it just as a paradigm. Based on this research it can be stated that phenomenology, at least the employed Giorgi's (2009) approach, has shown great promise to make the users' experience of VEs more explicit through describing the users' intentional structure of experience. It also shows that using phenomenology only as a research paradigm, as it has been sometimes employed to explain HCI phenomena, does not necessarily yield similar results what could be achieved with conducting a phenomenological *analysis*. For example Houliez and Gamble (2012) employed Heideggerian phenomenology as a research paradigm, conducting a focus group study in an online virtual world Second Life (Linden Lab) to understand the users' perception of the virtual world and their opinions of 'presence'. One of the aims of their study was to enquire from participants what "real" meant to them. The authors reported to receive mixed responses from idealistic ""Real" is a construct of the mind" (Houliez and Gamble 2012, 275) to ones that showed that the ability to act and create for example a monetary impact justified the "realness" of the virtual world. These results in relation to the "real" appear somewhat different when compared to the current study, even if both studies where underpinned by the phenomenological paradigm. The results of the current study highlighted that the users actually involved the "real" with the VE experience, and more importantly, *how* they did it. The phenomenological research method made present how the "real" was enmeshed as part of the whole VE experience from action-oriented awareness to constructing and maintaining VE logic. This was made possible by using a broad open-ended question and additional imaginative variation questions (asking the users to imagine how something might be in the VE) to ask the users to describe their experience, and then performing a rigorous phenomenological analysis. This indicates that phenomenology as a research approach can support the researcher to go beyond what using it only as a research paradigm might achieve, as it can make more explicit the users' intentional structure of experience.

6.11 Limitations of the study

Giorgi (2009) has suggested that as phenomenological descriptions of experience are taken to a more general level, they could be generalizable to different contexts. At the same time he also noted that more participants could make them more

accurate and detailed. The study results naturally raise the question of generalizability on several levels, i.e. are the findings of this study specific mainly to the studied context of hazardous environments training or also to e.g. entertainment context, and are the findings specific only to the studied VEs or perhaps also to other kinds of VEs e.g. VEs that employ virtual reality technologies such as HMDs? Although the views can sometimes be varied about if phenomenological studies can aim for generalizability in a similar manner than for example quantitative studies, when reflecting back to the participants' experience and how the VEs appeared to them, the strong indication is that some of the findings indeed transcend the specific contexts and VEs of this study.

For example, when reflecting the findings to the phenomenological literature review and Merleau Ponty's (2010) phenomenology, adopting the technology as a tool to seamlessly act through it is something that transcends VEs and can be found also in our day to day experience with various other forms of technologies. Also the participants' action-oriented awareness and the aim to find the logic of the VE in order to follow it through is present also in other forms of digital interactions such as when playing entertainment video games.

In contrast, what might actually be specific to the context of this study is how the users involved their world and the real. While playing entertainment video games, one clearly does not have the same personal level of involvement and experience of for example waging war in Mars than they do with working in a gas plant or with a machine that creates acid. On this aspect, these study results might indeed be more specific to serious games context. That said, all of this would still need more research to understand how specific the findings might or might not be, and in what regard. This should be determined with additional research of experience. As Giorgi (2009) has pointed out, the phenomenon is never exhausted. Adding different contexts and perspectives opens new aspects to it.

In addition to how general the findings are, there are at least two specific limitations of this study that could be addressed to make it more generalizable in different geographical and HCI contexts.

Firstly, one of the limitations of this study is that it is difficult to argue that the experience from five people from a Western Australian context is generalizable to other geographical contexts of other HCI contexts. Extending this study to other

geographical locations in hazardous environments training could shed more light to how well the structure and the constituents hold.

Secondly, conducting a similar kind of a study outside the hazardous environments context could offer something to reflect the current findings. Naturally this can be achieved by comparing the study results to previous VE studies. Still, extending the phenomenological approach of this study to other VE user contexts, such as entertainment, could create a more accurate ground for comparing VE experiences, as it examines specifically the intentional acts and objects of experience.

6.12 Future research

This study gives several openings for future research that could advance the understanding of VE experiences. First is to do with the richness of the results of the phenomenological analysis that describes the experience. Giorgi (2009) proposed that at least three study subjects would be sufficient in order to create enough variation between responses, and to form an essential picture of a phenomenon. Still, he did not give any limits to subjects, but proposed that more participants could give more variations to make the general structure richer and more specific. Based on these recommendations, there are various aspects of VE experience that could be studied further. For example, it was clear that the users learned the mode of acting-through-the-controller, but exactly in what ways does this take place? Also, in some regards it could be said that the design or procedural logic of the VEs somehow attuned the users to the logic of the real world of work. It could be studied further how intentional acts and objects might be similar and different in VEs and in real life. The data of this study gave some initial indications about this, but more research is needed. This could reveal how VEs might work as a relevant approach for training, and guide the development of VEs towards more useful directions that release the potential of this interactive medium. The results showed how some activities in the VEs of this study elicited conscious acts that were similar to forms of training that depend on simple remembering (for example taking a quiz or choosing the right objects based on how they were given before). When VEs are used in this way, it should be asked if they actually bring anything new to training. Thus it would be important to better understand how VEs might appear through different kinds of conscious acts and their objects that seem to correspond more authentically to the real world (cf. "cognitive

realism" in Herrington, Reeves, and Oliver 2010; 2007). Some of the users described that the VE experience affected their real world experience in a way that made them feel familiar with it or confident that they could act there. It would be interesting to understand this aspect better, as that could show how the VE experience impacts the users' post training experience of the real world of work.

The second opening for future research comes from a few users who described how the VE experience felt as a reduced bodily experience, and that in the real world their bodies were differently part of the job gestalt. For example user L described how she actual "feels" if the machine is working correctly, and both users B and L explained that the safety gear and the hazardous material affect what the work situation feels like. When asked if these aspects of work experience could be somehow integrated to VE training, the users were slightly skeptical if it can or even should be done (as it might take focus from the training). Still, as it can be seen in the development of control devices, motion capture techniques and screens especially in VR, it is currently possible to design quite complex multimodal VE experiences. Also vibrating video game controllers have been around for a decade or two, allowing the gamers to "feel" various things in VEs. It would be interesting to see how adding these levels of technology affect the users' VE experience.

The third opening for future research is related to the first one. Although Giorgi (2009) proposed that the results of a descriptive phenomenological study could be generalizable to other contexts, conducting a similar kind of a research in different contexts of VE use and comparing them to the results of this study would show how well the general structure of the phenomenological analysis of this study holds. This could be achieved with researching different kinds of hazardous environments training situations but also different geographical locations. For example Houliez and Gamble (2012, 276) suggested in their virtual world study that "the perception of ''presence'' in virtual worlds by other cultures (e.g., in Asia) may be significantly different from the Western one." The current study was conducted in a Western Australian context, and all the participants were Australian. It would be useful to study how other ethnicities and user groups experience VEs, and if some of the constituents described in this study are universal for the VE experience. Naturally also additional comparative studies between entertainment and "serious" VE experiences could more clearly bring forth the differences and similarities between the experiential structures.

Finally fourth opening is to do with how the results of this study could impact VE development practices. One possible future project could be to arrange a workshop or a collaborative project for VE developers to make use of the findings in designing VEs. This could also create further action and design research opportunities through multiple development cycles.

Chapter 7: Conclusions

In the beginning of 2015, Australian version of the Game Informer, a video game magazine, had a Science Fiction special #61. Although a theme issue, its main game preview article was about a game called No Man's Sky (Hello Games), a sci-fi space exploration game for PlayStation 4 to be released at some point of 2015. The article described the complex design process of creating a universe with an authentic feel and procedurally created virtual environment (created by an algorithm), with vast possibilities for space exploration. The New Yorker described it as "a galaxy containing 18,446,744,073,709,551,616 unique planets" (Khatchadourian 2015).

The Game Informer article described No Man's Sky as "the most promising sci-fi game of 2015" (*Game Informer #61* 2015, 35). The developers described they wanted "people to feel this is a real working universe" (*Game Informer #61* 2015, 42) where the player may experience various events unfolding, and experience the vastness of the universe. A sense of mystery was also illustrated in the form of unknown artifacts, buildings and ancient robot guardians.

As it turned out, the game was not released in 2015, but got delayed until August 2016. When it was released, some of the huge fan anticipation that had built up came down (Mahboubian-Jones 2016). If one searches "No Man's Sky" on YouTube, the first videos to appear are angry reviews. Some players felt they had been deceived with the promises about what the game was to be like: the universe did not feel vast and interesting for exploration, but repetitive by doing the same tasks all over again; the procedural environment with its alien species, spaceships and other objects did not have too much variety after all or serendipitous encounters with interesting events unfolding during the gameplay; the game had many technical issues inhibiting the play experience. In general, it felt half-finished when reflected that it had a price of a full working video game (AngryJoeShow 2016). The game was even reported to be investigated by officials for misleading marketing (Morris 2016). In short, what the game was anticipated and marketed to be like, did not feel the same in the actual user experience.

It seems that virtual environments invite anticipation of what they can achieve, which often fail to be fulfilled in the actual user experience. This research began from

the researcher's personal interest to VEs such as video games, and to understand their much-applauded potential for non-entertainment contexts, such as learning and professional development. Hazardous environments training as a context that employs VEs for professional development provided a genuine real-life use context to study the users' VE experience. The researcher wanted to understand the VE experience without predefining it with existing HCI concepts such as 'presence', or concentrating on a specific aspect of VEs through which their potential has appeared, such as the role of the avatar, interaction, narrative or others. Furthermore, the researcher wanted to transcend his professional and personal relationship with VEs, and to see them anew. Phenomenology, and especially Giorgi's descriptive phenomenological method, appeared as a promising research approach to understand VE experience with real users and to provide a new useful perspective to understand VE experience in a non-entertainment context, in hazardous environments training.

The research began with a question, *how users experience virtual environments in a hazardous environments training context?* The objectives were to create a general description of the experience and to understand what the invariant constituents of this experience were. This means understanding *what* the users experience when they use a VE and *how* they experience it.

The results revealed four interrelated constituents that were essential for the users' VE experience. Firstly, *acting-through-the-controller* shows that the users learn to act in the VE. Using control devices to act in a VE is a specific mode of embodied perception that is learned for the specific HCI context. If this is a novel experience, the users' awareness is directed towards learning this, and can inhibit from proceeding to the next phase in the experience. Secondly, when the mode of acting-through-the-controller has been acquired at least to an extent, the users proceed to act in the VE in a mode of *action-oriented awareness*, which establishes the VE as a system of signs that lead to further action possibilities. The users are active in discriminating what objects belong to action and what do not. Thirdly, the users employ action-oriented awareness to *construct and maintain VE logic*. This shows the temporal nature of the experience: when the users are able to operate in the VE correctly, they act in an anticipating future-oriented mode. When problems take place for example with navigation or activities, the users' become directed towards the past to solve those problems either by acting in the VE or if not possible, by thinking only. Furthermore,

VE design logic is learned through use, and it can be achieved with both correct and incorrect performance. The users also determine the parts and wholes of different activities. Fourthly, the users *compare and fulfill the VE experience with the real*. The users bring their life-world to the use situation, which affects how both perceptual objects and VE logic are perceived. This also brings to presence the differences and similarities between the VE experience and the real world experience.

These results have various implications for VE design, theory and research. Firstly practical implications. Even if contemporary users would be more experienced with interactive technologies and many of them can even be "gamers", approaching a new interactive product always has a learning curve. In order for the users to concentrate on learning, they should be allowed to become familiar with acting in the VE. This means more than just someone telling them what the buttons are, but giving users time to become familiar with the required form of interaction.

As the results propose, the users do not merely follow VE logic as it is designed, but actively construct it while they go. Perhaps due to the reason that VEs aim to simulate the so-called "real" world, the users involve more closely their everyday life to understand what they perceive and do in the VE. This does not only mean that they understand what a single object (such as a pipet) is, but the users' "real" world affects what they perceive a virtual character doing and if a logic of a scenario seems plausible. This aspect to HCI makes the development of VE experience more complex, and requires testing it with real users: the VE designers simply cannot anticipate or create the same meanings themselves. This testing should go beyond simple usability, and involve understanding how users perceive and interact with VE activities. Due to the fact that users do involve their everyday life, using real end-users seem as an appropriate way to both develop and test VE scenarios.

Even though phenomenology appeared as a useful approach for this study, it is difficult to determine if it works in a development situation. Phenomenological research takes time and requires certain set of research skills, and good understanding of its philosophical underpinnings. Therefore it might be that other kinds of field study methods are more appropriate and efficient for the development situation. Phenomenology can add to such studies with in-depth understanding of users' experience. That said, using phenomenology as a *research approach* to study real users showed that it can give different kinds of results than using phenomenology only as a

research paradigm. Phenomenology as a research approach was able to make explicit the users' experience through analyzing the users' intentional acts and objects. Using phenomenology as a paradigm, with comparing Heidegger's and Merleau-Ponty's phenomenological analyses to HCI phenomena have their place in HCI theory and development. With careful analysis of the users' description of use, phenomenological research was able to bring new details also to this discussion.

The results of this study naturally open up future research possibilities. Firstly, the general description of the experience could always be made more specific and detailed. Although it is accepted with phenomenological research methods that sample sizes are small, the experience from this research is that more users could have made some aspects of the experience more explicit. This is also one of the limitations of this study. Furthermore, as this study was conducted in a Western Australian context, adding new cultural contexts would show if the general structure and the constituents would still hold in other contexts. This is true also to finding out more specifically the similarities and difference between entertainment and serious VEs.

There are also two other research threads that could be followed further. One of the users commented that after the VE training, when she walked to the real world work environment, she felt familiar – when enquired more, she could not entirely explain what it was. Although this was interesting, experiential outcomes of VE training were outside the scope of this study. They could make an interesting focus for a future study, and might reveal how the VE experience appears in the real work environment after the training. Two users commented that the VE training felt more hands-on than traditional lecturing and reading about the job on paper. One of the users actually explained that getting all the job details on paper made him feel that the job might be awfully complicating, when the VE experience made him feel confident that he could perform the job. Further analysis of this experience could show what the experiential differences between VEs and some other learning approaches might be, and therefore make more explicit the reasons to use VEs in professional development.

The final future research opportunity is to do with virtual reality, and its role in VE experience. Unfortunately there was no chance to include any experiences of VEs with VR technology in this study (for example using a head-mounted display). Therefore it is not possible to determine how VR would have affected the constituents and structure of the experience. VR has been anticipated to make VE experiences more

immersive and closer to the "real world". Year 2016 was anticipated as the year of the VR by various media: some predicted more affordable, accessible and technologically advanced devices would bring VR also to learning and training. Phenomenological analyses have the potential to make also such experiences more explicit, and to go beyond existing conceptual presuppositions, anticipations and hype.

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Appendices

Appendix A
Information and Consent

INFORMATION AND CONSENT

Participation in Research Study

Dear co-researcher,

As a doctoral student at Curtin University in Perth, Australia, I am inviting you to participate in my PhD research study. The aim of this study is to interview people to understand their experience of virtual environments in safety training. Findings can potentially assist in better design of such environments, and also how they are used in future safety training. This can help create virtual environments that are easier to use, more efficient for learning, and promote safer work places and processes.

Your participation will involve an informal discussion where you are asked to describe your experiences of a virtual environment (VE) that you have used in the past for training. The interview can take place face-to-face or through videoconferencing such as Skype. It is scheduled to last an hour, but you can end it anytime, or it can last longer if you feel so. The interview will be audio recorded. I may contact you by email or phone should there be anything in your description requiring clarification or elaboration.

It is important that all research information will be kept confidential and anonymous. A nickname of your choice will be used so you will not be identified by your real name on any of the material collected or in any reports, presentations, or publications that come from this research. Similarly, the name of your organization and other potential identifiers including locations will be made anonymous or changed to protect your identity. All research related material will be maintained on a secure online drive

provided by Curtin University for research purposes for seven years following the completion of the research and then destroyed.

There are no known risks to your participation and your participation is completely voluntary. If for any reason you decide to withdraw from the study, you may do so without questions asked. You are welcome to contact me at any time with questions, comments or concerns at:

Email: [The researcher's contact details removed]

Tel.: [The researcher's contact details removed]

I am conducting the research under the supervision of Dr Torsten Reiners, who is a Senior Lecturer at Curtin Business School – School of information Systems, Curtin University in Australia. If you have any questions for him, he can be contacted as follows:

Email: [The supervisor's contact details removed]

Tel.: [The supervisor's contact details removed]

Curtin University Human Research Ethics Committee (HREC) has approved this study (HREC number RDBS-15-15). If you wish to discuss the study with someone not directly involved, any matters concerning the conduct of the study or your rights as a participant, or you wish to make a confidential complaint, you may contact the Ethics Officer on (08) 9266 9223 or the Manager, Research Integrity on (08) 9266 7093 or email hrec@curtin.edu.au.

Thank you for considering participating in this study. If you agree to participate, please type your name, preferred nickname, and add today's date. By doing this, you are indicating that you fully understand the above information and you freely and voluntarily consent to participate in this research study.

Participant name:

Your preferred nickname:

Date:

Thank you!

Regards,

Marko Teras

The interview question:

Please go back to the time when you were using the virtual environment for hazardous environments training. Describe as vividly as possible how you felt during that time, so that someone reading or hearing your report would know exactly what the experience was like for you. You might want to start from the beginning, or from a single moment / particular incident during the training. Keep your focus on the experience, not just the situation itself. Please do not stop until you feel that you have described your experience as completely as possible. Take as long as you would like to complete your description below. Please note that I haven't developed, used or seen the virtual environment myself.

Appendix B
Table of hazardous environments training studies

Study	Field	Context	Design software	Input devices	Output devices
Andreatta et al. (2010)	Healthcare/ disaster medicine	Performing a triage for mass casualty victims			CAVE
Cha et al. (2012)	Fire hazard	Decision making during a fire hazard	OGRE 3D rendering engine	Joystick	HMD & Motion tracking
Emond et al. (2010)	Military	Training soldiers in decision making during combat	Game engine (unspecified)	Firearm replicas with lasers	"Immersive scene projection on walls" (i.e. CAVE)
Filigenzi et al. (2000)	Mining	Various, e.g. evacuation from a mine, hazard identification	3DGE graphics engine, undefined additional 3D modeling software, Quake II editor, Unreal graphics engine, Custom C++ for physics	Unspecified	
Freeman et al. (2001)	Military	Patient simulator		Position tracking (head, lower back and hands)	HMD
Gatto, Mól, Luquetti Dos Santos, Isaac, Jorge and Legey (2013)	Nuclear industry	Modeling and ergonomic evaluation of a pressurized water reactor (PWR) nuclear power plant control room (simulation with computer avatars)	Unreal editor		
Guo et al. (2012)	Construction	Dismantling a tower crane in a construction site	Virtools game engine	Wii controller, keyboard	PC
Kinateder et al. (2013)	Road tunnel	Evacuation from a road tunnel during an accident and fire hazard	In-house VR simulation software, Cortona VRLM Renderer	Logitech G25 steering wheel and pedals, Logitech Rumblepad game controller	Z800 3D Visor HMD
Kinateder et al. (2014)	Road tunnel/ Fire hazard	Evacuation from a road tunnel during an accident and fire hazard	Valve Source Engine, in-house Source-SDK Modification, CyberSession 5.4	Logitech Rumblepad game controller	Powerwall system, passive 3D glasses

Lee et al. (2010)	Hydrogen station	Accident assessment and action at hydrogen stations	3D Studio Max, EON Studio	Keyboard and mouse	Monitor
Lucas and Thabet (2008)	Mining	Using safely a conveyor belt	3Ds MAX, Right Hemisphere's Deep Creator (later known as Esperient Creator)		Monitor (1st study), 4-screen CAVE (suggested for the 2nd study)
Mallett and Orr (2008)	Mining	Navigation and map reading in a coal mine	Unspecified "first person shooter computer game engine"	Keyboard and mouse	
McComas, MacKay and Pivik (2002)	Traffic safety	Children crossing different kinds of intersections	EON Software		3 monitors, a monitor
Mól et al. (2009)	Nuclear energy	Dose assessment simulation in a nuclear plant	UnrealEngine2 Runtime Demo Version		Projection screen, passive 3D glasses
Orr, Mallett and Margolis (2009)	Mining	Evacuation from a longwall coal mine during a fire hazard	Unreal editor	Keyboard and mouse	Monitor
Perlam, Sacks and Barak (2014)	Construction	Identification and assessment of hazards in a construction site	Building Information Modelling (BIM)	Tracking system, controller	3D vision goggles, 3-sided CAVE
Reiners et al. (2014)	Logistics and Supply Chain Management	Identifying and assessing hazards in a container terminal	Unity 3D	PS3 game controller, Razer Hydra, Microsoft Kinect	Oculus Rift head-mounted display
Ronchi et al. (2015)	Road tunnel safety/ Fire hazard	Analysis of evacuation paths and behavior during a tunnel fire	Half-Life 2 Source Engine, in-house VR control software	Traceable game controller, motion capture (PhaseSpace Impulse)	5-sided CAVE (BARCO I-Space), 3D glasses (Infitec), 7.1 audio surround system
Sabri et al. (2010)	Healthcare/ Surgery	Performing a total knee replacement in a surgery operating room	OpenGL 3D graphics API, Maya 3D, 3Ds Max, Z-Brush, OpenGL Shader Language	PC	PC
Sacks, Perlman and Barak (2013)	Construction	Identification and assessment of hazards in a construction site	REVIT (building modeling), 3D Studio MAX (other 3D), EON Studio v6 (VR scenarios)	Head tracking system and a trackable Xbox controller	Powerwall (2.4 x 1.8 m). 3-sided EON ICube CAVE, 120Hz active 3D glasses. Audio: EON Studio V7.0 audio

Smith and Ericson (2009)	Fire hazard	Children identifying possible fire hazards in a home, and evacuation during a fire	VR Juggler, OpenSceneGraph, Open Physics Abstraction Layer were used to create the training environment	Gamepad, 6DOF wand	4-sided CAVE
Stothard and van den Hengel (2010a, 2010b)	Mining	Identifying correct procedures when working at heights in a mining context	3D Studio Max, Maya, VideoTrace, Virtools game engine	Individual keypad for answering questions, joystick	Projection screen, stereo audio
Squelch (2001)	Mining	Identifying, assessing and correcting fall of ground hazards in a gold mine		Joystick (movement), touch-screen monitor (interaction)	Touch-screen monitor, stereo audio
Wray, Laird, Nuxoll, Stoke and Kerfoot (2005)	Military	Creating intelligent computer enemy to train urban combat situations	Unreal Tournament Infiltration, SOAR (cognitive architecture)		
Wyk and Villiers (2009)	Mining	Safety training for various situations in a mining context			
Xu et al. (2014)	Fire hazard	Evacuation from a subway station and a primary school during a fire	National Institute of Standards and Technology's Fire Dynamics Simulator (FDS), OpenSceneGraph graphics engine		
Zhao and Lucas (2014)	Construction	Recognizing electrical hazards in a construction site	3Ds MAX (mobile crane, electricity transmission tower). GarageGame Torque 3D v2.0 (environment). Simulation is programmed within the Torque 3D engine using C++ syntax.		
Zhou, Ding and Chen (2013)	Construction	Safety management in a metro construction site	From CAD to unspecified 3D software		

Appendix C
Meaning unit (MU) tables

MUs: Barry (B)				
Original transcript *(Discriminated meaning units in their original form – passages clearly unrelated to the experience of VE were removed)*	**Transformation 1** *(Discriminated meaning units expressed as much as possible in the subject's language and based upon perspective that description was an example of the experience of a virtual environment)*	**T2** *(Discriminated meaning units expressed more directly in HCI language and with respect to relevance for the phenomenon of virtual environment. Also the nickname is changed to 'the user' for easier analysis with the other accounts.)*	**T3**	**Reflection/notes**
1. B: As far as the virtual one goes, there's been nothing like it. I: Okay. B: Aaa, we had no other training. It was first exposure. [Someone interrupts] B: [continues] Aa… [lp]. It, it was just classroom stuff. Umm… I've been in the grand plant for… ten-eleven years. And it was, coming first over here. And that's the job [words missing] first up. So I had, no [real?] orientation the plant, hadn't seen the area. And umm, it gave me excellent insight… to where the valves were and everything else like that.	To Barry, as far as the virtual one goes, there's been nothing like it. They had no other training. It was the first exposure. It was just classroom stuff. He has been in the grand plant for ten-eleven years. He had no real orientation of the plant, and he hadn't seen the area. It gave him an excellent insight to where the valves were and everything else like that.	As far as the virtual one goes, there has been nothing like it for the user. There had been no other training before it, and he had not seen the area before; it was the first exposure. As such, gave him an excellent insight where specific objects and things like that were located.	The VE was a novel experience for the user; he says there has been nothing like it. It was also the first exposure to the work area; he did not have other training before it or he had not seen the area before it. The VE gave him an excellent insight where specific objects were.	
2. I: So, can you remember umm, what you had to do with the computer training? Like as… did you do a process or, or what did you do? B: Umm, it was an interactive… so-so you got, information first up. And then it was, questions and answers after that. I had been moving around the plant, going, basically, operate this valve. So you walk out, the, or the virtual man walked out… and umm… screen there of-of…, picture screen of the, of the… thing with umm… activated icons on them. Valve handles again. [word missing]	When asked what B can remember he had to do in the computer training, he replies it was interactive: you got information first up and then it was questions and answers after that. He had been moving around the plant, going basically, "operate this valve". You walk out, or the virtual man walked out, and picture screen of the thing with activated icons on them. Valve handles again.	When asked what the user remembers he had to do in the computer training, he says it was interactive. First he got information, which was followed by questions and answers. He describes moving around the building and operating different valves in the VE. He remembers walking out, but corrects the avatar [the virtual man] walked out, and he remembers a screen with activated icons and valve handles.		
3. B: So yes, it was, was, like I said, never done anything like that before.	B had never done anything like that before.	The user had not done anything like the VE training before.		Interestingly, in another MU he explains he has experience of playing strategy games.
4. B: And umm… it gave me enough heads-up that I could actually go out and do the job with no problem whatsoever.	It gave B enough heads-up that he could actually go out and do the job with no problem whatsoever.	The VE training gave the user enough preliminary understanding of what was to come [enough heads up], that he could go and perform his work with confidence.		'Confidence', compare to Gerrard.
5. I: So now, you are basically doing the same job? B: Yep.	B is now doing the same job. When asked if he sees the same kinds of valves every day and does he use them the	The user is asked if he sees the same kind of valves every day and uses them the similar way. To this, he confirms this, and		Vision here is an important constitutive dimension of perception. It does not actually matter, as Husserl says, if

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	I: Umm… You see the same kinds of valves every day and you use them the similar way? B: Well, yeah, it was, the virtual stuff was actually the worker (?)… I: Sorry? B: The-the virtual screen, were screenshots of the work area. I: OK. So it was like real pictures? B: Yeah, yeah. I: OK. That makes it quite the same… B: Yeah, yeah [laughing].	similar way, he replies well yeah, the virtual screen were screenshots of the work area. The interviewer confirms if they were like real pictures, and B says yeah.	says it is because the virtual screen was screenshots of the work area. Further probed "that makes it quite the same", he confirms yes. He does not refer to the part about using the valves.		those weren't actually real photographs (as I think the environment was fully 3D without camera pictures). What matters is that they look the same, which makes it quite the same.
6.	I: Would there be anything like, now that you are… doing the work, that is, if the developer knew now, would make it a better training…? B: I don't think you could've done much more with that. That was it, the only thing was the glitch part in it. When you door were coming in (?) [br] There was a bug in the program that when you tried coming out of a lab door… If you turned slightly sideways as you're coming out of the door… Umm…, you ended up on the roof. [laughing] And you couldn't get down, you had to turn it off and start from scratch [laughing].	When asked if B can think of anything that the developers could have done to make the training better, B does not think you could have done much more with that. The only thing was like pictures in it. There was a bug in the program that when you tried coming out of a lab door, if you turned slightly sideways, you ended up on the roof. And you couldn't get down, you had to turn it off and start from scratch, B laughs.	When asked if the developers could have done anything to make the training better, the user feels its potential for training had been met. He then remembers the problems he had with the VE [glitch part of it]. He explains there was a bug that showed itself in the manner that if you turned in a certain way when you tried to navigate out from a specific location, you ended where you should not suppose to be; on the roof of a building. It was impossible to continue the training without turning the program off and starting from the beginning.		B treats the program's potential for training and the glitch separately.
7.	I: And you found that glitch? B: Oh, three times I was on the roof [laughing] until I worked out "No, don't touch the…" Because it was… umm… basically you [gesturing a keyboard] I: Yeah, yeah, the keyboard and… B: So-so if you… you could go forward and sideways at the same time but if you did that coming out of the door… you end up on the roof. [laughing]	B found the glitch. Three times he was on the roof until he worked out, "No, don't touch the…" Because it was, [B makes pressing a keyboard button gesture with his hand]. You could go forward and sideways at the same time but if you did that coming out the door, you end up on the roof, he laughs.	The user was actively trying to work out what caused his problems. It took place three times before he realized there was a certain way of moving with the controls at a certain location that made it happen [user gestures like pressing a keyboard]. So he realized not to press them at that certain location.		Learning the inner logic of the VE. Cf. BD and Clubsport.
8.	I: OK. That's funny. And I think that's not possible to do like here? B: No, no, no I can't walk out the door and end up on the roof over me. [laughing]	B agrees that such an event is not possible to do in the actual plant, and that he can't walk out the door and end up on the roof over him.	The user agrees that the event that took place with his avatar in the VE could not possibly take place with him at the actual plant. It amuses him to think about it.		
9.	B: So it needed a jump function so I could jump off the roof. [laughing]	It needed a jump function so he could jump off the roof, B is saying while laughing.	The user laughs that a control function would have been needed that had gotten him out from the wrong location [the roof] in the VE.		
10.	I: Umm… Just thinking… Because… you said that… umm [lp] You did not have	B says he had no information of this place whatsoever. He was coming in blind.	The user was new to this specific work place and had no previous information about it before the VE training.		

	any other aa like training before the environment, or or any… B: No, no, I had no information of this place whatsoever. So I was coming in blind.				
11.	I: And… How was the information…? In the environment, like, what did you do to get the… B [talks over]: Oh, yeah well. The training… basically your orientation training is the virtual. [word missing] And then umm… you just got brought out in the field with the umm… [leading?] hand with basically got in there and umm. Simple "what do you do"?… Well, you know, you've basically done it… hands-on, you know it's on the computer screen. You've done hands-on, you just need to walk this through this [words missing] It's a reasonably simple process…	To the question of, how was the information in the environment, B says the orientation training is the virtual. And then you just got brought out in the field with the leading hand, with basically got in there and simple, "what do you do?" You've basically done it… hands-on. You know it's on the computer screen. You've done hands-on, you just need to walk this through … It's a reasonably simple process.	The user explains that the virtual is the orientation training, and because you have seen it there on the computer screen and done it hands-on, it makes it easier to do it again when required to show that you can. He also explains that it is a reasonably simple process.		This is a difficult to analyse as it is too vague. Compare to other MUs.
12.	I: About taking the samples, do you think it felt the same, doing that in the… with the computer and doing in… B: Nah, no, you… Because it is a hazardous material, it is getting kitted up in the… the chemical gear and respirators [word missing] gloves and goggles and all that sort of. With the computer [laugh], you're just [in close?]. [laugh] It becomes uncomfortable actually to do the testing.	When asked if taking samples felt the same with the computer and doing it in real, B say no. The reason for this is that it is hazardous material: it is getting kitted up in the chemical gear and respirators, gloves and goggles. With the computer, you're just too close. It becomes uncomfortable actually to do the testing.	When asked to compare between the virtual and the actual work environment if doing a specific task felt the same, the user says no, because the material you operate with gets kitted up with your safety gear and it can affect your level comfort when doing it. With the computer, you are just too close.	The user explains there is a difference between doing the same task in the virtual and the actual plant. In the actual environment the materials you are working with build up on your safety gear and can make you feel uncomfortable to do the task: with the VE, you are just too close.	Cf. to the "cut and dried" MU. Also, again 'virtual'. Is conveying the process that seems to matter in the virtual?
13.	I: OK. So how do you actually do the testing? B: You gotta go into your… where you control it from. You get your gear there. See, you got a… acid proof… chemical suit. Umm, rubber gloves, goggles. Umm, and a… It's an acid cartridge in a full-face respirator. Full-face respirator, that umm… protect you from the fumes. And you go out and get a beaker full of… the solution. You check the specific gravity. You take a measured amount, and run it through its test, which is umm… [possibly a word missing] peroxide and chlorophyll. Which then indicates	B explains how the testing takes place in the actual environment: You gotta go into where you control it from. You get your gear there. You got an acid proof chemical suit, rubber gloves, goggles, an acid cartridge in a full-face respirator. Full-face respirator, that protects you from the fumes. And you go out and get a beaker full of the solution. You check the specific gravity. You take a measured amount, and run it through its test, which is [possibly a word missing] peroxide and chlorophyll. Which then indicates if there's a contamination issue with it. And you're looking clarity of it. [See?] how clear it is in the beaker. It is a measure of the contaminants in it as well. And as B said, you really can't do that on… it is… it is hands-on… Whereas, you know, being out at the open and shut valves: most people have opened and shut valves in the	The user describes that the work process and the actions you perform are more nuanced in the real environment. Actions you take in the VE are simpler and possibly more mundane, even to the point that doing them as such is nothing useful in itself [most people have opened and shut valves in the past].		

	if there's a umm… contamination issue with it. And you're looking clarity of it. [lp] [See?] how clear it is in the beaker. Is a measure of the contaminants in it as well. B: And as I said, you really can't do that on… it is… it is hands-on… whereas, you know, being out at the open and shut valves: most people have opened and shut valves in the past. That doesn't necessarily need to be so hands-on.	past. That doesn't necessarily need to be so hands-on.		
14.	I: So how was the… do you remember how was it umm… presented in the… in the training environment? B: Oh it was more umm… just… verbal. And then you had um… [read?] the text. Umm, explaining what you did. They would step through it and then you had to go on umm… So, get a sample. So you had to go out to sample valve, click on the sample valve, and get the sample with a beaker. Take it back in umm… get the… pipet, fill it up with umm, the solution. And then put the additives in to it and all that, so yeah, that was that side of it. Which got you into the… routine of doing it.	When asked how this was presented in the environment, B says it was just verbal. Then you had to [read?] the text, explaining what you did. They would step through it and then you had to go on to get a sample. You had to go out to sample valve, click on the sample valve, and get the sample with a beaker. Take it back in, get the pipet, and fill it up with the solution. And then put the additives in to it and all that. So yeah, that was that side of it. Which got you into the routine of doing it.	The way the process was presented in the virtual was that they first explained it verbally and would go through it, and then the user had to go on and do a specific task that he explains in detail, which got you into the routine of doing it.		Cf. other participants.
15.	I: So you actually moved in the plant or…? B: Yeah. Yeah, you actually had to move your body out [br]… the-the virtual man out in the plant and do it all with the virtual man. I: OK. And then you took it somewhere and…? B: It took it [br] into the lab. I: OK, and measured it? B: Yep.	When asked if B actually moved in the plant, he says you actually had to move your body out, or the virtual man out in the plant and do it all with the virtual man. When asked if he took it [the sample] somewhere, B says it took it into the lab and measured it.	When asked if the user moved in the plant location, he says you actually had to move your body, which was the virtual man, and do it all with the virtual man.	When asked if the user moved in the virtual plant, he says he actually had to move the avatar at the location and do everything with it [the virtual man].	
16.	I: So could you imagine that, could that be done in any… you know… anyhow differently… in the training? B: I-I don't think so. I…… There was enough graphic interaction [with the rest of it?]. Umm… When it-it-it's basically how you would train a new guy if you can [interviewee 'mmm' possibly hides one word] have the virtual stuff. You take him, show him the valves. You know, they would	When B is asked if he can imagine if this testing could be done any differently in the training, he does not think so, but comments that there was enough graphic interaction [with the rest of it?]. B says, it is basically how you would train a new guy if you can [word missing?] have the virtual stuff. You take him, show him the valves. They would not necessarily touch them, but you would show them the valves, you would go and show them how to do the test. And you do your slow walkthrough first and then explain what's going on – which is what happened in the virtual. Then you'd get them to do it. Demonstrate to you, but they could do. Well, that's	When asked if the user could imagine if the specific task could be done in a different way in the VE training, he does not think so because there was enough graphic interaction. He compares the virtual process to how a person would train a new person by showing him around and explaining what different things do and how to do things, and then getting them to demonstrate to you that they can do it. Similarly in the virtual environment, there was a slow walkthrough and then you had to demonstrate there how to do it. The processes are similar.		He experiences the process of actual and virtual showing and demonstrating as being similar to an extent (but not the same?). The question about if this could be done differently, B does not think so. He ends up comparing it with the process of shadowing another colleague at a real plant. See that this comes through in the transformations.

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	not necessarily touch them, but you would show them the valves, you would go and show them how to do the test. And you-you do your slow walkthrough first and then explain what's going on. Which is what happened in the… virtual, then you'd… get them to do it. Demonstrate to you, but… they could do. Well, that's basically what this was. There was a slow walkthrough and then you had to demonstrate on the virtual real… umm… the virtual environment, how to do it.	basically what this was. There was a slow walkthrough and then you had to demonstrate on the virtual real, the virtual environment, how to do it.		
17.	B: But it would tend to lend itself to that. Umm… I don't think there's too many other… I: But let's say that, you could… like, you could use your hands more or. B: Yeah aa, yeah-yeah, but it's not that it's the fact that it's pretty "cut and dried". Umm… what you are looking for and what you do. Where a lot of the other processing… especially aa solids and material handling [between ?]. It has a lot to do with other senses as well, like hearing and you know. Feeling [stuff?] drop on ya. I: In the real? B: Yeah, in the real world. Yeah, I don't know how you you'd equate that… virtual stuff and do anything more with it [in the plain?]. For… the process that was set up for… was absolutely [ideal?].	But to B, it would tend to lend itself to that. B is asked what if he could use his hands more, but he replies it is not that it's the fact that it's pretty cut and dried, what you are looking for and what you do. Where a lot of the other processing, especially solids and material handling [between?], it has a lot to do with other senses as well, like hearing. Feeling [stuff?] drop on ya. When asked, in the real, he confirms, in the real world. He does not know how you would equate that virtual stuff and do anything more with it [in the plain]. For the process that was set up for, was absolutely [ideal?].	To the user, the VE would tend to lend itself to performing in it. When the interviewer asks if the possibility of using his hands more would change it, the user says it is not about that, but the fact that it is pretty much set in stone what you are looking for and what you do. He compares this to handling materials in the real world, which has a lot to do with other senses as well such as hearing and feeling stuff drop on you. He felt the VE was ideal for what it was set up for, but he cannot think how it could go beyond that.		Although asked if it changed it if hands were visible in the VE, B takes the thought further to the direction he wants, explaining the experience of the environment "tending to lend itself" to the objective, and how it felt "cut and dried". It is a reduced version of the real, with less for the senses.
18.	I: I wonder umm… The actual umm… Like the use situation, you said that you were using the, the environment with mouse and keyboard? Any… was that something that you remember that was… particularly hard, easy or no memory of that at all? B: I-I've played with computers since the…… late eighties. So yes, it's… I-I enjoy a certain type of computer game which is umm… basically… not the shooter platform one, but it's a bit more… umm… strategy-based.	When asked how Barry experienced using the environment with mouse and keyboard, he replies he's played with computers since the late eighties. He enjoys certain type computer game, which is basically not the shooter platform one, but it's a bit more strategy-based.	When asked how he experienced using the environment with the provided controls, he answers he has played with computers for several decades. He enjoys strategy-based games but not the shooters.		Playing for decades means he is familiar with controls.

19.	I: Yeah because I… This is a question because it seems that some people… like you say… who… are comfortable with using computers… umm… They perhaps concentrate more in the environment than the… I don't know if you [br] B [talks over]: Once you realized there were active locations… that the mouse would… activate. You could just scroll over the page and found where there were active locations to… Say you wanted to operate the valve, you went to get to the valve handle.	The interviewer explains that he is asking this question because sometimes it seems people who are comfortable with using computers perhaps concentrate more in the environment. To this comment, B explains that once you realized there were active locations, that the mouse would activate, you could just scroll over the page and find where there were active locations. Say you wanted to operate the valve: you went to get the valve handle.	The user explains that once you realized that there were active locations to interact with the mouse, you began actively to search for them with it; if you knew the object you needed to operate, you tried its control.		This and the next MU were originally together but were separated as two because this talks more about learning the inner logic of the VE and the next one about the VE leading the user.
20.	B: Soon as you clicked the mouse over the valve handle, [that] would come up, you know, "operate valves" [and things so?]… I: So did you… Was there like any instruction that it could be possible or you basically had to just find it? B: The-the [lp] You-you basically knew what valves and in what sequence you had to go to. But if you had problems, the next valve or the sequence was the one highlighted, not the… not the other ones around it.	Soon as you clicked the mouse over the valve handle, "operate valves" would come up. When asked if there was any instruction that it could be possible or did he basically just have to find it, B says you basically knew what valves and in what sequence you had to go to. But if you had problems, the next valve or the sequence was the one highlighted, not the other ones around it.	When asked how the user knew the interaction possibilities, he says he knew the objects and in what order to use them. Furthermore, the VE also highlighted the correct one in the sequence if you had any doubts.		There are actually two things here: finding the right object based on the given information about the objects and their sequence of use, and the VE helping him with finding the right object by highlighting it.
21.	I: If you… If you remember back umm… to the training environment and your like, your real environment. Umm… Do you think there are special, like objects in the environment that are… you know, you said 'valves', but, that are important for the environment, for the training environment. And with objects I mean everything form sight, sound, you know… B: There can be a need for them, if somebody hadn't done any… chemical analysis or something. Know what a pipet was. You know, [word missing] have an example of it there. But you would expect people… before they put them out there, would understand what a valve is. You wouldn't be frying… somebody fresh out of high school [in that area?]. You know, you gotta have some sort of operating	When asked if B thinks there are specific objects in the environment, such as the mentioned valves, that are important for the training environment, B replies there can be a need for them, if somebody hadn't done any chemical analysis or something; know what a pipet was. [To?] have an example of it there. But B says you would expect people would understand what a valve is before you put them out there. You would not be [frying?] somebody fresh out of high school [in that area?]. You gotta have some sort of operating experience to be out [word missing]. He has done a whole range of work in my working life, including running co-governance departments and HBI plant up in Port Hedland. So yes, he has got a variety of skills [that have made it easier for him to pick that sort of stuff up?].	When asked if the user thinks some objects are specifically important to be in the training environment, he acknowledges there might be a need for them if a person did not know what a certain object was or had not done specific tasks. Still, the users should be familiar with basic objects, such as what a valve is. Experience is needed and makes it easier to come to such training and learn more.		

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	experience to be out [words missing]. But yeah, I've done… a whole range of work in my working life. Including running co-governance departments and HBI plant up in Port Hedland. So yes, you know, I've-I've… umm… I've got a variety of skills [that have made it easier for me to pick that sort of stuff up?].			
22.	B: And one of my biggest philosophies is what I try to tell people of, you know, how to train or how to learn… is, go and put your hand on something. Visualise your hand on it. And then you will be able… to get that… cognitively between you and the item you wanna try to remember. [Where?] the screens [word missing] made that happen for me.	One of Bs biggest philosophies is what he tries to tell people of how to train or how to learn is, go and put your hand on something. Visualise your hand on it. And then you will be able to get that cognitively between you and the item you wanna try to remember. [Where?] the screens [word missing] made that happen for me.	For the user, visualising your hand on something has been one of the most important things in relation to learning. The virtual environment made that happen for him.	
23.	I: Someone was talking umm… about that-that… the actual operation of the machine it's-it's not just visual because… there are other ways also to… experience if it works correctly. Do you have any…? B: Well… You don't need to turn it off. 9 times out of 10 it turns itself off on a [plug ?] pressure (?). So you get a noise to tell you that the… system's deactivated. Umm… There's nothing… Nothing that I would say in the process… There is-is smell… I mean, there is colour… umm… visual component. Everything else is visual as well. But yeah, there's no distinct smell [word missing] if it's wrong or… you know, if you've done something wrong. It really is a simple process to… to actually… get your head-head around. It's only becoming aware that it is hazardous material and that you need to be in the right gear.	The interviewer prompts that another person mentioned that operating the machine is not just visual and there are other ways also to experience if it works correctly. B says you don't need to turn it off. 9 times out of 10 it turns itself off on a [plug ?] pressure (?). So you get a noise to tell you that the system is deactivated. There's nothing that he would say in the process, there is smell, there is colour, a visual component. Everything else is visual as well. But yeah, there's no distinct smell [word missing] if it's wrong or if you've done something wrong. It really is a simple process to actually get your head around. It's only becoming aware that it is hazardous material and that you need to be in the right gear.			This MU is unrelated to using the environment, but talks about using the machine in real life and has thus been left here in case any comparison is needed.
24.	I: How do you think it was… presented in the training environment. Like, what… was it somehow specifically… like… presented that it is hazardous. B: Yeah-yeah. It was the first thing you had to do go and get you PPE in the	When asked how it was presented in the training environment that it is hazardous, B says the first thing you had to do was to go and get your PPE in the cupboard. So you need to get your overall, and your [word missing] boots, and your respirator, and goggles, [word missing] before you actually went out.	To the user, the task of going to get a list of specific objects from a certain location before proceeding forward communicated the hazardous nature of the environment.	When asked what presented in the VE that the user was dealing with hazardous materials, he says it was getting and selecting the right gear before actually going out to do the work in the VE.	The specific objects contain contextual messages.

	cupboard. So you need to get your overall, and your [word missing] boots, and your… respirator. And goggles, [word missing] before you actually went out.			
25.	I: Yeah. Could you get hurt in the environment? Or…? B: It will if you [mixed talk]… no, there wasn't a [death]? for functioning [laughter]. Or a harm… health-health bar, just saying, you know, "You've done that wrong" and you're… now that you are out of 30 precent health that that… I: So nothing like if you put the wrong gear or…? B: Nah.	When asked if you could get hurt in the environment, B first says it will, but then laughs that there was no death function, or a health bar saying, "you've done that wrong" and you are now out of 30 precent health. So nothing if you put the wrong gear on.	When asked if the user could get hurt in the virtual environment, he laughs that there was no specific object such as the health bar to indicate he had done something wrong or that he is down 30% of health. According to him, nothing happened if he put the wrong gear on.		It is to be noted also here how an interview is clearly, as e.g. Mishler argues, a discourse. The understanding about this specific constituent of the phenomenon is co-constructed using language, such as the 'health bar' familiar to both of the participants of the discourse. Also asking further questions is prompted by the interviewee answers, based on how the interviewer understands them.
26.	I: I think… we kind of went through all of these. In a way. Based on… Based on now what you hear what I've been asking. Do you have anything… like, any questions back to me or anything like that? That puzzles you why I'm even studying something like this or anything that came to mind…? B: Well as I said, in our environment there's not much else I could see… if they'd utilise more, so I haven't really though about it. It-it is a simple process. And-and there's not that much wrong. That can go wrong. I: In real or…? B: In real. So, you know, if you know the valves right and then you've… you know, you've got the strength right, you will get… what you want in the end. That's in real and in… virtual. Umm… B: It doesn't need that much of a… [handle or?] loop… process in it. I: What do you mean? B: Aa, well, it's not… "if that happens, do your this", you know. Umm… Then you've done that, "do this" you know sort of umm… Where a lot of all the other stuff we've been playing that is… more of a… "do this and if that does not work" umm, you know, you've got to this point and go back and do this. I: Yeah, so you don't need a… long flowcharts…	When asked if B has any questions about the study, he says that in their environment there's not much else he could see to be utilised more. So he hasn't really thought about it. It is a simple process, and there is not that much that can go wrong. The interviewer asks in real, and B confirms, in real. He says that if you know the valves right and then you've got the strength right, you will get what you want in the end. That's in real and the virtual. B continues by saying that it does not need much of a handle or loop process in it. It's not, "if that happens do your this". Where a lot of all the other stuff they have playing that is more of a "do this and if that does not work", you've got to this point and go back and do this. The interviewer confirms this by stating that there is no need for long flowcharts, which B confirms.	The user evaluates that for him, the virtual environment has reached its potential for training and he cannot think how it could be better utilised. Also, as there are not many things that can go wrong and because the work process is simple and straightforward, it does not require variations on what to do if something happens or if something you have done does not work.		

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B: Nah. I:…of different commands. B: Nah.				

MUs: Blair Doe (BD)				
Original transcript *(Discriminated meaning units in their original form – passages clearly unrelated to the experience of VE were removed)*	**Transformation 1** *(Discriminated meaning units expressed as much as possible in the subject's language and based upon perspective that description was an example of the experience of a virtual environment)*	**T2** *(Discriminated meaning units expressed more directly in HCI language and with respect to relevance for the phenomenon of virtual environment. Also the nickname is changed to 'the user' for easier analysis with the other accounts.)*	**T3**	*Reflection/notes*
1. BD: So it was for a heat stress training, so, they put us in the position of being off… offsite… onsite person. Umm, which I've never been onsite so it's… straight from the beginning for me. Umm and just safety… safety wear and they made us go through and select what safety wear that they think we should be wearing. Which I guess is umm… From my perspective I've not been… onsite so I didn't know exactly what… safety eq[br] safety wear was required so it was good to know.	It was for heat stress training. They put her in the position of being an offsite… onsite, person. Blair Doe (BD) has never been onsite so it was straight from the beginning for her. They also made her go through selecting what safety wear they thought she should be wearing. From her perspective, as she has not been onsite, she didn't know exactly what safety wear was required so it was good to know.	The VE topic is about heat stress training. The user takes the position of being an onsite person. To the user who has never been onsite, it was straight from the beginning. The software requires the user to select and learn what kinds of safety wear her virtual character needs.	The user defines the VE as being for heat stress training. As she has never been in the actual environment, she feels she began the training from the very beginning. She was put in the position of a person in that context to select what sort of objects she would need there. As she has not been on-site, she did not know what objects was required, so it was good to know.	
2. BD: Umm… It was pretty, some, I think some of the instructions were little… vague. So I had to, I killed a guy. 'Cause I didn't give him enough water, 'cause I didn't… the instructions weren't very clear. So I think… More common sense was expected from people than what… information was provided I guess.	BD thinks some of the instructions were little vague. She killed a guy because she didn't give him enough water. The instructions weren't very clear. She thinks more common sense was expected from people than what information was provided.	The user thought some of the instructions were vague. She blames them for killing the virtual character in the training environment, as she did not give him enough water. The user estimates that more common sense was expected from users, instead of giving more information.	The user experienced the instructions were imprecise. She gives an example where her inaction caused a poor outcome to take place [she killed a guy]. She felt that the users were expected to recognize a situation and act on it based on common sense, and without correct level of information.	There are several things here, but most importantly that she feels there was not enough instructions on what would happen, and that the user should recognize situations and be able to act on them based on universal, day to day experience, or 'common sense'. To her, nothing signified or made her anticipate that she would have to act specifically in such a situation when it occurred. It was not totally without instructions, but instead of making it explicit, it was implied with 'vague'/'unclear' instructions.
3. BD: Umm… but it was informative it… again I've never been off-site so it umm… on-site sorry, so it gave me a whole different… umm, view on… the actual… like environment that it offers.	But she thought it was informative. She has not been on-site, so it gave her a whole different view on the actual environment that it offers.	The user hadn't been onsite and the virtual environment gave her a view on the actual environment.	For the user, the VE was informative; to a person who has not been in the actual context, it gave a whole different view on what kind of an environment the context offers.	In this, she is concentrating on the perception aspect of the site: the virtual environment gave her a view to the site, which made it informative.
4. BD: So we had to do, so one of the activities was to umm… ensure that you're always hydrated so you're always drinking water throughout the day and it, sort of made you aware that the heat environments do dehydrate you more than you think they do. So that was informative for me.	One of the activities they had to do was to ensure that you're always hydrated, so you're always drinking water throughout the day. It sort of made you aware that the heat environments do dehydrate more than you think they do. So that was informative for her.	The software activities made the user to keep her hydrated, and to drink enough water through the day.	The system made her perform an activity of which goal was to ensure that you always maintain a certain kind of a bodily condition by maintaining an activity throughout the day. It sort of made the user aware that such contexts in question affect you in a certain way. You might know this to some extent, but their effect is greater than you think. That was informative for her.	There is again someone or something neutral, vague or impersonal(?), 'they', which is making her to do something. She already knew the "fact" of staying hydrated to an extent, but the activity made her even more aware of it.

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5.	BD: Umm, I thought it was pretty, it was pretty good, it was hands-on. So you got to walk around and it sort of felt like you were there and…	She thought it was pretty good. It was hands-on. You got to walk around and it sort of felt like you were there.	Walking around in the environment made the user feel she was as if there. It was hands-on.	The user reviews the VE as reasonably good and describes it as hands-on. She could walk around and it somewhat felt like you were there.	BD is making two judgments here of it being "good" and "hands-on". That said, it does not mean they have a connection, i.e. the hands-on making it good. Also, she is describing that "you got to walk around" which means it was allowed or she was able to do that, which communicates a level of freedom. Similarly in this case, it does not mean that the walking made it feel almost like being there. It should be noted that these two come together to constitute the experience for her. Furthermore, it was "almost" like being there, but not quite. Next time in such an interview situation I could probe more: You mentioned you felt like "being there". Could you describe a specific moment, an event or what you did while using the software that made you feel you were "there"? Does this connect with MU 26?
6.	BD: Umm… But, yeah, I don't know. Out [02:37 word missing] was more based on our heat stress training that they got us to do. With more [02:24 word missing] ensuring that you're hydrated and if someone's showing symptoms of… umm… not being hydrated so, umm… having fits or seizures or anything like that what procedures you were doing. In that… occasion. But yeah, I don't know. [laughter] What else do you want me to say?	It was more based on their heat-stress training that they got them to do. Ensuring you're hydrated and if someone's showing symptoms of not being hydrated, having fits or seizures or anything like that, what procedures you were doing in that occasion.	The activities were based on their specific training where you learn to ensure you maintain a certain bodily condition, and how to recognize if other people are not, and what procedures to do in such a situation.		General description of the aims of the program.
7.	I: Umm… So can you describe it from the beginning, like how, how things started? BD: Well, my virtual person got out of bed and they [laughter] the supervisor called up and said "We're going… off-site today to do your induction" or something like that I'm not hundr[br] can't remember sorry.	When asked to describe the experience from the beginning and how things started, BD says laughing that her virtual person got out of bed and the supervisor called up and said "We're going off-site today to do your induction", or something like that she can't remember it entirely.	Amused, the user states that her virtual person got out of bed and answered a phone call from the supervisor who said they would be going to the site to do her induction.	When asked to describe it from the beginning, The user remembers amused that her avatar performed a particular activity [got out of bed] and another specific avatar, the supervisor, called up. She remembers the topic of this call but not entirely its form.	She remembers what her and the other character did, and the general topic but not the exact form of the call from the specific character.
8.	BD: But umm, I then had to walk [br] I could choose between… using my keypads to walk around the room to the wardrobe or I could just click the button to go straight there. So I clicked the button 'cause I don't play video games [laughter]. Umm, it took me straight to the wardrobe	Then she could choose between using her keypads to walk around the room to the wardrobe or she could just click the button to go straight there. So she clicked the button because she doesn't play video games. It took her straight to the wardrobe.	The user was prompted by the program to use either a keyboard or a mouse to interact with the software. As she is not a person who plays video games, she chose the option to click a button that would take her directly to the next stage of the software.	The system made her choose from controls that allowed her to move in the environment to get to a destination and from pressing a button to go straight there. Because she does not play videogames, she chose the button that took her straight there.	The first option allowed her to move (walk), but the second didn't: the second takes her straight there. The connection to videogames here is vague, and by saying "she chose the easier option because she does not play games" would be going beyond the data. Also there are other participants in this study who do not play videogames, but have chosen the more complex way of controlling their movement. From Van Manen: How can things be experienced as intimate or strange? Why does a person who uses the computer the whole day (as BD expresses in another MU)

				experience using the keyboard as strange in this case? As a side note to data analysis: the most difficult thing for me to understand and, perhaps even more, to accept was that this takes time and lots of thinking to try to penetrate the natural attitude expression with the phenomenological attitude. If you do not do it, you do not "see" anything in the data but what is expressed. As Sokolowski (2000) has said, you see directly to the object, but not what constitutes it. You see the painting, but not the lines and colors and how they created what the painting represents.
9.	BD: and then basically had to select, it said, "what safety gear do you think you should be wearing today and what umm… equipment do you think you should be taking". So it gave me a whole offer of, so what footwear, what eyewear, what hat wear. What umm… safety clothes should've… ah, I think it of[br] asked if we wanted to wear singlet or just things like that and we had to go through and select each one	and then she had to select, or it said "what safety gear do you think you should be wearing today and what equipment do you think you should be taking?" It gave her a whole offer of footwear, eyewear, hat wear and safety clothes, and asked if she wanted to wear singlet or just things like that. And they had to go through and select each one	At the wardrobe, the program posed a question, "What safety gear do you think you should be wearing today and what equipment do you think you should be taking?" Then it made the user go through clothing such as footwear, eyewear and hats, and to select the proper ones.	Then the VE asked the user what sort of objects she should or would like to wear and take today. It presented her a variety of objects to wear from which to select each one.	Another of these impersonal 'its'. The system asks and gives her options from which to choose from.
10.	BD: and then it would take us to the next level which was umm I think, going on-site and just getting a rundown, I did this about a month ago sorry [laughter] umm, getting a rundown on the situation, what's going to be happening umm… And then it explained, went into detail, signs of heat stress and it made us, it quizzed us on what… umm, so related back to the information that they told us and got us to do a quiz on what umm heat stress… symptoms are.	Then it would take them to the next level, which was going on-site and just getting a rundown [she says she is sorry as she did the training a month ago] on the situation and what's going to be happening. It went into details to explain the signs of heat stress. It also got her to do a quiz about the information they told her on what heat stress symptoms are.	On the next stage, the software took her onsite. Another detailed explanation or a rundown was given on the situation, the signs of heat stress, and what was going to happen. After that, she took a quiz on heat stress symptoms.	The user says she is sorry as she did the training a while ago but she thinks it then took them to the next level, which was going to the actual site and getting a summary of what was going to take place next. Next she was explained with details the visible human signs related to the training topic. She was also made to take a test related back to the information about these symptoms.	This is a tricky MU as there seems to be several different meanings to it. Firstly, without any explanation, she automatically considers going on-site as going to the next level. Also, by saying she did the training a month ago and is sorry, she is implying that she does not remember the correct details because she did the training, subjectively, "that long ago". This implies to a subjective time concept and that a month ago is long ago because she does not remember the details. This also raises a question if it is the fact that not remembering the details defines how long ago it feels like for her.
11.	BD: And then it put us in the environment of umm actually working. So, it would make us lift… poles and drag them to another area	Then it put them in the environment of actually working. It would make them lift poles and drag them to another area.	The next stage of the program required the user to perform work in the environment. Her avatar would lift poles and drag them to another area.	Then it put them in the environment of actually working, and made them interact with specific objects and to move them from one location to another.	The first sentence could be one of those sentences that summarise the whole study (Van Manen 2014): "it put them". The impersonal. Check other accounts for this too, as they appear in some of them. Decide the level of its significance and how it fits the experiential structure.
12.	BD:, but it… we had to m… manage the person working with us and ensuring that they'd stayed hydrated as well and if they didn't… umm, what we would do in case of an emergency umm… drag them into the shade or call	They had to manage the person working with them and ensuring that they'd stayed hydrated as well. If they didn't, what they would do in case of an emergency, drag them into the shade or call first aid or give them water. So it was more like you making sure that the person you are working with didn't dehydrate and have a fit.	The software goal required that the user managed also the virtual person's hydration and prevented him from having a fit. If the virtual person did, in case of emergency, she would need to drag them into the shade or call first aid or give them water.	The user had to manage the condition of another person that was working with her. If the person did not stay in this condition, which meant an emergency, the user would need to move the person to a defined location and act accordingly.	12 and 13 were originally together, but during analysis I realized they signify different things, 12 describes what she needed to do and 13 refers to constituent of 'withheld information'.

	first aid or give them water, just things like that. So it was more like you making sure that the person you are working with… didn't dehydrate and… have a fit.				
13.	BD: That was a part that I struggled 'cause it didn't… I don't think it's… was clear enough to say that you need to watch that person. Because in a real work… well, you'd probably looked after yourself first and… you wouldn't really… constantly check up on somebody else. But umm, so that's probably the bit that confused me the most, that's when I killed a guy. [laughter]	That was a part that she struggled because she did not think it was clear enough to say that you need to watch that person. Because in a real work, well, you'd probably looked after yourself first and wouldn't really constantly check up on somebody else. That's probably the bit that confused her the most and that's when she killed a guy.	The user struggled to complete this goal, as the instructions did not state clearly that she needed to watch the virtual person. She reasons that in real work, she'd probably look after herself first and would not constantly check up on somebody else. This is what confused the user the most and that is when she killed the virtual character.	The user struggled with this part, as it was unclear to her that she needed to watch that person. In a real environment, it would be more likely a person to look after oneself first instead of continuously observing somebody else. This bit confused her the most and that's when she "killed a guy".	
14.	BD: But, it was–it was good, once I sort of picked it up I realized once I… killed him that… my intentions were to… keep him alive [laughter] so… yeah…	But it was good, once she sort of picked it up she realized once she killed him that her intentions were to keep him alive.	Killing the virtual character while using the training environment showed her that her intentions were to keep him alive.	Performing the activity in a way that resulted in a poor result made her realize what her objective was.	She realized her objective based on the failure. An objective has to have an object, as there cannot be an objective of nothing: "My objective was to." is wrong. Her object is "keeping him alive". Also, she could not have been able to pick it up, or learn it, without the event. The event is the moment of realisation, picking up, or learning the objective. Still, what is important is that this MU does not yet say that she learned how to do it. Also, she talks about "killing the guy", which means she actively was part of the poor outcome. Otherwise it could be "the person died", or something similar that is more disconnected from the user's own actions.
15.	I: But how did you like umm… realize that he… you know, that he's having a heat stress? BD [talking over]: Umm, 'cause at the… at the beginning when they went through the symptoms they showed umm like he was pale and sweating and he was having fits and then umm… I: Was it like in pictures or…? BD: Yeah it was like actual virtual… umm… see, like 3D or whatever so.	When asked how did she realize he was having a heat stress, BD explains that at the beginning when they went through the symptoms, they showed, like he was pale and sweating, and he was having fits. It was like actual virtual, like 3D or whatever.	The user remembered from the initial in world virtual training that showed in 3D what the heat stress symptoms were and what having fits looked like. This made her see them in the virtual character she was meant to look after.	To the question how the user was able to recognize the specific condition of the other avatar, she remembers that in the beginning when they went through the symptoms, the avatar presented the specific recognisable visual and behavioural aspects of the condition. She tries to find words to describe the form of these, and calls them as virtual or 3D.	This is a typical MU where one could begin to hypothesise what is "true" in the participant's account: were the symptoms actually described like that, and was she able to draw these decisions in retrospect because she had done the training. This does not matter. What matters here is what appears and how it appears. When prompted about the condition, heat stress, she describes the specific visual and behavioural aspects of the discussed condition, and the form which their representation took place (virtual or 3D). It is also important to note that she describes the aspects of heat stress in an active voice, on the person: "he was having fits". This could indicate something about learning, but need to be analysed more in a later stage.
16.	BD: I was too busy working really hard to notice the first time that he was fitting.	She was too busy working really hard to notice the first time that he was fitting.	The user was too busy with another activity to notice when the virtual person was having heat stress symptoms the first time.	During an intense concentration to her activity she did not notice the other avatar's changed bodily movement the first time it took place.	In this MU, it would be easy to say her activity prevented her to see the fits. At the same time, she is only saying she "worked hard" and the fits took place. This is not necessarily true, and it is not possible to verify what actually took place (was the character fitting or not), but it does not matter. What matters is that she assigns her concentration in the doing and it to be the reason that prevents her to see the fits. Also, she does not express this

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				as a static bodily condition, but motion or movement: "fitting".
17.	BD: And that's when I realized I was supposed to be watching him so then when I looked at for the symptoms I saw them and… saw him like shaking more than a normal… virtual person shakes [laughter].	And that's when she realized she was supposed to be watching him. So when she looked at for the symptoms she saw them, and she saw him shaking more than a normal virtual person shakes.	When the user began to consciously look at heat stress symptoms, she saw them in the virtual character that was shaking and moving differently from "normal" virtual characters.	This was a specific moment when the user realized she was supposed to observe the other avatar. Looking for the symptoms made her see them, which meant seeing the avatar moving differently from normal.	Again, animation instead of static: "shaking".
18.	I: So, what happened then when he…? How did it occur, can you explain the… like, when he had the heat… however you call it? BD: Heatstroke. I: Yeah, stroke. So what happened then and how did you… what did you do? BD: It gave you options so umm… I can't remember, I think maybe a box was on the side and said "Do you want to…" or you go over to him and offer him water and it said umm "He's too… dehydrated" or… you know, "Thanks for the water, I'm not still feeling well.". So you have to… then it comes up with an option to call… your supervisor , umm, drag him into the shade or call the ambulance. Then you just have to go with what information they provided you before. You just have to select which one it is.	When asked what happened and what did she do when the person had a heat stroke, BD says the program gave you options. She can't remember, maybe a box was on the side and said "Do you want to…", or you go over to him and offer him water and it said "He's too dehydrated" or "Thanks for the water, I'm not still feeling well". So then it comes up with an option to call your supervisor, drag him into the shade or call the ambulance. Then you just had to go with what information they provided you before. You just have to select which one it is.	When the virtual character had a heat stroke the software gave her options in a pop-up window for what actions to take. One was to give the virtual character water, but choosing that prompted a message that communicated it was an incorrect option. Other options to select followed after that. The user had to select the right option based on the information she was given before.	When asked what happened then and what did she during the event, she vaguely remembers there might have been a box on a section of the screen that gave you options, or you might move to the avatar or the character replied to your action. After this, the program came up with different options from which to choose from, and you made a selection based on the information they have given you before.	The user interface parts and specificities of the messages in this MU are vague to her, but she remembers clearly that there were options from which to choose from (actions) and that the actions should've been based on the information that was given before in the environment. It is an interplay between perception and action.
19.	BD: So all the communication is through people talking to each other. So when it comes to the supervisor coming over and saying "Well done", they actually pause… the little scenario and group them all together and… the supervisor's speaking to you.	All the communication is through people talking to each other. So when it comes to the supervisor coming over and saying, "Well done", they actually pause the little scenario and group them all together, and the supervisor is speaking to you.	Communication in the environment is through virtual characters talking to each other. When a character such as the supervisor is speaking directly to the user, acting in the scenario is paused.	For the user, people talking to each other forms the communication in the environment. During one event when a specific avatar arrives to the scene, the training is stopped, the people are gathered together, and the avatar is speaking and acknowledging the user directly.	This is a difficult MU and should be re-checked later. What is the meaning in it? "Objectively" speaking, was all communication through talk? There seems to be a radio and telephone at some point, so yes, but there is also pop up boxes from which to choose options: does she not regard this as communication? What appears in this MU? At least it gives the impression of some sort of social intimacy, and that a specific character, the supervisor, is directly addressing the user in a group situation.
20.	I: And so, how do you drag him to the shade or…? BD: Umm, you just pick, pick options, and they do it for you. So you'll be, real life worker, you'll be clicking from one spot to the next. And then you go over [br] you see the person, and you click onto him and offer to give him water, and then umm, if that's not enough, umm, it'll come up like a little	[To the question, how she drags the virtual person to the shade] You just pick options, and they do it for you. You will be, real life worker, clicking from one spot to the next. Then you see the person and you click onto him and offer to give him water and then, if that is not enough, it will come up a little box or pop-up and say "The water is done not enough, he looks like he is having heat stroke, what would you do?" And then if you select "drag him to water" then, she says sorry, "drag him to the shade", then it goes back to like a video-sort-of-thing,	The user proceeds from one stage to the next by clicking available options with a mouse. The virtual person can also be selected. Clicking onto him gives the user options such as to give him water. When that option is not right, another prompt suggests the water is not enough anymore and that the virtual character might be having a heat stroke. The program asks what actions the user would like to take. She selects from the given options. When selecting drag the virtual character to the shade, the software goes to a stage where the dragging to the shade is	When asked how she performs a specific activity in the environment, the user says you just pick options and it does it for you. There are options she can choose by clicking them and the specific activity takes place. You take the role of a real life person and click to proceed from one area to another. Then you see a n avatar and click onto him to perform an action. If that is not enough, further information and action possibilities come up. When you select another action, it goes back to video-sort-of-thing and you watch the activity to take place. You	Check this again later. This is already different from doing in at least some video games. In a game, such as Gears of War, you might actually drag a virtual person. What's the difference though, and does the acting/representation difference matter?

	box or pop-up and say umm… "This person… the water's done not enough umm… he's, looks like he's having heat stroke, what would you do?". And then if you select "drag him to water" then… "drag him to the shade", sorry. Then it goes back to like a… video-sort-of-thing, so like a movie, and they, you watch me[br]… you watch them dragging him to the shade. So you don't physically drag them. But umm, you just mostly click, and it does… all the work for you.	like a movie, and you watch them dragging him to the shade. So you don't physically drag them. But you mostly click and it does all the work for you.	presented to her. The user chooses options and the software proceeds from one stage to another, representing what is taking place.	don't physically perform the action.	
21.	I: How's the moving in general in the environment? BD: A bit slow! I walk a lot faster than they walk. [laughter] Umm no, yeah. I guess for the… you don't really want it to go too quick 'cause then you don't… sort of see what's going on. So it was OK. The speed was OK. Umm, if that's the answer. [laughter] I: No, no, moving like, how did you move your virtual… person? BD: I just clicked… to where I wanted to go. And it would walk me there itself.	When she is asked how the moving was in general in the environment, she says a bit slow. She walks a lot faster than they walk, she says laughing. She is guessing you don't really want it to go too quick because then you don't sort of see what's going on. So for her the speed was OK. When specified that with moving it was meant how did she move her virtual person, she says she just clicked to where she wanted to go and it would walk her there itself.	When inquired how she experienced moving in the environment, she refers to her character's speed, and says jokingly that she moves a lot faster than them. When specified how did she move her avatar, she describes she pointed where she wanted to go and it would then walk her there itself.		Instead of choosing from anything such as 'difficult', 'abrupt' or something else, she describes it as 'slow', which is a quality of speed. Also, moving her character did not mean moving her character as such, but as choosing and showing where she wants to go ("clicked to where she wanted to go and it would walk her there itself"). This also describes moving as in a vessel (otherwise she would be saying, "I walked there (as my avatar)."
22.	I: Aa, OK, so you don't… BD [talks over]: So you, I think you could choose between using the keyboard… umm, which I didn't… because that would probably frustrate me too much. So I used the mouse option. [laugher] I: OK. So you're not a gamer then? [smiling] BD: No, I'm not a gamer. [laughter] Not at all.	She thinks you could choose between using the keyboard, which she didn't because that would probably frustrate her too much. So she used the mouse option.	As the user felt choosing the keyboard to operate the virtual character would have frustrated her, she chose the mouse.	The user vaguely remembers there was an option to choose between using the keyboard and the mouse. She did not choose the keyboard as she anticipated it would frustrate her too much. So she used the mouse.	There is a sense of anticipation here: "that would probably". There are control options and she has a predefined basis for her decision.
23.	I: OK. Umm… So you told me that… there's a guy… apparently a guy, explaining the heat stress. BD: Yeah. I: So… It's in the beginning or [BD: Yeah] how does it go? BD: So that's at the beginning when you first get to site. Umm, they… tell you to go over to a different shaded area and they give you the load down of what heat stress symptoms you need to look out for "because today is going to be really hot". So, we went, I	The interviewer asks more about the beginning where the person explains the heat stress, and how does it go. BD says that's at the beginning when you first get to the site. They tell you to go over to a different shaded area and they give you the load down of what heat stress symptoms you need to look out for, "because today is going to be really hot". So she went, she clicked over to go to that little shaded covered area and then a lady would speak at back to you. It was like half of it was video, half of it was you do it yourself. So she was speaking back to her in video.	When the user first gets on site, she is directed to go to a specific shaded area. She clicks to go to that area where she is given information about heat stress symptoms and also prompted that the day is going to be very hot. Part of the virtual heat stress training was a virtual female character speaking to the user in video, a part of it required the user to do something herself.	To the question how does the situation go where an avatar explains the heat stress, she expresses it to be in the beginning when you arrive to a specific location. In that location, she is first told to go to a little shaded area. She clicks to go there. There they explain what she needs to look out for with heat stress and underline it with current extreme environmental conditions.	'They' determine where she needs to go, what is in the load down and how it will take place. 'They' are in charge, and she is made to follow. What she refers to here is that part of this situation appears as she having control on and partly not. "she was speaking back to her in video" must mean that BD is also "talking" to her. Otherwise why would she say "talk back"? What she describes is 'interaction' as such, as is it not so that in the simple way, we do not have control to other people when they talk to us? We can only determine where it might go next… These were originally two different MUs (the break was in "and then a lady would

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	went, I clicked over to go to that little shaded… umm, under… covered area and then a lady would… speak at back to you but you would… It was like half of it was video, half of it was you do it yourself. So she was speaking back to me in video.				speak…"). Still, the meaning seemed to break, as BD is referring to the interactive experience, which is the same she talks about with "the load down". This made me to combine these as one MU.
24.	BD: And then after she explained everything, they went through all the symptoms and… then they made you do a quiz to make sure that you… could go to the next… level I guess yeah.	And then after she explained everything, they went through all the symptoms and made her do a quiz to make sure she could go to the next level.	The heat stress information and symptom descriptions are followed by a quiz to make sure the user could proceed to the next level.	After the avatar explained everything, all the specific details, they made her to do a quiz, which she believes is to make sure you can go to the next level.	
25.	I: Can you explain more, you said… in some point that… it felt like you were there? Can you expand that? In what sense? BD: Umm ,when… well because you had to do everything. You had to click to the next level and click on the, you had to do the instructions and follow… each [by part?] to get to the next level but it wasn't… umm… I guess when they did the video part, instead of just having one person pop-up, like a face popping up and speaking to you like that, they had you still in the environment, and they had the people grouped around you, and you were seeing all of their faces. And they were speaking to you as the virtual person. I: Who were the other people? BD: Oh, just supervisors or co-workers.	When asked to explain more what BD meant by that it felt like she was there, she replies because you had to do everything. You had to click to the next level and do the instructions and follow each part to get to the next level. When they did the video part, instead of just having one person or a face pop-up and speaking to you like that, they had you still in the environment, and they had the people grouped around you, and you were seeing all of their faces. And they were speaking to you as the virtual person.	Doing everything, clicking to proceed in the program to the next level, going through instructions, having virtual characters speaking directly to her as a virtual person, and the user being grouped with other virtual characters such as co-workers whose faces she could see, made her feel sort of like being there.	When asked to explain more what she meant by that it felt like she was there, she replies because you had to do everything: she had to click and do specific tasks to proceed to the next level. There is also a social dimension. Instead of an individual or only a partial human body communicating to you, you are held in the environment as part of a group, people that you can recognize – and they are speaking to you as the virtual person.	This is a probe to MU5 where BD explains it felt like you were there. This MU also has very clearly the user experience aspect in focus. It is interesting how she explains also here a "video". If I understand this correctly, it is actually not video as such, but a situation where she cannot control her character, but she is still "in the character", similar to a video game cut scene where you can't control you character, but what takes place is presented from the first person perspective. The social aspect for the "being there" is strong here, but also the fact that she maintains as part of the environment the whole time. She perceives the environment from the avatars' perspective.
26.	I: OK. So in general, if you can remember, what were the… other people doing in the environment? BD: Just standing there… in virtual. I: Like, the whole time? BD: Umm… I: If you remember… BD [interrupts]: Oh! Maybe there were people walking around. There might have been people walking around. Like, in the background. I: OK. BD: I can't remember. [laughter] They should've got us to do the test the same week that you were coming to interview.	When asked what the other people were doing in the environment, BD replies they were standing there. When asked if this took place the whole time, she replies maybe there were people walking around, like in the background. She doesn't remember that well and hopes they should've got them to do the test the same week that the interviewer was coming to interview. When further probed if she remembers what other people in the environment were doing, she replies that when she was doing the activities, like clicking and following the instructions, she doesn't think there was much action on the outside, but when you're speaking and the supervisors were speaking to you, you could see people walking around in the background which obviously made it seem more effective as that's	From doing the activities in the program, the user did not remember what happened in the background. When she had a discussion with the virtual supervisor, she remembers there might have been people walking around at the back.	The user does not remember well what other characters were doing in the environment, but she thinks they were just standing there. She has no memory of this while doing the activities, but while she was communicating with other virtual characters and doing the activities, like clicking and following the instructions, she is guessing there might have been people walking in the background. She evaluates making it more authentic this way would obviously make it more effective as that is what she assumes the actual site is like. She also assumes she would remember this better if she had used the environment during the same week the interview was taking place.	Her attention is concentrated in the activity, not looking at the background. If she was describing the background, she would be concentrating more to looking around (more distributed perceptual act (discussion + background activity), which takes place in the discussion with the supervisor). Compare to Halo 5 when I visit Sanghelios, a specific alien planet, where alien allies are waiting for me, and mostly standing around! If I just follow my tasks, to which the game tries to guide me to, I miss perceiving all the little details of that environment and what the characters are doing there. Then, my attention is in my mission, which includes going to people I need to talk to. Furthermore, when I am talking to a virtual person, I might not always concentrate 100% to what he or she is saying. I

	That probably would've been… I: No-no that's OK. BD:…a bit better. I: Anything else umm… the other people in the environment, what were they doing, can you remember? BD: Umm… I think when you were… doing… the activities, like so you'd, you are doing the clicking and following the instructions. I don't think that there was much action, on the outside, but when you're speaking, so when they did the…umm, virtual and the supervisors were speaking to you, you could see people in their background walking around which obviously made it seem… more effective, 'cause that's…what it's like… what I would assume it's like onsite. Umm… But yeah just, just walking around I guess.	she would assume it's like on-site. Just walking around, she is guessing.			might also look around what is happening in general. My perceptual act in this situation is more distributed than during the act of getting there.
27.	I: How about the guy who collapsed? BD: He… was… umm I don't… oh, he just collapsed, he fell. I: He… he didn't just appear from somewhere, was he…? BD [talks over]: No he was standing there! So umm, so I had point A, point B and he was in the middle. And I had to drag poles from, or click to get poles from here to there, and he was in the middle of doing something else. And umm it was so walking back and forth that's when you sort of get your view on him and you see… how he's going, so that' how I saw him collapse. I [talking over]: So you have poles somewhere and you… BD: Had to drag them to a truck. And… [laughter] And umm like he was in the middle doing something in between the two points and so you'll always seeing him… going from back and forth, so and then when he collapsed you just saw him… see him fall, I think, I think he collapsed. BD: I know he wasn't well. [laughter] I know he died. [laughter]	When asked about the guy who collapsed, she first hesitates but then says, he just collapsed, he fell. When asked from where did the person appear, she says he was just standing there. She had point A, point B and he was in the middle. She had to drag poles from, or click to get poles from here to there, and he was in the middle of doing something else. She was walking back and forth and that's when she sort of gets her view on him and she sees how he is going. So that's how she saw him collapse. When asked she has poles somewhere, she says she had to drag them to a truck. And he was in the middle doing something in between the two points and so you would always see him going back and forth, and then when he collapsed she just saw him fall, she thinks. She thinks he collapsed. She knows he was not well, she knows he died, she says laughing.	The user's activity in the environment was to drag poles from A to B, to a truck. The virtual character who was going to collapse from heat stress was somewhere in the middle of her route, doing something else. She would always see the person while going between the points A and B, and also saw him when he collapsed.	When asked about the co-worker avatar who collapsed, the user does not remember exactly what he was doing; she vaguely thinks he might have been just standing there. She remembers the co-worker's location though, which was in the middle of a route she had to take when performing her active task. She also remembers the co-worker was not well as he died.	She does not remember perceiving what the co-worker was exactly doing, but she remembers doing her immediate task well.
28.	I: OK. So you basically… Would	When asked what took place then, she says he fell and a	When asked what happened after that, the user says a pop-		

you say that the dying… What happened then actually? BD: Aa, he fell and… And a pop-up came and said "You let your co-worker die". [laugher] "You let your co-worker umm… out of sight" or something and "You didn't keep him hydrated" and, umm… "We've called medics" umm but, I think it said like "It doesn't look like he's gonna make it" or something like that so…	pop-up came and said "You let your co-worker die". Also, "You let your co-worker out of sight" or something, "You didn't keep him hydrated" and "We've called the medics" and she thinks it said "It doesn't look like he's gonna make it" or something like that.	up came saying she let her co-worker die. There were some other details in it describing the reason and what happens next, but of those she is not entirely sure.		
29. I: So what were your thoughts at that time? BD: I think it was probably very effective because… like it sort of puts you… it makes you think like if this was in the real world and I… didn't keep an eye on a someone that looked like they were showing signs of this, or I just let them go 'cause I didn't like them or… I didn't really alongside of them as much to know their name. Then, they could–they could… die in real life. So it's probably a bit extreme, but it was effective. I definitely didn't kill him the second time.	When asked what were her thoughts at that time, she thinks it was probably very effective because it made her think if this was in the real world and she didn't keep an eye on a someone that looked like they were showing signs of this, or she just left them go because she didn't like them or didn't really alongside of them as much to know their name. Then they could die in real life. She thinks it's probably a bit extreme, but it was effective: she definitely didn't kill him the second time.	The virtual person dying the first time made her keep the virtual character alive the next time.	Asking about the event does not bring forth more description from the time of the situation itself, but the user takes a mode of reflection and judgment. She assesses the VE was effective for two reasons, one is that it made her question her behaviour and what might affect it in a real situation, and two, she did not kill the co-worker the second time.	The question could've probed: So what happened then, or What did you do after the pop-up?
30. I: So can-can you remember, you know about your… thoughts about using the actual software when-when the pop-up came? What were your thoughts? BD: Umm… At first I thought how's this going to be effective with all of the offsite guys because they, I work in the learning, the training department and we've got a computer program that they're supposed to book all of their training through and they are not very… good at doing it. We probably get more… emails asking how to use it instead of just reading the instructions.	When asked what were her thoughts about using the software when the pop-up came, she at first thought how's this going to be effective with all of the offsite guys. She works in the training department and they've got a computer program that they're supposed to book all of their training through, and they are not very good at doing it. Her team probably gets more emails asking how to use it instead of just reading the instructions.	The user's experience from the training department made her ponder how workers might manage with the virtual training program: people working on the site need to use a training booking software, but her team receives many emails asking how to use it.	When asked about her thoughts about using the actual software when the pop-up came, the user begins to reflect the possible effectiveness of it for employees in her company: they have another training-related program the employees should use on their own, but they have not been very good at using it. Helping them with it has increased her team's workload.	Is this related to the UX question and if so, how? Perhaps in a way that she is trying to make sense of how people might enjoy using the software based on her previous experiences with other software-user situations.
31. BD: But, I found it effective umm… I probably think it is better that way than just reading… Because I've done a lot of the modules that you have to do online, and… after half of the reading you have to go through you just… you can't concentrate. So the virtual one I thought	She found it effective, and she probably thinks it is better that way than just reading. She has done many modules online and after half of the reading you have to go through, you just can't concentrate. She thinks the virtual one was more effective because you feel like you are there, people are speaking to you and then you are acting out the actions. She thinks it's definitely a good step forward. Just reading online modules, staring at the	Compared to previous experiences with online learning where too much reading gets stressful and disengages your concentration before you even finish it, the user feels the virtual environment is a step forward – especially because she works in front of the computer all day. Instead of just reading you feel like you are there, people are speaking to you and then you are acting out the actions.	The user compares the effectiveness of the VTE to other online learning she has done, which has mostly been concentrating on reading. Too much reading disengages and becomes stressful, especially if you work with the computer the whole day. To her, the VE was more engaging and effective in the sense that you feel like you are there, people are speaking to you and then you are acting out the actions.	Too much of an opinion? I feel the reflection is important here as it shows how she is trying to make sense through previous UX she has had. She shows that the activity? what is different from other online learning she had done, makes it more compelling? interesting? less stressful? easier to concentrate?

	actually was more effective because you feel like you're there, you feel like you're… you know, people are speaking to you and then you're acting out the actions and it's… Ah, I think it's definitely a good, a good step forward. Online, just reading online modules, like staring at the computer screen just reading gets really… stressful. Especially 'cause I work in front of one all day long so…	computer screen, just reading gets really stressful; especially because she works in front of the computer all day long.		She judges this as a good step forward.	
32.	BD: I'm a doer though. I prefer to be, I learn better from doing things, rather than just being told or reading. So… I found it a lot better.	She is a doer though. She prefers to be. She learns better from doing things rather than just being told or reading. So she found it a lot better.	The user defines herself as a 'doer' who likes to learn by doing instead of reading or direct instruction. That made her to enjoy the software more.	The user reflects she is a 'doer' and believes she learns better from doing instead of direct instruction and reading.	Too much of an opinion? Is there something in "I'm a doer" though? Also, this is clearly connected to the previous meaning unit in a way that she defines using the training software as 'learning by doing', at least as she understands learning by doing.
33.	BD: But it's just I guess… it took a bit long… or maybe not. Maybe it didn't take as long as normal, but I can just imagine… all of the… mining guys, not… not thinking it as a way forward, 'cause it would probably take them a bit longer to figure out… But they might be gamers. [laughter]	But she's guessing, it took a bit long, or maybe not. Maybe it didn't take as long as normal, but she can just imagine all of the mining guys, not thinking this as a way forward because it would probably take them a bit longer to figure out. But they might be gamers she ponders laughing.	At the same time the user doubts her performance of using the software efficiently, and wonders if the 'mining guys' would think it a way forward and how long it would take them to figure it out. But perhaps some of them are 'gamers'.	The user reflects that perhaps it took her longer than normal to figure out how the VE worked. This makes her think about some employees and how long it might take for them, and if that would make them judge this as not a way forward. Still, they might be gamers and able to figure it out faster.	The message here is, people judge training, and if they do not understand what they need to do, they might judge it as poor. It also communicates that virtual environments are something that need to be learned to be used, and gamers are in a privileged position in this. It also suggests that this "learning to use" is an expected phase and takes place temporally ("maybe it didn't take as long as normal"). Thinking about other users (cf. Linda)
34.	I: Any ideas that would make the environment feel more real? You say that it's like being there instead of reading paper. BD: Yeah well, because they put you in a scenario. You have to, you have to… you'll[br] they, they get you to do things and… It's as though… I would assume that a normal day at work would be. So I think that the heat stress one that we did they, you know worked it based around… the umm… off[br] the onsite facilities but… For someone who doesn't work offshore and someone who… hasn't been… offsite, someone who hasn't been onto a site, I had no idea. And so… doing that training sort of gave me a bit of an idea what would be going on in the actual… umm, if I was to, if I was to go offsite. So sort of yeah, so sort of made you… realize… the environment I guess that it, that it's in. So I though that was pretty effective. If	When asked if BD has any ideas what would make the environment feel more real as she has said that it's like being there, she replies because they put you in a scenario. They get you to do things. It's as though she would assume that a normal day at work would be. The heat stress one that they did was based around the onsite facilities, but for someone who doesn't work offshore and someone who hasn't been onto a site, she had no idea. Doing that training sort of gave her a bit of an idea what would be going on in the actual, if she was to go offsite. It sort of made her realize the environment that it's in, she is guessing.	For the user who has never been on site, doing the activities in a scenario give her the impression of what a normal day at work or the environment might be like.	Replying to a question what would make the VE feel more real, the user says they put you in a scenario and get you to do things. It's as though she would assume that a normal day at work would be. As she has never been on-site, she had no clue what it is like. Doing the training gave her a bit of an idea what would be going on in the actual site.	The VE tunes her in what the actual site might be like. Although it sounds vague and there are no specific details she points out, general familiarity might be very important outcome of an induction. More details in the next MU after further probing. Too much of an opinion and a leading question? At the same time this meaning unit is about the same topic addressed in earlier meaning units, which as based on BD's own words, I would label as 'being there'. Becoming more familiar with a site for her is a broader whole than just pieces of information and reading about the site: it is about acting there and the training software facilitates that possibility.

	that made sense. [laughter]			
35.	I: Any specific like, what comes to your mind… BD [talks over]: That it's hot. [laughter] I:…about the environment? Like, that makes it more familiar for you? BD: I've never been on-site! I: Yeah but, let's imagine that you would go there. BD: I guess the PPE [Personal Protective Equipment] gear that they got them all wearing umm… the red dirt [laughter] It was all color, color-coded I suppose umm… they get, had little [company name removed] badges on their PPE gear. Umm… I'm not too sure… They had umm, they had, some of the guys had hair… They went to pretty good detail.	When asked what specific things come to mind from the software, she laughs and says that it's hot. When further probed what things in the environment might've made it more familiar to her she guesses the PPE [Personal Protective Equipment] gear they got them all wearing. The red dirt, she laughs. They had little company badges on their PPE gear. Some of the guys had hair. She thinks they went to pretty good detail.	Specific details that the user remembers from the environment are for example the protective equipment, company badges on them, the red dirt and that it was hot, and that some of the guys had hair. She remembers it was pretty well detailed.		MU not included in the constituents as it is too vague.
36.	I: About… You said that you're not a gamer, but you umm… you use the computer the whole day anyway. BD: Yeah. I: How, how was the… interaction with the environment, like, using… the controllers? BD: I used the mouse, so I just clicked around. I didn't use the controllers. But umm… what do[br], what do you mean? I: So, you used only the mouse? BD: Yeah. I: What do you do with the mouse? You… BD: You just click on the options that come up. I: OK. BD: So umm… I: Do you use it for looking around or…? BD: I think when you used the keypad… I: OK. BD: When, 'cause there's the two options. So the keypad, you actually… yeah, do it all manually. But I could just imagine that would've taken me a lot longer than… doing the umm, mouse option. So umm, it did it all for you when you did the mouse one. I don't know, I don't know what the keypad one would be like.	When asked how was it like using the controllers, she said she used the mouse, so she just clicked around. She didn't use the controllers. Then she asks a clarifying question what the interviewer means, to which the interviewer affirms that she only use the mouse. Then she replies she used the mouse to click on the options that come up. She thinks one would use the keyboard to look around. Because there's the two options. So the keypad, you do it all manually. But she could just imagine that would've taken her a lot longer than doing the mouse option. So it did it all for her when she did the mouse one. She doesn't know what the keypad one would be like.	The user chose to use the mouse option for interaction. Interaction with a mouse consists of clicking options that come up, and the program does the rest of it all for you when you do the mouse one.	When asked how it was like to use the controllers, she says she only used the mouse. She chose this option as she though using the keypad for controlling would've taken her longer than the mouse option. Using the mouse meant clicking around and choosing options that come up, and it did it for her automatically. She did not try the keypad and does not know what it was like.	Note: she did not experience using controllers, but only the mouse which she called as "automatic", although clearly it is not but even in that you need to click for something to take place. For her, the keypad would've been "manual". Note that trying to get a person to speak about using controllers already brings her attention away of the actual activity in the environment. This is an interesting finding and needs to be discussed, and what are its implications for phenomenological research that tries to deal with unreflective life world accounts that take place directly with the world. At the same time, using technology is also "living", but e.g. Ihde has mentioned, it poses a different kind of a layer and human-technology relations in our lives. Another thing is how does such 'interaction' relate to video games. Nowadays interacting in video games is much more complex than this. Does that have any impact in anything? Think about your own gaming: for example in Halo when you fight against the Covenant troops, you move around, shoot, click for picking up weapons and so on. When they introduced quick-time-events in Halo 4, it felt to me like you were detached from the games world to a mindless spectator who just clicks at the right time. At the same time, clicking the right options is OK with games such as SceneIT! where it naturally fits with the theme of a movie quiz.

37.	I: Can you put the whole thing… in a way on a timeline? So… In a way, just… it doesn't matter if it's… wrong. But… or right. But… you said that you wake up… BD: Yeah. You wake up, you get the call to say "It's gonna be super hot today, going on-site, make sure you wear the correct PPE gear and become prepared".	When asked to put the whole thing on a timeline from the waking up, she says you wake up, you get the call to say "It's gonna be super hot today, going onsite, make sure you wear the correct PPE gear and become prepared".	The user's character wakes up and gets a call that lays the background of the training and also leads to the next stage in the program by saying "It's gonna be super hot today, going onsite, make sure you wear the correct PPE gear and become prepared".	When asked to put the whole thing on a timeline, the user begins by describing the beginning with the call she receives that communicates a message about the environmental conditions and gives her instructions.	What does this mean? She explains what took place through message given to her.
38.	BD: You go to the wardrobe, select there your PPE gear if you need… I [interrupts]: So you have your PPE… BD: Yes, so it gives you options. So it gives you… normal clothes, normal hat, safety… hat, hard hat umm, sunscreen, sunglasses, all of those options and you have to go through and select which ones… you think are… required for the day.	She goes to the wardrobe, select there her PPE gear. It gives her options: normal clothes, normal hat, safety hat, hard hat, sunscreen, sunglasses, all of those options and she has to go through and select which ones she thinks are required for the day.	The user goes to the wardrobe to select the right PPE gear from the options provided.	The user goes to a wardrobe to go through and select from given accessory options the ones she thinks are required.	
39.	BD: Umm, then you get to site and then they give you another rundown, aa, that "it's gonna be really hot today", so they give you the heat stress training. And then you have to do the quiz to make sure that you know all the symptoms to what umm… the lady had just spoken to you about.	Then you get to site and then they give you another rundown that "it's gonna be really hot today", so they give you the heat stress training. And then you have to do the quiz that makes sure you know all the symptoms to what the lady had just spoken to you about.	When the user proceeds to the stage that describes the site in the program, another "it's gonna be really hot today" message from the virtual character there underlines the topic or context of the software. Then the virtual character discusses heat stress symptoms, after which the user takes a quiz about them.	When you get to another location in the VE, the same message is repeated from the earlier call to underline the environmental conditions. This is followed with topic-related training. Then the user is required to do a quiz which she judges is there to make sure you know all the details the virtual character has spoken to you about.	This meaning unit communicates repetition; repetition in communication, repetition in details (information + quiz). It is behavioristic process.
40.	BD: Then they send you out to work. And that's when I was dragging the poles from two different locations and that's when I had to monitor… the… my other co-worker. And then you see the symptoms and it gives you the option to… umm, like, offer him water or if, when he starts shaking, take him into the shade or… those kinds of options and then… Once you call a sup[br] 'cause your option's to call your supervisor. So you call your supervisor, and he'll say "That's great, drag him into the shade until I get there". Then when the supervisor gets there, he'll look at it and say "He's in heat stroke, we have to get him to the ambulance". So you call… the ambu[br] Or you call the ambulance straight after the	Then they send her out to work. And that is when she was dragging the poles from different locations and that's when she had to monitor her other co-worker. And then she sees the symptoms and it gives her the option to offer him water or when he starts shaking, take him into the shade or those kinds of options. She calls her supervisor, and he'll say "That's great, drag him into the shade until I get there". Then when the supervisor gets there, he'll look at it and say "He's in heat stroke, we have to get him to the ambulance". So she call's the ambulance straight after the supervisor. She thinks she failed that twice too. She doesn't think the ambulance actually comes. She thinks they just take him to the first aid shade, and then the supervisor's speaking to her saying, "Congratulations, well done. You kept him alive. Just goes to show how hot it gets out here, why you got to stay hydrated. And then that was it. When asked how the training program ends, she thinks he, the supervisor, speaks about how she kept him alive and then says, "Well done, go back to work" and then it ends, she laughs.	At the next stage the user takes her virtual character to work. The work consists of moving poles from two different locations. After she fails to notice the person having a heat stroke at this stage and the virtual character dies, she begins to pay closer attention to the virtual co-worker and sees more clearly the heat stroke symptoms during the sub-sequent try?tries?. When the virtual co-worker begins shaking, the user understands he is having a heat stroke. The software gives options to interact with him such as offer him water, take him into the shade. One option is also to call the supervisor, who will thank the user for the call and asks her to "drag him into the shade until I get there". After the supervisor arrives, the user is able to call an ambulance. Ambulance coming is not shown. The user is not sure about this part and thinks she failed twice also calling the ambulance. At the end, the supervisor character congratulates her for job well done and ask her to go back to work. This ends the program.	When the user is assigned for her job, she remembers actively doing two things in the environment, dragging the poles but also that she had to monitor her co-worker. After seeing her co-worker's symptoms, she gets different options from which to choose her next actions. Then she calls her supervisor who communicates to her what to do next. The supervisor also arrives and assesses the situation, prompting what should be done next. The user does this, but does not remember if its outcome is entirely presented. Still, after a successful performance, her supervisor congratulates her for job well done, and reaffirms the topic of the learning environment (just shows how hot it gets here and why you got to stay hydrated). When asked how the training program ends, she is not sure. She thinks the supervisor just congratulates her for a good performance and keeping the co-worker alive, and directs her back to work and then it ends.	This MU reflects how the program scaffolds the user in many ways from putting her to work to giving options what to do and the helping supervisor. This is tricky meaning unit. Should it be divided into other meaning units? I think it all deals with the situation or an event, perhaps this should be thought relationally? Does this for example show that lived virtual space is also perceived as intentionally driven, similar to an actual space?

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	supervisor… I think I failed that twice too. [laughter] Umm and… Then… Yes, so then, the ambulance co[br] I don't think the ambulance actually comes. I think they just take him to the first aid umm… shade, and then the supervisor's speaking to you saying "Congratulations, well done. You kept him alive." Umm… "Just goes to show how hot it gets out here, why you got to stay hydrated" and then, that was it. I: So how does it end… the training environment? You… BD: I think it just says, yeah, he just speaks about how I kept him alive and then says "Well done, go back to work" and then it ends. [laughter]				
41.	I: About the… like like the start when you try out different clothes… BD: You don't try them on, you just… pick. You just select which ones. I: Can you pick the, the wrong ones or…? BD: Yeah. I didn't. I: OK. BD: But you can. So you can, they've got… So it's like a wardrobe and they've got… all the hat's on the top, shirts in the middle, pants in the mid[br]… second middle [laughter] Shoes on the floor… I: Like no ones wardrobe ever [laughter] BD:… accessories. Yeah [laughter]. And yeah, no one's wardrobe ever. And… there's so many different options. You just have to use… what… safety gear you think are correct. So if you selected the wrong thing it would turn back and say "No that's… that's not right. You're not gonna stay safe in… in the heat today". I: OK. So… Bascially it doesn't allow you to step forward from that… BD: No. I:…screen at all. BD: Yeah. I would assume you'd have to… select the right stuff.	When asked about the beginning of the program and trying out different clothing, she says she doesn't try them on she just selects which ones. She did not select any wrong ones, but it is possible. It's like a wardrobe and they've got all the hats' on the top, shirts in the middle, pants in the second middle [laughs] and shoes on the floor. And there's so many different options, she just has to use what safety gear she thinks is correct. If selecting the wrong thing it would turn back and say "No that's not right. You're not gonna stay safe in the heat today". She would assume you'd have to select the right stuff.	In the beginning of the program the user is prompted to select what are the right clothes for her virtual character. If she selects the wrong ones, she is prompted with a message saying "No that's not right. You're not gonna stay safe in the heat today". The user needs to select the right ones to proceed to the next level in the program.	The program makes her select from several different objects that she thinks are correct as safety gear. It is possible to choose wrong ones, but she did not. By choosing wrong ones prompts a message that communicates they are not fit for the environmental condition. She assumes the right ones had to be selected.	This is similar to what Giorgi (1985, 18) explained to think about in regards the level of abstraction: are the clothes important here? No, as you could change any object with them. What is important is that there are predefined objects from which she is directed to choose the right ones. This is again the interesting difficulty for analysis here that I see: instead of just concentrating to what she did, she jumps in and out of what actually took place while she was doing the training, reflecting it, and using the environment.
42.	I: Was there anything… During the use that you felt that… You wanted to do but wasn't	When asked about the one thing she wanted to do but wasn't possible was, she replied that maybe select if she was a boy or a girl. Because it	The user was not able to choose her virtual character based on her gender, but the only available avatar was a male by default. She would've	When asked was there anything she wanted to do but was not possible, she says maybe to select her avatar's gender. It was a boy although	

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	possible? BD: Maybe select if I was a boy or a girl. Because [laughter] it made me a boy and I think that's a bit sexist – not that I'm a feminist in any way, but it would've been nice to… have the option to be a female worker. In this environment I think it's pretty umm… Pretty evident that there's girl workers out on-site now.	made her a boy and she thinks that's a bit sexist – not that she is a feminist in any way, but it would've been nice to have the option to be a female worker. In this environment she thinks it's pretty evident that there's girl workers out on-site now.	enjoyed the option of choosing a female worker avatar.	it is nowadays common to have female workers out there on-site.	
43.	BD: Like I said at the beginning, maybe a bit clearer instructions. They were just a bit… vague. I think they will… Think that they may be assumed that all people… that were doing that training have already been… offsite. Or onsite, sorry. But [word missing] can't so, I was coming in blank, no idea. I: So how do you mean like vague, in what part of the actual… environment? BD: Aa… Maybe… I don't know, they probably just said… umm… So they, when they said like "Keep an eye out for your co-workers" it didn't really insist that I was gonna kill somebody. I've just never recovered from that. [smiling] I: So that's during the induction? Where they say you that have to look… BD: Well they say "You're off to work now. Make sure you keep an eye out on… your co-workers" or something like that so… I mean I was watching him but I didn't know [laughter] that he was dying.	When asked about the one thing she wanted to do but wasn't possible was maybe a bit clearer instructions. They were a bit vague. She thinks they may be assumed that all people that were doing that training have already been onsite. She was coming in blank. So when they said, "keep and eye out for your co-workers", it didn't really insist that she was gonna kill somebody. She has never recovered from that, she laughs. She recalls they say something like "You are off to work now. Make sure you keep an eye out on your co-workers". She was watching him but she didn't know that he was dying [laughter].	The user expected clearer instructions. Although she was prompted to keep and eye out for your co-workers, it was not explicit enough to guide her to focus on keeping the virtual co-worker alive. She was watching her, but she did not anticipate him dying.		Her attention?perception?focus?was in moving the poles, and also the unrealistic situation of constantly checking her co-worker (as she expresses in another meaning unit, see also MU 45) did not underline keeping the co-worker alive as the primary goal in this section of the program. Also as mentioned in the next meaning unit, the fact that the software was about heat stress did not result in such an understand either.
44.	I: How were you introduced with the environment? There wasn't anyone, you know, standing behind your back and saying that "This training environment is for heat stress and you should do…" BD: Aa, I think it was, the training is called "heat stress". [laughter] So I think that was umm… Pretty straight forward. I: When you start the program, the actual software, what, what pops up? BD: Oh, I can't remember. Umm… Oh, I did it took to a… homepage, or it took to him	When asked how she was introduced to the software, she thinks it was called "heat stress". So she thinks that was pretty straightforward. When asked what actually takes place when she starts the program, she says it took her to a homepage, or it took to him [BD's avatar] answering the phone call in the morning saying "It's going to be hot today. Make sure you select the correct gear". Then it gives you the options to choose if she wants to use mouse or keypad. When asked if there was any introduction movie, she says none that she can remember although it might be a good idea.	Launching the program and the short introduction scene at the beginning as a phone call "It's going to be hot today. Make sure you select the correct gear" outlined the focus of the software. It also gives the user the possibility to choose between two different interaction possibilities, the mouse or the keyboard.	The topic of the VTE is communicated to the user by the fact that it is for heat stress training. The user is not entirely sure how the program starts, if it is a homepage or her character answering the initial phone call. She remembers after this she was given options to choose what controls to use.	Another section that emphasise the fact that the software is about heat stress training. Still, if the "goal of the game" was to look out a co-worker who might die, nothing prepares BD for that. Is that a good idea?bad idea?does not matter as she clearly learned from the co-worker dying? The co-worker dying seems like inevitable; it is not a goal that can be reached "at the first go" (see Clubsport's transcript). What examples of such situations are there in games? There are some, where no matter what you do, your character dies in the end. Halo Reach Lone Wolf the eleventh level ended like this: you cannot survive. The difference to this occasion is, even if you know it, it is made impossible to survive Lone Wolf. This event might resemble more Mario games where you cannot anticipate

	Original transcript	Transformation 1	T2	T3	T4	Reflection/notes
	answering the phone call… umm, in the morning saying "It's going to be hot today. Make sure you select the correct gear". And then it gives you the options to choose if you want to use mouse or keypad. I: OK. So there's no cool introduction kind of a movie… BD: Noo, I thought that yeah, actually yeah, there wasn't, I can't remember, I don't remember there being umm… like a little introduction. No, so that would be… A good idea. I: OK. BD: Maybe like a… module like "In this… virtual training you're going to be ensuring that you keep someone alive". [laughter]					something the first time and fail, but on the second go, you already know it, and triumph because of that. This is similar also to Halo 4 quick time events that could not be anticipated, as they were not there in the previous games.
45.	BD: He slowed down my work. I: He? BD: He did. I had to stop and give him water all the time 'cause he wasn't responsible enough to take his own water. I: Poor colleague.	He slowed down her work. She had to stop and give him water all the time because he wasn't responsible enough to take his own water.	The user felt the co-worker slowed her down, who was doing the work given to her virtual character.	The user says the avatar colleague slowed her down. So she had to stop her activity all the time in order to interact with him, because he was not responsible enough to take his own water.		Although a light comment perhaps, it is an interesting one. She perceives her activity, taking the poles around, as her activity although the only genuine activity and the aim of the environment was to learn about heat stress.
46.	I: So anything you, you know, anything you would like to add? On top of these? BD: I think they're good. I think it'd probably get annoying having to do every single training virtual training. Umm but I think… for the ones' offsite or onsite, whatever, whatever it's called. Umm, I think they're pretty effective. Especially if you're a newcomer, coming in, and you have not worked in that kind of an environment before. Umm… I–I think it's effective. It's good that they've put you in the situation and you have to action everything yourself as though it was real life. So that's good.	She thinks it'd probably get annoying having to do every single training virtual training. But for the ones' off-site or on-site, whatever it's called, she thinks they're pretty effective. Especially if you are a newcomer, coming in, and you have not worked in that kind of an environment before. She thinks it's effective. It's good that they've put you in the situation and you have to action everything yourself as though it was real life. So that's good.	She thinks that the VE might be especially good for people who have not worked in this kind of environment before. She also assesses the effectiveness of the environment with the fact that they put you in the situation and you have to action everything yourself as though it was real life.			

MUs: Clubsport (C)					
Original transcript *(Discriminated meaning units in their original form – passages clearly unrelated to the experience of VE were removed)*	**Transformation 1** *(Discriminated meaning units expressed as much as possible in the subject's language and based upon perspective that description was an example of the experience of a virtual environment)*	**T2** *(Discriminated meaning units expressed more directly in HCI language and with respect to relevance for the phenomenon of virtual environment. Also the nickname is changed to 'the user' for easier*	**T3**	**T4**	**Reflection/notes**

			analysis with the other accounts.)		
1.	C: OK, so when I, when I started the virtual… umm… what do you call it, a virtual experience? Is that how you describe it? [I: How would you describe it?] C: OK, well, a virtual experience.	C tries to find a term for using the training program and describes it as a 'virtual experience'.	The user himself describes the training as a virtual experience.	The user tries to find a term that is sufficient to describe his user experience by asking what the interviewer might call it. When asked how the user would call it, he decides on virtual experience.		
2.	C: Initially… umm… I felt a bit confused with it, you know, getting used to how to… to navigate my way through it. But once I got through, through that part, it was umm… It was just… trying to identify where, where I was going.	In the beginning, C felt a bit confused with it, and getting used to how to navigate his way through it. Once he got through that part, it was just trying to identify where he was going.	Not being used to virtual experience navigation makes the user feel confused. Getting used to it means getting through that part. After that, it was just trying to identify where he was going.	In the beginning, how to navigate in the virtual environment was unfamiliar to the user. Before the user was entirely able to concentrate on where he needed to go in the environment, he had to get through the part of learning to navigate. After that, it was just trying to identify where he needed to go.	The user felt slightly confused with the VE in the beginning; navigating his way through it demanded getting used to. After he got through that part, he just needed to identify where he was going.	Note that he does not say controlling (cf. Linda) but "navigating my way through it", which signifies a wider construct.

I remember when I was trying out Second Life the first couple of times. Navigating in the environment from island to island was confusing, and so was flying with the avatar. Still, the controls had some basic similarities and I eventually learned it. After I had learned it, I could concentrate more fully to going to place, instead of controlling the avatar. This still takes place in some games I've played even today, for example Bayonetta. Also if I have gotten used to Halo's control scheme, it has been easy to adopt CoD's control scheme, but in the beginning I make mistakes for example, trying to throw a grenade by using a button that is in Halo but not in CoD.

It is clear that when you allow yourself to think more field-specific terms, such as HCI/UX/IxD, creating an output language for the account becomes easier – and most likely more meaningful to the audience who reads it (the developers, company instructional design and other training personnel). |
| 3. | C: I knew I had to follow the green… the green arrows, or the green spots on the, on the screen. And then sometimes I… rather than follow it in a… probably the correct manner… I'd, I'd spotted a green arrow… ahead of me, so I just… go to the first green arrow I saw. Rather than… But when I got to that arrow I did whatever I needed to do there then I had a bit of a look around I thought Aa, I passed that green arrow, so I had to come back to… back | C knew he had to follow indicators on the screen, such as green arrows and spots on the screen. Then sometimes rather than following it in probably the correct manner, he just goes to the first green arrow he spotted ahead of him. When he got to that arrow he did whatever he needed to do there. Then he had a bit of a look around and he though he had passed a green arrow. So he had to come back to the start, and from the start he moved forward. Which was fine. He probably should've looked around what he was doing: he just does a 360 to see where the closest green arrow was. | For the user, specific indicators, the green arrows, imply where to go but not in what order. After doing whatever he needed to do in a specific spot makes him think he might have passed a step. This makes him return to the start from where he again moves forward. In retrospect, he thinks he should've looked around more carefully, instead of proceeding to the closest green arrow. | Environmental cues [green arrows] guided the user to find different activities in the environment, but not in what order to do them. At the same time while the design of the virtual training was linear and demanded a correct manner of moving through, the environment allowed the user to move in it in a non-linear fashion. That is why the user, while seeking for cues what to do next, sometimes went to a wrong "`spot of activity". In such a case, he went back to the beginning to find how to get back on track. Despite of this, he said it was fine and reflects he should have been more careful himself. | | This is first a discriminating and then a signifying act: C sees green arrows as environmental cues but needs to interpret their significance. Still, his a priori signification is that the green arrows are indeed signs: if he did not have this predefinition, the arrows could mean nothing or anything from being merely decorative elements (like palm trees in the Far Cry game). Also, this is how VE differs from a real-life situation, as C explains elsewhere further in his account: in a real-life situation, there would be someone waiting for you, welcoming you on to site. This prevents getting lost.

This is what takes place for example in Legacy of Kain: Soul Reaver (Crystal Dynamics). The whole game is situated in a semi-open world, and in a revenge journey to the different parts of the world, the player goes |

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	to the start, and from the from the start I moved forward. When… which, which was fine I'd, I'd… probably… maybe umm… I should've looked around and see what I was doing and I just… do a 360 to see where the closest green arrow was.					fighting evil vampire lords and their minions. The different lords have different worlds, and there is a loose sequence to playing through the game in loosely right sequence. In some sections of the game, it becomes difficult to find where to go next, and walkthrough is needed. This made me to return to the "main crossroad" between different sections of the world and continuously see if I had missed something.

There is something to do about sequence here and linearity. At the same time the environment clearly lets him stroll freely, but "winning the game" has a linear nature: you have to go through it in a certain order. Some other participants also mentioned about this pre-defined nature. |
| 4. | C: When umm… when I completed, you know, the induction and, and, gone into the, the hut. Did the induction there as, or did the testing I think was in the hut and then come out and started my work… I umm… I wasn't exac[br] I knew I had to pick up the scaffold tubes, and put them on a rack. But I wasn't aware that I was… supposed to be looking at the… at the bloke next to me and you know I had a few, few goes that until I realized… what I was… what the task was. So I'm not sure if the test was to… for me to figure out what the task was or whether I should've followed that procedure on… on umm, completing the task. But anyway after a few goes that I… I realized that… now I had to take the scaffold tubes out… umm… have a drink, watch the, watch my… umm, work colleague. Make sure, get him out to the [laughter]… to the umm… to the umm… the shaded area and cool down and give him a drink | C completed the induction and pre-tests in the hut. Then he started his work. C knew he had to pick up scaffold tubes and put them in a rack. What he wasn't aware that he was supposed to be looking at the bloke next to him. It took C 'a few goes' until he realized what the task was. C is not sure if the test was for him to figure out what the task was or whether he should've followed that procedure on completing the task. After a few tries C realized that he had to take the scaffold tubes out, have a drink, watch his work colleague, get him out to the shaded area, cool him down and give him a drink. | When starting his work, the user knew what he had to do, but he wasn't aware there was another task. It took him a few goes to realize what the task was, and how to perform in the right order to complete it. | The objective of the activity was unclear to the user, and he was not sure if the goal was for him to figure out what the task was or to follow a procedure. As he was directed to do one task, the intended way of completing the activity got concealed from him. He failed the task several times. It took him a few goes before he realized what were the correct parts and sequence to complete the entire activity. | | Is this a classical Tomb Rider puzzle or getting continuously killed in a specific FPS battle type of situation? The designer has developed an activity in a way that he or she intends the user to complete it, but for a reason or another, the user does not or is unable to perform it that way (and often needs a walkthrough). |

5.	C: When I was going through it I though it was fairly well informative… Yeah that's, that's pretty well… yeah that's pretty well how it is. It was pretty good.	When he was going through it, C thought it was fairly well informative.	Using the training environment means going through it.	Using the VE [going through it], the user found it informative.		
6.	C: I think, it was more of an induction. Or the environment was a… a gas plant. And I think the aim of it was, is, for the person to follow through the umm… follow through like an induction process, if you, you know, you're a new person on-site. Probably a step back is, you have a breath test, and then you get to site. And then you umm, you have your induction. And then you go to a hut where you do some, some testing. And then after the tes[br], I think that's just the test to make sure you've done your induction correctly. And then umm… Then you go out to… the site supervisor. And the site supervisor gives you the rundown on, on heat stress and [br]…	C considered it was more of an induction – or the environment was a gas plant. He thinks that the aim of it was for the person to follow through like an induction process, if you are a new person to site. A step back, you have a breath test and then you get to site. Then you have your induction. And then you go to a hut where you do some testing, which is to make sure you have done your induction correctly. Then you go to the site supervisor who gives you the rundown on heat stress.	For the user, it was about induction, something for a new person who is unfamiliar with the site to follow through.	For the user, the aim of the virtual experience was to follow through a specific step-by-step process that formed an induction for a new person on-site. He describes steps of that process in active terms [you do/have/go].		
7.	C: At each stage they're talking about heat stress 'cause that's what it's topic is. And then, you got the designated job, which is… moving scaffold poles. And that's the point where moving the poles and keeping an eye on your work colleague I wasn't… aware that, that was my task.	C explains that at each stage they are talking about heat stress because that's what it's topic is. And then you got the designated job, which is moving scaffold poles. And that's the point where moving the poles and keeping an eye on your work colleague he wasn't aware that, that was his task.	The designated job that was given drew the user's attention to itself instead of the discussed topic, blurring what the full task requirement was.	The focus of the training is mentioned several times, but then the user is designated a task that is something else. The user recognizes in retrospect that at that time he was not aware of that his full task actually consisted of two parts instead of just the designated job.	Despite that the overall topic of the training was mentioned at different stages, the designated task became the focus of performance to the user. He never became aware of the other task that was only explicitly communicated, but was actually the main objective of the activity he was performing.	Is this similar to a situation for example in one of the Halos where you need to escort an NPC, an alien engineer character, through a certain level and keep it alive, but instead of performing accordingly and shooting the closest enemies to it to protect it, you just keep on shooting any enemy without thinking the main task, keeping the engineer alive? The difference to C's experience is that in Halo, you know explicitly what your full task is and you perform it by shooting enemies that are closer to the engineer instead of any enemy. In C's task, the theme of "keeping a fellow colleague alive" falls outside of awareness and becomes merely the concrete activity of "carrying scaffold poles".
8.	C: 'cause it, it just stops… [lp] But you don't know… umm… Has it stopped	At one stage, it just stops and C does not know why it has stopped; because he failed or because the training is complete?	It just stops without any conceivable reason. Using a possibility to receive more information ends up in repetition, the	When the activity just stops without any reason, the user is not sure if it is because he completed or failed it. This makes him to try		There is at least one event in Bayonetta that gives me a similar impression where you don't know if you correctly pressed the buttons in a quick time event

	because I failed or has it stopped because it's complete? And then you, you press "talk" again and they get the same spiel. And then you realize that… you haven't completed the task	And then you press "talk" and you get the same spiel. And then you realize that you haven't completed the task.	same spiel, of what's already known. Such a lockdown situation makes the user realize he has not completed the task.	to find more information with the user interface option available [press "talk"]. When this options gives him the same explanation [spiel] as before, he realises he has not completed the task.		accordingly or not. It took me many times to understand why I failed and to finally perform it successfully. In addition to that, there is another act here, which is trying to get more information when you need it, but the information does not help you or provide addition aid even if you try it several times. This is similar to a game mission where you are uncertain what the next step is, and you always have the same line of text or spiel to help you. This took place a couple of times in LA Noire while I was trying to find environmental clues for how the crime took place.
9.	C: and like I said, after a couple of… a couple of goes that it… I realized what the task was, which was to move the scaffold poles and keep an eye on your work colleague. 'Cause he's in the… what he ends up doing, if you don't keep an eye on him. Is he collapses from heat stroke. So your… Your task is to move the poles and make sure he doesn't collapse. And he doesn't collapse by taking him to the shade and, and giving him the drink. [laughter] C: So you know, I guess it's a little bit corny but, I, I mean, the reality of it is that if you don't… keep an eye on who you're working with, well, maybe they can collapse. [laughter]	After a couple of goes, C realized what the task was, which was to move scaffold poles and keep an eye on your work colleague. Because what he ends up doing if you did not keep an eye on him, is that he collapses from heat stroke. So your task is to move the poles and make sure he doesn't collapse. And he doesn't collapse by taking him to the shade and giving him the drink. He thinks it might be a little bit corny, but the reality of it is that if you don't keep an eye on who you're working with, well maybe they can collapse.	Doing the process a couple of times revealed the user the full performance that was required. The user thinks it might be a little bit corny, but the reality of it is that if you don't keep an eye on who you're working with, well maybe they can collapse.	After a couple of goes, the user traced and realized all the necessary steps that were needed to perform the task. The user laughs that the scenario might be a bit corny (in real life), but accepts that it is something that might take place if one does not maintain awareness in such a situation.		A short version of this idea is present in the first quick-time event in Halo 4 where you need to climb the wall to get to another safe ledge. It took me a couple of goes to first realize it was a quick-time event instead of just an animation, then what were he correct button sequence that corresponded to the activity on the screen that always took place in the same order.
10.	I: You move the scaffold poles. How is it expressed in the environment that's the task? C: You umm, you use your arrow keys on the computer and you get to the, a truck. And… I can't rem[br] I think… [word missing] [because?] you get to the truck, I think as you get to the site… the scaffold pole goes green. And then you, I think you select it with your mouse, it	[To the question how the task was expressed in the environment] C used arrow keys on the computer to move to the truck. C thinks as you get to the site the scaffold pole goes green. He thinks you select it with your mouse, it says something like "pick up" or it might be green and then you just select your mouse key. And then you pick it up and then you can move with your arrows to the rack. When you get to the rack and put the pole down it says "release", "drop", or "place" or something like that. You know you're in the right target area, and so you	The environment responds to the user's proximity, showing him that something is ready for interaction, inviting him to choose from proper actions, and letting him know he is at the right location.	When asked more about the designated task, the user describes he used arrow keys to get to a specific location. There is an object that changes status when you get closer to it; he is not entirely sure what is shown on the screen to indicate you can select the object. Then you use arrow keys to navigate to another location where a text of some sort indicates you are in the right spot and can leave the object there. Then you need to turn around and do the same thing again.		

	says something like, I think it says "pick up" or it might be green and then you just select your mouse key. And then you pick it up and then you can move with your arrows over to the rack. And when you get to the rack and… and put the pole down it says umm… "release" or "drop"… or "place" or something like that. You know you're in the right… target area and so you just select it and umm… the pole just drops and you need to turn around and do the same thing again.	just select it and the pole just drops and then you need to turn around and do the same thing again.			
11.	I: So is that… a genuine task that the people who work in that environment have to do C: Could well be, yeah. Scaffolding would… I: So why would you do that? C: You migh[br] In this case you were taking it off the truck. But you could be taking it off a trolley and putting it back, you may have, may have come back from a job where all your scaffold poles are on a, on a trolley. You've taken it over where you store your scaffold poles. So you've taken them off the trolley and put them in the rack. That's, that's an offshore situation. But… this is an onshore gas, or a gas… plant situation, I had a truck. So you've taken the poles off the… back of the truck and putting it in on a… I: [interrupts] So that's also in the, the virtual thing? C: Yeah. I: That you, you see the truck or… C: Yeah, you	When asked if moving poles was a genuine task C replied scaffolding could be. In this case, you were taking it off the truck, but you might be taking it off a trolley and putting it back. You may have come back from a job where all your scaffold poles are on a trolley, and you are putting them back to the rack where you store your scaffold poles. C says that is an offshore situation, but this is an onshore gas plant situation: you have a truck. To the question, do you do scaffolding, C replies that in the training environment you are not creating scaffolding but only moving the poles from one spot to another.	The task could well be a task that takes place in a real environment, as to the user, it resembles the process that takes place in such a context, but based on its objects and their relation, scaffold poles are on a truck and not a trolley, it is similar, but not exactly the same.	To the user, the task in the VE could resemble a real-world case where you are doing a similar kind of a task, although the specific situation and some of the objects involved are different.	

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	see the ute that the scaffold poles are in. I: OK. I: And… so do you like create scaffolding, or, or…? C: No, all you doing is moving… I: OK C: …moving the scaffold poles from one, one umm… spot to another spot.				
12.	I: So what are your mates doing then? C: He's cleaning up the… well it looks like he's cleaning up the scaffold clamps. 'Cause he's standing… next to a bench. You know… it's animated. So you're not exactly sure what he's doing but it, I… I: Checking his email [laughter] C: Yeah or I've seen scaffolders offshore and that's what they, you know, there's, there's several blokes… loading poles and then there's… there's always a couple of blokes cleaning up the clamps… so I'm guessing that's what this guy was doing, cleaning out the clamps out in the sun. I: So what do the clamps do? C: The clamps umm… clamp unto the… they're like a umm… a rota[br] there're two clamps rotating. [showing] One… you clamp… so vertical… pole. Clamp unto a vertical pole. And then you can rotate the other one… to a horizontal position. And then you clamp it, tighten it up and clamp it into a horizontal… I: So it holds the poles together? C: Yeah, yeah it holds the… the scaffold poles together.	C says that it looks like the other person is cleaning up the scaffold clamps. Because he's standing next to a bench, and it's animated. Your are not entirely sure what he is doing, but he has seen offshore scaffolders where there are always several blokes loading poles and a couple of them cleaning up the clamps. So he is guessing that's what this guy was doing, cleaning out the clamps out in the sun. When inquired what the clamps do, C explains that they hold the scaffold poles together.	The user is not exactly sure what the other person is doing, but his location to a certain object and the character animation make him remember a real-world situation and a specific job task there.	Although the user is not entirely sure what one of the avatars in the VE is doing, he says it looks like he is doing a specific task [cleaning up clamps]. Because the avatar is located next to a certain object, has certain animated movements, and the user has been in a situation that resembles this where people perform this certain task, the user is guessing this is what the avatar was doing.	
13.	I: So this person in the	When asked if the person in the	The user spots the other character		

	environment aaa… Is he, you know, with you all the time or how did you spot him? C: He's working to the side where I'm, I'm passing with the, the scaffold pole.	environment is with the user all the time or how did he spot him, C says the person is working to the side where C is passing with the scaffold pole.	working to the side as he passing with his object.			
14.	C: And… the way… you're… and this is, this is part of the, the process. Unless you, you're aware of… look I don't think you can do it the first go, unless you are aware of what's happening. Or what your task was.	C thinks this is part of the process. Unless you are aware of what is happening or what your task was, he does not think you can do it the first go.	The user thinks it is part of the process not to be able to finish it the first go. It is only possible if you are aware of what is happening or what your task was.	The user judges that if you are not aware of what your task is, or the aim or what will take place, you are not able to finish it the first go.	The user judges that unless you are aware of what is going to happen or exactly what you need to do, you cannot succeed the first go. He thinks it is part of the process.	[A breakdown]. The word 'exact' in the final transformation is related to other MUs that convey that C was not aware all the parts of his task, just the one carrying the poles.
15.	C: You start to see him… umm, waver. And then you just go over to him and… I think it must highlight him… I, I can't remember how you grab him anyway, but… There's something on the screen to show that you can take him and then move him over to, to the shaded area. I: So how did you spot him, like… wavering? C: Umm, as I'm walking back to the… to the ute to get a scaffold, I could see him… moving… umm, sideways. So I figured that must've been [br] the first time I figured that must've been… the indication that he was about to collapse. So yeah, you go and grab him.	You start to see him waver. Then you just go over to him and C thinks it must highlight him. C is not sure how you grab him, but there is something on the screen to show that you can take him and then move him over to the shaded area. When asked how C spotted him waver, he says that as he was walking back to the ute to get a scaffold, he could see him moving sideways. So he figured that must've been the indication that he was about to collapse. So yeah, you go and grab him.	Unusual character movement indicated that something was happening with the other character. The user does not remember exact details, but when moving closer to him, something on the screen shows that the user can interact with him.	Unusual movement of the other virtual character, seeing him wavering, made the user aware that something was going to happen. Although he does not remember how he actually interacted with the character, he remembers there was something on the screen that indicated it was possible when he got closer to him.	The user remembers walking back to one location when he saw one of the avatars moving in a specific manner. To the user, it was an indication he was about to collapse. He does not remember how you grab him but he thinks when you move closer to him, it must highlight him or there is something on the screen to indicate what you can do.	Often in games, the non-player character you need to interact with gets highlighted, and when you get closer, an indicator of interaction ('talk' etc.) appears. Why all these passive "you"? What lies in it? All the participants use "you" in some sections of their accounts. Why? Also interesting is how he uses 'it' to describe the VE while something happens.
16.	I: So when you started using the environment, umm, did it say somewhere that it's about… that, that you… kinda have to keep… you know, your colleagues safe, or, or… How was it introduced? C: It, it, at that point, at that… It was introduced with the umm… [lp]	When asked if in the beginning of using the environment it was introduced to C that he would need to keep his colleagues safe, C thinks it was introduced with someone who must be the site supervisor. Each of the steps he goes, like induction and testing, then first the site supervisor, then the local supervisor, which is at the scaffolding, they go through a list if things that they want him to be aware of	At the beginning, the user is prompted by virtual characters specific information about the topic of the training, and that he should be aware if his colleague is not acting normal and to be prepared to act accordingly. In another instance, he took the role of a medic assistant, and during a scenario was asked from specific options what he should do.	When asked if the objective of the failed task was somehow introduced in the beginning of the training, the user explains it must have been a specific character that did it. He continues to explain that in each step he goes through, different characters, to which all he gives a title, go through a list of things they want him to be aware of regarding the topic of the training. One of them specifies what he	When asked if the objective of the failed task was somehow introduced in the beginning of the training, the user explains that first of all an avatar must have done it, to which the user gives a specific job title. The user continues to explain that each step he goes through, different characters, all to which he assigns titles, go through a list of things they want him to be aware of regarding the topic of the training. One of the things is related to what to do if the user sees one of his colleagues not acting normal.	A role of a character was clearly anticipated based on C's work experience in a similar kind of an environment. Also, I really need to think about this 'you' and "1st person" variation. Edit: Today (1.2.16) I found an interesting article through Martin's paper which might explain the slippage of the pronoun. Burn, A., & Schott, G. (2004). Heavy Hero or Digital Dummy? Multimodal Player–Avatar Relations in Final Fantasy 7. Visual Communication, 3(213), 214–233. I might add this to

	he was at the… I think he must be the site supervisor. 'Cause each [br]… each of the steps you go to, like your induction and testing and then… first of your site supervisor and then your, your local supervisor which is at the scaffolding. They go through a list of things that you want to… they want you to be aware of, with, with heat stress. And one of those is just, if you see one of your colleagues… umm… not acting normal. Get him out of the, get him into the sun.… I-I, the other thing with… with that virtual umm… test or virtual training is there was a couple of instance where… you umm… acted as a medic assistant. And there were people collapsed… one person collapsed on the… on the ground and you're asked what to do. You know, to, to revive the person, you call the medic… Umm… Get him to a shaded spot, cool him down with a sponge. Offer him… umm… hydration of from water, pure water.	with heat stress. And one of those is just if you see one of your colleagues not acting normal, get him out of the sun [he mistakenly says, into the sun, but most likely he meant out]. The other thing with that virtual test or virtual training is there were a couple of instances where he acted as a medic assistant. And there were people collapsed, or one person collapsed on the ground, and he was asked what to do. You know, to revive the person, to call the medic, get him to a shaded spot, cool him down with a sponge, offer him hydration from water, pure water.		needs to do in the environment if the user sees one of his colleagues not acting normal. In another instance, he took a specific role of a medic assistant, and during a scenario was asked to select from specific options what he should do in a situation.	In another instance [the virtual test or virtual training], he acted as a medic assistant. There was a person or persons in a bad condition and he was asked to select from a list of options what he would do in such a situation.	the discussion, but need to stay away from it for the duration of the analysis.
17.	C: So those, those points all lead to… the task, the final task where… if you didn't get the person… as he starts wavering, he collapses. And then you got to drag him into the… Oh no actually you don't drag him you're I think that's when it… when the umm… the training stops and then you got to restart it again. [I: OK.] And then umm… 'cause it comes up and says "Your umm, work	So those points all lead to the task, the final task where if you didn't get the person as he starts wavering, he collapses. And then you got to drag him into the, C suddenly stops. Oh no, actually you don't drag him, but C thinks the training stops and then he has to restart it again. Because it comes up and say, "Your work colleague has collapsed". And C did not know he was supposed to keep an eye in that. But as he said, it is all leading up to that where he gets the exposure, he is guessing, of recognizing people in the workplace who might be suffering from heat stress.	The user experiences these points all lead to the task, the final task, where if you cannot respond to the avatar's visible changed condition accordingly, he collapses. First the user remembers that the next step was to react to that with another action. Then he remembers that, as a surprise to him, the training actually suddenly stops. A message on the screen informs the user what has happened, and he needs to restart. The fact that the training ends suddenly like this comes as a surprise to the user, as he did not know he was expected to keep an eye in that what ended the training.			Again, 'it'.

	colleague has collapsed". And [it's like?]… I didn't know I was supposed to keep an eye in that… the, like I say that, it's all leading up to that where you umm… you get the exposure I guess of… of recognising people, in the workplace that could be umm… suffering from heat stress. I: Is it, is it before or after or in what stage does it occur? C: It's… There was two… There were two instances… where there were collapsed people and I think… One of them was after the first [like?] of an initial training. And then the next one was… I think… I can't remember the next one whether it was before the job or after the job or before the work, or before the work task or after the work task. I might've been [lp] Yeah now I can't remember. It might've been after the work task. The reason that I can't remember now is I can't remember how I though it… I can't remember how the, the training stopped. And whether training stopped after I had shifted all the scaffolds. And that's when I thought it was, but now thinking back… there was a umm a collapsed person and the supervisors asking me "Where are you?". And then my response is umm… I'm helping someone out that's… umm… that's got heat stress. Or heat…heat stroke. [lp] So if I…	When asked at what stage does such a thing occur, C estimates there to be two instances where there were collapsed people: one of them after the initial training. The next one for C is a bit blurry, and he cannot remember whether it was before the job or after the job, before the work task or after the work task. He thinks it might have been after the work task. The reason why he cannot remember now, is that he cannot remember how the training stopped, and whether it stopped after he had shifted all the scaffolds. Now remembering back, he thinks there was a collapsed person and the supervisor asking him "where are you?" And then his response is, "I'm helping someone out that's got heat stress, or heat stroke."	The user tries to remember at what stage did the training stop through the instances of collapsed people, and also how it happened in relation to the job, before or after it, and also was it after he had finished the task. Remembering this is difficult, and he doesn't remember how the training stopped and at what stage. Remembering back, there was a collapsed person and one of the avatars asking him something to which he had to reply.			
18.	I: So how did you pick your	When asked how C picked his answers, he	When asked how the user picked answers in			

	answers, like…? C: Umm some of its, was animated. Animated answers. And then the others were… umm… were a selection. Umm for the… for the supervisor one, I think you were given the, the choice of helping a person out… that's heat stressed, or… "I'm on my way", 'cause he's asking the question "Where are you?". And… I: By phone or…? C: Aa, just on the radio. I: Okay. C: And umm… One of the, one of the questions is "I'm helping a person out that's heat stroked", umm, "I'm on my way to the job now", and I think there might've been one other. Another answer as well.	explains that some of it was animated, animated answers, and then the others were a selection. For the supervisor one, he thinks you were given the choice of helping a person out that's heat stressed, or "I'm on my way", 'cause he's asking the question, "Where are you?". When asked if this took place by phone, C says on the radio. C thinks one of the questions is, "I'm helping a person out that's heat stroked", I'm on my way to the job" and he thinks there might've been another answer as well.	the VE, he groups them under two categories, animated and a selection. At one particular moment, he was given choices how to react to a certain situation. This was initiated through a radio. He remembers one of the options, but thinks there might have been others.		
19.	I: So you say there's like an initial training in the environment when you… how, how does the actual, like the, when you start the software? C: Yeah. I: What happens, like…? C: Aa, when you start the software you… First of all you get a phone call… to say umm "We're supposed to be down at the bus blah blah blah whatever time". And then… it says… umm, don't forget to bring your safety equipment… which then was umm… heap of PPE [Personal Protective Equipment] that you, you got to take with you. And then you go past the cupboard, and select all the, all the PPE. You go down to the, the bus stop…. And I think at that point, before you get on the	When asked what happens when you start the software, C replies, when you start the software, first of all you get a phone call to say "We're supposed to be down at the bus blah blah blah whatever time". And then it says, don't forget to bring your safety equipment, which was heap of PPE that you got to take with you. And then you go past the cupboard and select all the PPE. You go down to the bus stop, and C thinks at that point, before you get on the bus, you are breath tested. But just before you are asked a couple of question, you are talking to a person, work colleague. And you work colleague is saying, "Aa, it was a rough night", you know, "been out on the beer blah, blah, blah", and then you get an answer, you get to response to that by saying, "Yeah so was I", or "NO, I had a quiet night at home." And then you select, C selected "Quiet night at home" and then went to the random drug testing. Then you are breathalysed and then you got on the bus and then you go to site.	When starting the software, the user's character gets a phone call, which explains the general situation, and what should take place next. It also points to specific objects he needs to have with him. Then the user needs to move to select the right objects. After this, the user needs to go to the next required specific location, a bus stop. Before the bus stop, the user is talking to a work colleague who is explaining about drinking too much last night. the user is required to response to that by selecting from two answers. He selects the one that says he did not go out drinking but stayed home. After this, the user is tested for alcohol. After this, he got on the bus and went to site.	When starting the VE, the user's avatar gets a phone call, which explains the current situation and what should take place next. It also points to specific objects he needs to have with him. Then the user goes to select these objects. After this, the user needs to go to the next required location. There, a breath test takes place. There is a work colleague who explains he had a long night. The user gets to answer to this from a selection of replies. After replying to this a drug and alcohol test takes place. Then he gets to a vehicle that takes him to site.		

	bus, you're breath tested. Umm… I: For alcohol or…? C: Yeah, alcohol aa… You know, breathalysed. And but before, just before that you're asked a couple of questions, you're talking to a… a person, a work colleague. And your, your work colleague is saying "Aa, it was a rough night", you know, been out on the… on the beer, blaa, blaa blaa. And then you get an answer, you get to response to that by saying… "Yeah, so was I." or "No, I had a quiet night at home". And then you select, well, I selected "Quiet night at home" and… then went to the… selected the… the umm… the random drug testing. [I: Okay]. Umm… Yeah, and then you breathalysed and then you got on the bus and then… then you got to site, and…				
20.	C: When I got to site, this is where I… I wasn't sure where… 'cause I went to the first arrow and that was… that was incorrect, I should've gone, gone to the second arrow.	When C got to site, this is where he wasn't sure where he should've gone, because he went to the first arrow and that was incorrect. He should've gone to the second arrow.	The moment of getting to site was a moment of confusion to the user. He did not know where he was supposed to go. So he went to the first arrow. That was incorrect; he should've gone to the second.	The user was not sure what he was supposed to do next in the location as the first option he tried proved to be incorrect.	When the user got to the next location in the VE, he was not sure where he was supposed to go there. So he went to the first spot that indicated a place to go [an arrow]. This was incorrect. Now he knows he should have gone to the spot which to him is the second arrow.	
21.	C: The first arrow was… like a basic induction with… I think he's the site supervisor said, you know… Gave you a list of things to… to be aware of with heat stress again, and then you went to the, the hut. And… Same deal again, but a little bit umm detailed.	The first arrow was like a basic induction with, C thinks he is the site supervisor who gave you a list of things to be aware of with heat stress again, and then you went to the hut. Same deal again, but a little bit more detailed.	The user estimates that the first place of activity where he goes to is a basic induction where an avatar, possibly the site supervisor, gives him a list of things to be aware of with a specific focus in in the training topic. Then the user goes to the next location where the same information is repeated but in more detail.			
22.	C: And then you had to, had to do a, a test in the hut. I: What sort of a test? C: 'Cause they gave you a list	Then you had to do a test in the hut. They gave you a list of what to be aware of heat stroke, like clammy or hot or sweaty, and you had to select what were these symptoms	At a specific location [the hut] after getting a list of correct terms in relation to heat stroke, the user does a test where he needs to select the right ones.	The user goes to a specific location in the VE to do a multiple-choice test. Before that he is given a descriptive list [symptoms] related to the training topic that		

	of… of what to be aware of for heat stroke, you know. Like… clammy or… or hot or sweaty. And you had to select… you know… what… what were these symptoms of heat stroke. Umm… So that was like, like the test that you did and once you… I [interrupts]: Like a multi [br] multiple choice or…? C: Yeah, there was… It was like… It was… There was maybe a selection of five and three of them were the correct answers, so you just dragged the three… correct answers into a box and… In the… Then you moved on to the next question the same deal again. Once you completed them all, you're, you left the… the hut.	of heat stroke. So that was like the test that you did. When asked if it was like a multiple-choice test, C replies that there was maybe a selection of five, and three of them were the correct answers. So you just dragged the three correct answers into a box and then you moved on to the next question, the same deal again. Once you completed them all, you left the hut.	The words have right and wrong answers in the same collection, and the pre-defined number of correct answers can be dragged into a box. This process is repeated until the user has completed them all. After this, he leaves the hut.	he needs to be aware of. Doing the test requires him to drag the correct answers into a box: this is repeated with each question. When he has completed all of these, he left the test location.		
23.	C: And that's when you… you come to your… first supervisor. Who ran through the… the heat s[br]… I'm, I'm forgetting where I, I… I've come across the umm… the people on the ground, yeah I'm not sure. I: That's OK. C: I'm not sure at what stage that was. But anyway, I went to the, the first supervisor. He runs the [br], down the list of umm… heat stress again, you know "Keep an eye on your, your buddy blah, blah, blah". And then… go to the person, gave me the job. And that's when I go to the… the on-site supervisor… to do the task. And like I say, in between there somewhere there's two instances where I've, I've had to… assist with umm… people	And that's when you come to your first supervisor, who ran through the heat stroke, C is forgetting or not sure where he has come across the people on the ground. He is not sure at what stage that was. He went to the first supervisor. He runs down the list of heat stress again, "Keep an eye on your buddy blah, blah, blah". And then C goes to the person who gave him the job. And that's when he goes to the on-site supervisor to do the task. And in between somewhere there are two instances where he has had to assist people that have collapsed from heat stress.	At this stage the order of stages, or when specific moments took place, becomes unsure to the user. He remembers going to the one person he regards as the first supervisor who gives him a list of things to be aware with heat stress. Then he goes to the person who gives him the job, who he considers as the on-site supervisor. the user approximates that in-between these two moments he also needed to perform specific tasks related to the topic of heat stroke.	The specific order of different stages in the training whole is uncertain to the user. He remembers going to avatars that are associated with specific information and tasks. He also remembers that at some stage between visiting two avatars, he had to assist avatars that were in a bad condition [had collapsed from heat stroke].		

	that have collapsed from… from heat stroke.				
24.	I: So where do you… you, you say that… you have the, like… the software where it starts you having a conversation. Where do you have that actually? What's the place? C: Umm, in the hotel room. I: Aa OK, so you're in a hotel and it's… C: Yeah and the phone rings yeah. I: OK, you're, and it's the hotel, it's like modelled and, and… C: Yeah. I: …it looks like a hotel room and…? C: Yeah, or a donga or something like that yeah, yeah.	When asked in what place the software starts him having a conversation, C replies, in the hotel room. He is in the hotel room and the phone rings. When asked if the hotel room is modelled and that it looks like a hotel room, C says yes, or a donga or something like that.	To the user, the place where the beginning scenario takes place looks like a hotel room, or more specifically, a donga.			
25.	I: So do you walk to the bus station or are you there all of a sudden or…? C: You walk out the room, and I can't… think when you get out of the room, I think it just might go s… Oh that's right. When you get out of the room, it loads up again and then you had another scene. You know once you do… do each scene… you know like… once you've done the breath testing. You do the next scene.…umm, which is… I can't remember who got on to the bus or you're getting on the bus, but… Each time you've done the scene, it loads another scene in. So you complete that scene… And then you, you move on to the next one. 'Cause it keeps loading. Each time you move forward it loads again.	When asked how C got to the bus station, did he walk or was he there all of a sudden, he explains that you walk out the room, and he thinks when you get out of the room, it loads up again and then you had another scene. Once you do each scene, like once you've done the breath testing, you do the next scene which is, he can't remember how getting on the bus went, but each time you've done the scene, it loads another scene in. So you complete that scene and then you move on to the next one. 'Cause it keeps loading. Each time you move forward it loads again.	First the user remembers that getting from a particular place to another takes place by walking between them or just going, but then he remembers that when he got out from a room: it loads up again and then you have another scene. Moving takes place from a scene to another. When you complete that scene, it loads another scene in, and you move on to the next one.	For the user, transition to a location takes place in scenes, and alternates between user agency and software controlling what takes place: you do each scene, and after you complete that scene, it loads up another one, and you move on to the next one.	When asked how the user gets to a specific location in the VE, he explains that after doing each scene, the VE loads in another one: you complete that scene and then you move on to the next one. It consists of VE control and user action.	The intentional object here is something related to 'transition' or 'movement'. Also, he uses "walking" instead of e.g. "moving the avatar". When you have reached a visible line for example in Call of Duty Black Ops III, the game takes the control away from you and takes you to a cut scene, moving the story forward. This is a regular structure in contemporary games: mission task (player has the control) -> cut scene (game has the control -> mission task (player has the control)… This is an important looking MU, which might even work as the starting point for the general structure of the experience.
26.	I: So does anything happen in the bus or, or…? Do you actually	When asked if anything takes place in the bus or does he see going to site, C replies that you are sitting in	The user remembers you are sitting in the bus, things passing by behind the window, but he is not sure if	In one scene, the user is sitting in the bus. He does not remember anything special happening in the bus.		C's attention is in doing and anticipating what task is up next. He was not interested in specific things that either

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	see going to the… site, or…? C: Yeah, yeah, you're sitting in the bus. I can't remember if anything's happening in the bus. [lp] Yeah no I'm not sure if there was anything happening in the bus, I can't remember, but… I: But you can look out the window and stuff…? C: Yeah you can see scene[br], you can see things passing by as you, sit in the… I: OK. I: How did that feel? C: Aa, it was just… just going through the program you know… with, you know, what's the next task? I: Yeah. I: So it didn't take long or…? Like the sitting at the, in the bus or…? C: No. I: OK. C: No.	the bus, but he can't remember or is sure if anything was happening in the bus. When probed if you can look out the window, he says you can see things passing by as you sit. For the question how did it feel, he says it was just going through the program, with "what's the next task?"	anything else takes place in the bus. Also the duration of the bus ride didn't take long. Sitting in the bus felt just going through the program, with "what's the next task?"	When asked what he sees, he remembers seeing things passing by. In general, he just felt going through the program, thinking, "what's the next task?"		took place or were visible in the bus scene. Just "being there", as in just travelling as a spectator, did not engage his awareness. His intentional act is aim-oriented ("going through the program") and task-oriented ("what is the next task?"): the mode of givenness, instead of perception, is anticipation.
27.	C: I guess that the bus scene is… And if it, if that program was for an induction… that's part of, you know, I, I guess it's trying to umm simulate every step… of the process of getting to work. Before you… you actually… start work. So if you were a novice going on to site… and you, and you did this training in the office you would see that, you know, you're a… umm… You would leave your, your donga or your hotel room. Then you… I: What's a donga? C: Aa, just like a… like a demountable hut or an ATCO hut, you know. I: One of those you can take with a truck or…? C: Yeah, yeah, they can be transportable yeah.	C thinks the bus scene, if that program was for an induction, that's part of trying to simulate every step of the process of getting to work. Before you actually start work. So if you were a novice going on to site and you did this training in the office you would see that you would leave your donga (demountable hut or an ATCO hut) or your hotel room. It's just taking the new person through each step before they get to work, from their room to the meeting place to the bus, to the security gate, the on-site supervisor or an induction or HSC rep, whoever does the on-site induction.	The user evaluates that the purpose of the program and the person using it are related. There are sections that can be created as scenes that try to simulate every step of the process of getting to work, before you actually start work. Steps are made of different spaces, objects and people that are related to the goal of the program, for example induction.	The user evaluates that the scene is part of simulating every step of the process of getting to work in that specific context. The steps are made of different spaces, objects and people that are related to the goal of the program, for example induction. This will convey to a novice what the whole process will be like from the hotel room to the site.		

	I: OK, that's a new word for me, so. C: Yeah, so I guess umm… It's just taking the, the new person through each step before they get to work, you know, from their, their room to the meeting place, to the bus. To the security gate. You know the… on-site supervisor. Or an induction or… HSC rep, whoever does the on site… umm, induction.				
28.	I: So aa, do you know if the… like the software, does it model an actual, actual place that you guys have or…? C: Umm… I: Like have you been to… a place that resembles that? C: I, I guess it could resemble the umm… the gas plant, could kind of resemble the onshore gas plant you know. Just with the… some of the structure there, that it… umm… I wouldn't recognise anything only just because of the… I just know what the onshore gas plant structure looks like, and this, this structure kind of looked… similar, but I wouldn't say it was… exactly… I: Can you describe that? C: It… It's mainly… umm like umm… large beams, large poles of the ground. And then you got your, your piping block, piping racks if you like. And then you got your, your pipes running across, across the top. And beside it is just vessels you know, there's a couple of vessels around the place and… Yeah and a couple of tanks.	When asked if C knows if the software models or resembles an actual place, he thinks it might kind of resemble the onshore gas plant. He knows what the onshore gas plant structure looks like, and this structure looked like similar, but not exactly. When asked to describe the gas plant, C describes it mainly as large beams or large poles on the ground. Then there is piping block, or piping racks, pipes running across the top. And beside there's a couple of vessels around the place, and a couple of tanks. The vessels could be holding air or nitrogen or some sort of process fluid. And the tanks could be waste oil or even water – although he is not sure if they still keep water in them onshore.	When asked if the training program might model an actual place, the user is guessing that based on some structures it could resemble an onshore gas plant. He knows what that looks like and there are some structures that look similar, but not exactly the same. The user describes specific objects of a gas plant, remembering them from past. He remembers the objects, but cannot say for sure if they hold the similar properties anymore.	When asked if the software models an actual place, the user thinks it could resemble a location [onshore gas plant]. He knows what its structure looks like and this structure looked similar but not exactly the same. When asked to describe it, he describes individual elements and their location in the structure, and other objects in the proximity.		The definition of 'virtual'. There is a mission in Black Ops III which takes place in future Singapore. If you've been to Singapore, you get the overall impression that it is Singapore, although it does not look exactly the same.

	I: So the vessels being, it's onshore like…? C: Yeah, vessels. Like umm… that could be… holding air or nitrogen or some sort of… process fluid. And the tanks could be, you know, waste oil or… or even water. Whether I don't know [whether they?] still water [them?]… onshore but, you know. Waste oil or… or some sort of waste product.				
29.	I: Was there anything… apparently you've been to a… an actual plant? C: Yep. I: Anything that caught your eye that… this is ridiculous or it doesn't look the same or it's out of… picture? C: Umm, no. I-I… And I wasn't even thinking down that line, you know. It's just… it's just umm… I knew it was animated the start with. And it was… I mean, I-I, I guess if I… if I was doing the training… to umm… criticise the training I guess I could've found plenty of things wrong with it, but I wasn't… because it's animated and, and because I know it's some sort of training program. It's just go with the flow, you know. Go with what, what's umm… trying to be taught. Another method of… of learning.	It becomes apparent that C has been to an actual plant. When asked if anything in the VE caught his eye as something that did not seem to belong there or was off picture, he replies that he wasn't even thinking down that line. He knew it was animated the start with. He's then guessing that if he was doing the training to criticise the training, he could've found plenty of things wrong with it, but he wasn't, because it is animated and because he knows it's some sort of training program. He's just going with the flow, with what is trying to be taught. Another method of learning.	As the user has been to a similar location in real-life, he is asked if there was anything that caught his attention as being wrong in the VE. The user explains that he wasn't even thinking down that line: as he knew the VE was animated and some sort of a training program, he was focusing on doing the training, going with the flow. To him, it was another method of learning. If he had been doing the training to criticise it, he could've found plenty of things wrong with it.		
30.	I: So based on your expectations, how did you find that like, in, in general now after you've used it? C: Umm, yeah I-I found it… reasonably… good. Wouldn't say it was, was excellent, but i… yeah it was, it was OK…. And like I say	When asked how C found it to meet his expectations now that he's been using it, he is saying it was not excellent, but reasonably good. He thinks that with some that's new to a site, it would give you each of the steps and maybe some of the expectations you may find if someone was having heat stroke or was collapsed.	The user expresses that doing the activities in the virtual reality type situation, might help to initiate a more active and useful behaviour instead of a less productive one if a similar kind of a situation happened in the real. Doing the virtual reality training might also help you to know the steps you should be taking. And even if you, like the user he,	When asked how the VE met the user's expectations after using it, he says it was not perfect, but something that could give a new person the steps and some of the expectations that are involved in such a situation. Although one might not remember the steps exactly, one would have the basics of what to do.		It is this general "familiarity" or something similar that is mentioned here again. Some other participants have it too. Check if this might be part of the general structure for this group and in what form.

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with, with some that's new… To, to say, a site. It would give you, each of the steps and… and maybe some of the expectations you would… may find if someone was… having heat stroke or… or was collapsed.… C: I guess that's that… That is the better part of it, is that the people that have collapsed, you are actually going to the process of, of moving them to the shade. Giving them… a drink. Cooling them down. Where is if you'd… if you hadn't come across that at, you know, virtual reality… type situation and it happened, in real. Maybe you wouldn't do anything. Maybe you'd just leave them lying on the ground in the sun, not realising you had to give them water… and, and just, b[br], yeah probably not even call the medic. You know, just go running around trying to find someone to help ya. Or run around trying to find someone that would umm… know what to do. Where as by doing the virtual reality part of it, you, sort of… you're head of the game anyway by knowing… the steps that you should be umm… umm, should be doing. Well some of the steps anyway that you should be doing. Even if you don't remember, I can't remember… every single step that… that I had to do, but, you know… I knew the basics of, of what to do.	He thinks that is the better part of it, that the people that have collapsed, you are actually going to the process of moving them to the shade, giving them a drink, cooling them down; where as if you hadn't come across that at, virtual reality type situation and it happened in real, maybe you wouldn't do anything. Maybe you'd just leave them lying on the ground in the sun, not realizing you had to give them water and probable not even call the medic. [Instead you would] just go running around trying to find someone to help you, or know what to do. Where as by doing the virtual reality part of it you're head of the game anyway by knowing the steps that you should be doing – well, some of the steps that you should be doing. Even if you don't remember, as he can't remember every single step he had to do, but he knew the basics of what to do.	does not remember every single step, it is better you know the basics of what to do.	Doing the steps of the process in the virtual reality type situation might also guide you to perform the right kind of action in a real situation yourself instead of having to run to other people for help.		

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31.	I: So, can you remember aa… just you know… you, you mentioned that there's at least two supervisors? C: Yeah, there's the initial supervisor, which I call the site supervisor. Or the plant supervisor. And then you go to, before you get your job… There's another supervisor, which is the leading hand. I: OK, what is he doing? C: He… he just gives the umm… the task. The first supervisor… gives you the location of the job. And the second supervisor… gives you the task. Umm, which is the scaffold tubes. I: The actual task. C: Yeah.	When asked more about the two supervisors in the virtual environment, C describes that in the training environment there is the initial supervisor, which he calls the site supervisor or the plant supervisor. Before you get your job, there's another supervisor, which is the leading hand. The first supervisor gives you the location of the job. The second supervisor gives you the task, which is the scaffold tubes.	The user assigns specific titles to the encountered supervisor avatars. The first supervisor he meets is called the initial or the site supervisor. The next one who gives the actual task he calls the leading hand. The user also explains what tasks they give him.		Does C designate these titles to the supervisors, as I do not think they were called that directly? Is it based on their position on the timeline and with events occurring?
32.	I: And between you… basically have to walk where they are or…? C: Umm, I think that was the… the green arrow, I think the, the green arrow took you to [smiling] I: [laughing] The green arrows, they, they seem important. C: Yeah, yeah. I: So they kinda directed the…? C: Yeah. I:…thing? C: Yep. I: OK.	When asked how C moved between the supervisors, he thinks it was the green arrow that took you to. When probed more if they sort of directed the thing, he agrees.	For the user, a specific object, the green arrows, took him around the virtual environment.	When asked if the user had to walk to a location or how he got there, he remembers the green arrow that "took you to".	When asked how the user moved in the VE, he thinks specific signs [the green arrows] directed his navigation.	
33.	I: So there were the supervisors, and then one guy…? C: Umm, at the start of it I guess he was the HSE… person, 'cause he did the initial… I [interrupts]: HSC? C: Umm… Health and Safety… Environment representative. He did the umm…the initial… welcoming on to site. You know… I: In the hotel or…? C: No, at, when you… got off the bus and…	When asked more about the different characters in the virtual environment, C is guessing one was the Health and Safety Environment (HSE) representative. He did the initial welcoming on to site when you got off the bus and on the plant. Then when you went to the hut to do your testing there was someone else there, but C doesn't know who that person would've been. He is guessing it would've been a HSE person as well. And then prior to that before you got on the bus there was the person giving you the breathalyser. C is not sure if the hotel room phone call was from a friend or	For the user, many of the avatars he encountered have at least an estimated work title even if it was not made explicit. This was determined in some cases by avatar's actions, or the moment and space where they were located in the virtual environment.	The user is guessing the possible role of a character in the environment through describing that person's task. In a specific location there is a character whose specific title is guessed. Another character's task is described but not the characters role. In one case the use is not sure who was the avatar who called him.	For the user, many of the avatars he encountered get at least an estimated work title even if it was not made explicit in the VE. In some cases it is affected by what the avatar does, or the moment and space where they were in the VE.	The question here is, how is the task and character correlated? Does the task and location define the character if a definition is given?

	on the plant. Umm, so he went through that. And then when you went to the… the hut, to do your testing. There was someone else there I don't know… who that person would've been they… they would've been a HSE person as well I guess. And then prior to that before you got on the bus there was… the person giving you the umm, the breathalyser. And… in the hotel room phone the call was… I'm not sure if that was from a friend or… or from a supervisor saying, you know, where you got to meet.	from a supervisor saying where you got to meet.				
34.	I: So the colleague [before the breathalyser], did he come with the bus or did he stay at the hotel? C: Umm… I: Because of a too long night? [laughter] C: I'm not sure… I'm not sure what. I'm not sure if they animated that as well. I-I'm… I don't, I can't remember if I thought "Well, he's not gonna get through" or if I did… I, actually saw that he, he did blow out right. I think he may have blown over to give you that… impression that, you know, if you, if you drink too much well you're not gonna get on to site. So… I: Yeah, OK. I: So it's basically a moral test at the same time. C: Yeah. [smiling]	When asked about if the colleague from the hotel also came in the bus. When inquired, because of a too long night, C is not sure, and he is not sure if they animated that as well. First C can't remember if he thought, "Well, he's not gonna get through" or something else, but then he remembers he actually saw that he did blow out right. C thinks he may have blown over to give you that impression that if you drink too much, well, you're not gonna get on to site.	The user is not sure if the avatar from the hotel was in the bus: he cannot remember if his transition was animated. Based on the previous arguments by the colleague of a too long night, the user thinks he might have thought the colleague avatar will not be allowed to work. Then he remembers he actually saw him blow over. To the user, this was to communicate that after drinking too much you will not be allowed to go to work.			This colleague's presence carries on even if his animated appearance is not there. His actions create an effect in C to think.
35.	I: So can you…? Umm… you know, describe it more… while you were doing the actual task of the [br] moving the scaffold? How did it work, like the actual using	C is asked to describe more about doing the task of moving the scaffold, how did it work, actually using it with the computer. C says that moving around was with the arrow keys. He is not sure if both arrow keys worked but he just used one. He used the forward arrow key and	The user was using the controller based on what felt easy. Even if the movement felt uncanny or slightly unorthodox, such as turning only to one side with the avatar, he still managed to perform the task. The user does not remember exactly what controllers did	The training environment offered options to move around with arrow keys or the mouse. The user chose to use two arrow keys to move around in addition to the mouse button to select because this combination felt easy to him. He did this even if he had to go	The user remembers that moving around took place with arrow keys. Because he did not use all of them, just the one, he is not sure if both of them worked. Even if moving took place perhaps in a slightly unorthodox way, that's what he did and it got him where he wanted to pick up an object.	C does not remember specifically how the controllers worked, but he remembers using them slightly oddly but still being able to perform. He also chose his way of performance because it felt easy. Based on this, we can't predict what the user will find easy or what the user will choose.

it, with the computer? C: OK, the umm… Moving around was with the… the arrow keys. Umm, move forward and… I'm not sure if, if both arrow keys worked but I just used one. I used the forward, the forward arrow key and the, the left one. And if I had to go around the circle that's what I did but, but, that [sort of?] got me… to where I wanted to pick up the… scaffold tube was right next to the… umm, next to the ute. And then… C: I can't remember using the arrow key to pick up the… tubes, I think when I got to the ute, the scaffold tube went green to say "Yep, you could pick it up" and I think I selected it with the, the mouse key. The-the left hand mouse key. And then umm [lp]… I can't remember if… if I moved the mouse to take the scaffold tube over, or if I used the buttons again. But, either way, it, after I'd picked up the tube, I went over to the rack. Once you got close to the rack… and umm… or within the vicinity of the rack. It umm… said "drop", or "lower" or something like that and selected with the mouse key again and umm…	the left one. If he had to go around the circle that's what he did, but that got him to where he wanted to pick up the scaffold tube that was right next to the ute. C doesn't remember using the arrow key to pick up the tubes. He thinks when he got to the ute, the scaffold tube went green to say, "Yep, you could pick it up". he thinks he selected it with the mouse key – the left mouse key. And then, he can't remember if he moved the mouse to take the scaffold tube over, or if he used the buttons again. Either way, after he'd picked up the tube, he went over to the rack. Once you got close to the rack or within the vicinity of the rack, it said "drop" or "lower" or something like that, and selected with the mouse key again.	what, but he was able to perform the task.	around in a circle. This got him to where he needed to pick up the object of the task, a scaffold tube, which was located next to another object, the ute. A green colour showed the user that the object, a scaffold tube, was something to be picked up. the user thinks he might have selected it with the left mouse key. the user does not remember if he had to use the arrow keys or the mouse to move the tube to its place, the rack. When in the vicinity of the rack, another indicator showed him that he could leave, "drop" or "lower", the tube there.	When getting close to a location to an object [the ute], his target object [the scaffold tube] went green to indicate you can pick it up. He thinks he selected it with the left mouse key and not the arrows. The user is unsure what controls he used to deliver his object to the next location, but he remembers that whilst close to the target location, there was a text on the screen that indicated he could leave it there. He remembers selecting it again with a mouse key.	
36.	I: Does it say like, what key to press or anything? C: At the start of it, it went through all of that but… I remember the umm… The forward… yeah, the arrow keys on the computer and I remembered the mouse… I think you could	When asked if it said anything about what key to press, C says it went through all of that, but he thinks you could move backwards and forwards with the mouse, but he found it easy with the key to move around and just select with the mouse – the mouse button.	When asked if he was given instructions what key to press, the user says the VE went through all of that in the beginning. He thinks you could have moved with the mouse, but he chose the other option, as it felt easy to move with the buttons and select with the mouse button.			

	move backwards and forwards with the mouse but I found it easy with the key to… to move around and just select… with the mouse. With the mouse button.				
37.	I: How, how comfortable was the, the, using the thing, in-in, overall. C: Umm, yeah I found it all right. It was, took a little bit of getting use to but, you know, that's just… Like all those videogames [word missing] once you know the [laughter] know the keys well you can sort of move around a lot, a lot quicker.	When asked how comfortable was using the environment, C says it took a little bit of getting use to, but it's just like all those video games: once you know the keys, you can sort of move around a lot quicker.	For the user, comfortable use means getting used to. In a similar way as it is with video games, once you know the keys, moving around becomes a lot quicker.		
38.	I: Yeah. You said… in the email that you had some problems with the software? C: Initially I… when I loaded it up the first time, when P loaded it for or showed me how to launch it… Umm… I didn't have any sound. And umm… And then when I got back a couple of days later I got P to launch it for me again and all the sound was there. So I don't know if it was… that my computer didn't have any sound to start with… and then I set up the sound. And then when I shut it down over night… and come back the next, next morning or the [br] it was all loaded up on I'm not sure but… Either way, I did not have sound to start with and then… second time I did it… there was sound there, so I just… went through the umm… went through the process of doing the… training.	C had initially mentioned he had some problems with the software. When asked about this, he said that initially when he loaded it up the first time, when P [real name removed] showed him how to launch it, he didn't have any sound. And then when he got back a couple of days later, he got P to launch it for him again and all the sound was there. So he doesn't know if it was that his computer didn't have any sound to start with. And then when he shut it down over night and came back the next morning, it was all loaded up. He didn't have sound to start with and then the second time he did it, there was sound there. So he just went through the process of doing the training.	The user had problems when opening it the first time: he did not have any sound. A couple of days later, he got another person to launch it for him and the sound was there. The missing sound is still a mystery to him, but he is guessing that shutting down the computer for the night might have helped. Absence of sound made him postpone doing the training, but as he got the sound, he went through the process of doing the training.			Open mystery with the sound (cf. Gerrard)
39.	I: So apparently it uses sound, like…?	When asked more about the sound, C says you don't need	Computer sound problems and the reason to do the	The user explains that sound was not necessary for doing it,		This MU and the previous are very much connected but

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	C: Well, I need, you-you, you don't need the sound to do it, but you need the sound to do the induction part of it. Aa, not the induction, the umm… how they describe… I: So it's, it's spoken? C: Yeah, what to, what to do. C: And I didn't… I think I probably could've done it without the sound, but I didn't wanna… because I was doing it for someone else. I didn't want to… muck it up. 'Cause I though it was your program. I: [laughter] C: I didn't wanna… I didn't wanna muck it up and then… umm… not to be able to get back into it, so I never, moved forward from… from when they were talking about how the umm… how it worked. I: Yeah. C: So once, once I got sound and I… I knew how it worked…	the sound to do it, but you need the sound to do the induction part of it, which is spoken what to do. C thinks he probably could've done it without the sound, but he didn't want to muck it up, because he was doing it for someone else. He thought it was the interviewer's program. He didn't wanna muck it up and then not be able to get back into it, so he never moved forward from when they were talking about how it worked. So once he got sound he knew how it worked.	training prevented the user completing the training at first.	but it was needed for the induction where they explain what to do. He thinks he probably could have done it without the sounds but he thought it was the interviewer's program and he did not want to muck it up and not being able to get back into it. Not having the sound prevented him moving forward from the initial stage that introduced how the VE worked. Once he got the sound, he knew how it worked and could continue.		emphasise different things around the object of 'sound'. Also, doing it and not doing it was motivated by a possible interview,
40.	C: Or actually umm… I think you did need sound for the initial one, thinking about it now, 'cause that's the phone call. The phone call says umm… yeah actually there is talking through it, yeah the phone call says, umm… goes… that's what… what's your umm… colleague talks about is umm… picking up your PPE. And I think there was talk, talking down, I think there was talking all the way through it actually thinking about it and then… Your response was umm… umm… by selecting… a couple of different, different answers. Yeah. I: So the spoken sound weren't like…	C remembers suddenly that actually you did need sound for the initial one, because that is the phone call. The phone call says, C remembers more that actually there is talking through it, the phone call says or your colleague talks about picking up your PPE. And he thinks there was talking all the way through it actually thinking about it. Your response was by selecting couple of different answers. When asked if the spoken was also as text, C thinks or is fairly sure there was text there as well.	An event [the phone call] that took place in the VE makes the user remember that sound was actually needed in the training. He remembers there was actually talking all the way throughout it and it gave him information. He selected his response from different answers. The user is not sure if the spoken was also in text, but is fairly sure it could have been.			

	it wasn't also as a text or…? C: Umm yeah, I think it was a text there as well. To umm… like… yeah I'm fairly sure there was a, was a text there.				
41.	I: Did it have any other sounds, like the environment when you are at the plant or, do you remember? C: Mm no, I can't remember. There might've been a sound on the bus but I can't remember anything… I can't, no I can't, I don't think there was… when… within the plant itself. I: Would you say it's… it would be important to have that like, is there any distinctive things…? Are there distinctive sounds that you, kinda, would need? C: Umm, if it was… a… a full induction, yeah you will go through the sounds. You, you wouldn't need the sounds for… for doing the heat stress training. But if you're doing a full induction, you, you'd need to know the sounds for hearing protection et cetera. Like that, you know. I don't know if that's… if that… have noisy environments… for you to recognise it. You know, this is where you should be wearing your hearing protection and you, you move over to the… the smoko area and it's nice and quiet and you don't need your hearing protection, I'm not sure if there's training like that. But in this case I can't remember there being any, any noise or anything. Yeah.	C is not sure if there were other sounds in different sections of the environment such as the plant. There might have been a sound on the bus, but he can't remember anything, within the plant itself. When asked if C thinks it would be important to have distinctive sounds, he says if it was a full induction you will go through the sounds. You wouldn't need the sounds for doing the heat stress training. But if you are doing a full induction you'd need to know the sounds for hearing protection etc. He is not sure if that would be needed to recognize noisy environments. In a way that, this is where you should be wearing your hearing protection and you move over to the smoko area and it's nice and quiet and you don't need your hearing protection. He is not sure if there is training like that. In this case, he can't remember there being any noise or anything.	When asked if the training had any environmental sounds, the user vaguely remembers there might have been at one specific location but not in another. When asked if he thinks the presence of distinctive sounds would be important, he says in a full induction you would go through the sounds. For doing this particular training he does not feel the sounds are important.		C thinks about distinctive sounds as something related to noise.
42.	I: Did the guy when he… he	When asked if the guy who collapsed made a	The user says there was no sound related	When asked if the avatar that collapsed		This is slightly vague, but in the light of other MUs that

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	collapsed, did he make a sound? C: No… no. That's part of the recognition.	sound. He says no, that's part of the recognition.	to the safety instance he needed to be aware of, as it was part of the recognition.	made a sound, the user does not think so, and experiences it to be part of the recognition.		refer to being aware of the collapsed colleague, this reply is treated so that he means you were supposed to recognize by seeing the symptoms.
43.	I: OK, this… one question umm… Was there anything when you were using the environment that you wanted to do but couldn't? C: Umm… When I was in the hut… I-I think I did the questioning… 'Cause it, it's finding your way through it again, and when I… You-you've done… Like I said, I didn't do the first induction I went straight to the hut. Then I realized, I wasn't supposed to be there so I went back and did the induction. Once I've done the induction, went, went in to the hut. I went to the computer, and the computer is where you do your… your exam. So I did the exam first. And then as I'm, I'm leaving it, it gives you targets to, and it says, I think the targets are talk. So as I'm leaving I see this target pop up and I, I press the talk. And it's the lady, the HSE lady… giving the lecture on heat stress. And then that's when I realize that… I should've gone to her first, asked her… to talk, and give me the… the umm… instructions. And then go to the umm… the computer and do the test. And then… then I could leave. So I think I had to go through the test again… to be able to leave. But… Yeah but… I think I did the… the test twice.	C is asked if there was anything using the environment that he wanted to do, but couldn't. He says that when he was in the hut, he thinks he did the questioning, 'cause it's finding your way through it again. He didn't do the first induction; he went straight to the hut. Then he realized he wasn't supposed to be there so he went back and did the induction. Once he'd done the induction, he went in to the hut. He went to the computer, and the computer is where you do your exam. So he did the exam first, and then as he is leaving it, it gives you targets to, and it says, he thinks the targets are talk. As he is leaving, he sees this target pop up and he presses the talk. And it's the HSE lady giving the lecture on heat stress. And then that's when he realises that he should've gone to her first, ask her to talk and give him the instructions, and then go to the computer and do the test. And then he could leave. So he is thinking that he had to go through the test again to be able to leave. So he is thinking he did the test twice. When asked if he thought it was mandatory to do it in a certain order, C says no, it didn't stop him doing the test first.	When asked if there was anything in using the environment that he wanted to do, but could not, the user remembers he was allowed to perform the induction sequence in the wrong order. He remember going directly to a specific place to do a specific activity. When he was about to leave that area, a pop up draws his attention and he presses 'talk'. One of the characters gives him more information, which makes him realize he has done things in the wrong order, and that he should have talked to this character first. This also makes him to realize what is the order of the whole sequence he has to perform, and that he has to do it in a certain order to be able to leave the place. Still, the fixed sequence did not prevent him of doing one of the steps before it was due.	When asked if there was anything in using the VE that he wanted to do but could not, the user describes performing an activity in a certain location in the VE. When he left this location, there was a popup that required his attention. This brought up a virtual character with a specific title to inform him about the topic of the training. This made him realize he had done the activities in the wrong order. This also made him realize what the order they should have been performed. This made him think he did one of the activities twice.	When asked if there was anything in using the VE that he wanted to do but could not, the user describes performing an activity in a certain location in the VE. When he left the location, an event occurred that did not fit the logical sequence of the experience. This made him realize he had done the activities in the wrong order, and one activity twice. This way he realized the correct order the activities should have been performed.	The environment requires proceeding step by step, but still allows proceeding without following pre-defined agenda. This confused C.
44.	I: So it's mandatory… to do it in a certain order or…?	When asked if he thought it was mandatory to do it in a certain order, C says	As nothing prevented him doing one of the activities before it was due, the user does not think it was mandatory			

	C: Umm… No, yeah, no it didn't stop me umm… Didn't stop me doing the test first.	no, it didn't stop him doing the test first.	to do things in a certain order.		
45.	C: But I think… I think what you do is you… you move around the area. And that's when the green arrows come up and that's when you got a task to do. I [talks over]: I have to ask about the green arrows. So how do they appear like, do they… C: They're just like a… umm, you know like those… "sign here"… stickers. It's just like… one of those, a solid arrow. That you see sticking up or. I: OK. So they are like pointing the ground or they are in the ground or…? C: Umm… No I think they're just vertical… arrows. Just to… to identify that there's a task to be done here. I: So like, "walk here"? C: Yeah, and then, as you get closer it comes up with a… in the HSE's… umm… case it… umm, says "talk". And then she gives the lecture. Can't remember what, what it was at the computer. But… umm… Whatever it was anyway it was easy enough to decide that all you do is answer questions.	C thinks what you do is you move around the area, and that's when the green arrows come up and that's when you got a task to do. The interviewer asks how the green arrows appear. C says, the arrows are just like those "sign here" stickers. It's just like one of those – a solid arrow that you see sticking up. When inquired are they pointing the ground or in the ground, C thinks they are just vertical arrows, to identify that there's a task to be done here. And then as you get closer it, in the HSE's case it says "talk". And then she gives the lecture. C cannot remember what it was at the computer, but whatever it was, it was easy enough to decide that all you do is answer questions.	The user remembers that you find green arrows by moving around the area. When asked how the arrows appear, the user describes them as those "sign here" stickers, a solid arrow sticking up. When asked are they pointing something or placed in a certain way, the user describes them just as vertical arrows to identity that there's a task to be done here. He gives an example where when you get closer to an arrow, it gives you an option to "talk". Then you get more information.	The user described that when you move in the VE, specific signs [the green arrows] come up informing you there is a task to do. The signs look like "sign here" stickers, to identify that there's a task to be done here. When you approach them, an option to interact appears, and you get more information.	The arrows do not point, but they work as signifiers. Could it be anything that gets the users attention? In the Farming Simulator game, you don't have arrows, but question marks and other icons that hover above the ground to indicate there is something to do. The stand out from the background as unordinary objects that do not exist in the environment as themselves.
46.	I: So basically you kinda by-passed the first lecture and, and did the test first? C: Yeah. I: And umm… you had to go back to listen to the lecture. C: Yeah, that's right, yeah. I: OK. I: I guess that… could be… like, in the real case… would be impossible? C: No, yeah it would be	The interviewer comments that C sort of by-passed the lecture and did the test first. C agrees with this. The interviewer follows up by noting that C then had to go back to listen to the lecture, which C says is right. The interviewer comments that this would be impossible in the real case, to which C says that it would be impossible, because they'd be waiting for you at the door, you know, "come in" and, "I'm expecting five	The interviewer reflects the user doing the steps of the induction in the wrong order, and if that would be impossible in real life. The user says it would be impossible, as there would be someone at the door expecting a certain amount of people, welcoming in, and giving a talk after which one would do the test before going to the next step.	The interviewer reflects the user doing the steps of the induction in the wrong order, and if that would be impossible in real life. The user says it would be impossible, as there would be someone who knew how many people were coming, welcoming them and directing them with the activities.		Interestingly, C did not feel a fixed order was imposed on him (earlier MU) although he clearly notes there was a fixed order he needed to maintain. This would be impossible in the real life as there was a person managing the induction. Cf. Linda and Barry: "it would be impossible in real-life".

	impossible. This… yeah, yeah. 'Cause they'd be waiting for you at the door, you know, "come in". I: Yeah. C: This is, "I'm expecting five people" you know… Give a lecture and then this is "you have to do your test before you"… I: And the one dude is already doing the test there on his own. [laughter] C: Yeah.	people". Give a lecture and then "you have to do your test first before you…".			
47.	I: So there's anything like…? On your opinion how would you change… what, what would you change in the actual software? C: Umm… With, with the software I'd give more directions on… on what was expected, you know, like the tasks for instance, you know. Just… maybe in the umm… the preamble before it. Just… Give a bit more of a description on… on what was expected. Maybe in that. But, it wasn't difficult like I say. It… You just… First time it's wrong, you just do it again and then… just keep doing it 'til you get it right. So it's… probably clarity is, is probably… could be a little bit better. But… But in not having that clarity didn't stop me… performing… the tasks. I: In what way would you say it wasn't clear? C: Aa just what I was expected to do. Like I say, going into the hut, you know. Understanding I had to listen to, there was a lecture that I had to listen to first before I did the test. Going down… to site, and then,	When asked about what C would change in the actual software, he says that with the software, he'd give more directions on what was expected like the tasks for instance. Maybe in the preamble before it. Just give a bit more of a description on what was expected. But it wasn't difficult. First time it's wrong, you just do it again and then just keep doing it 'til you get it right. So probably clarity could be a little bit better. But not having that clarity didn't stop him performing the tasks. When asked in what way he would say it wasn't clear, C says just what was expected was not clear. For example going into the hut. Understanding there was a lecture that he had to listen to first before he did the test.	When asked what the user would change in the VE, he says he would make the expectations more explicit. What was expected was not clear, that there was something he needed to do first before doing something else. Still, the aim being unclear did not make it difficult or prevent him performing the tasks: in case you got it wrong, you just did it again until you got it right.			What is expected is not clear.

48.	C: 'cause I thought my task was… Sorry, I should go back in… and say that umm… Part of what you're supposed to do is stay hydrated as well. And you stay hydrated by, I think it's pressing the Escape key. So… press the escape key, you can have a drink, press the Escape key, have another drink. So that's what I thought my task was, is to… to load scaffold tubes and remain hydrated. So each time I took a scaffold tube, I pressed the "Escape" and had a drink.	Because he thought his task was… C says sorry, he should go back in and say that, part of what you're supposed to do is stay hydrated as well, and you stay hydrated by, he thinks it is pressing the Escape key. So, press the Escape key, you can have a drink, press the Escape key, have another drink. So that's what he thought his task was, to load scaffold tubes and remain hydrated. So each time he took a scaffold tube, he pressed the Escape and had a drink.	The user remembers a specific task was part of what you were supposed to do. A specific button was assigned to this task, which he had to press once in a while. This task took place at the same time with another task and he thought his task was the activity sequence of these two tasks. So that's what he thought his task was, to load scaffold tubes and remain hydrated. So each time he did a specific part of task 1 he also pressed the assigned button to perform task 2.	Part of what you are supposed to do has a specific function, and a button that you need to press to do it: press the button and the activity takes place. He thought this activity, which took place together in sequence with another activity, was his full task.	The user explains that there is one other part that you are supposed to do to that is related to maintaining positive state for your character, and you doing it by pressing a key in certain duration. So he thought his task consisted of these two parts, and he mapped their sequence and performed it accordingly with the buttons.	It is as if he had found individual pieces that together play the correct melody. There is already the component of staying hydrated here, which corresponds to the topic of the training. That might have confused him, and made him not to expect you had to make someone else drink too. He took what was only a partial activity as the whole task. What is the smallest denominator of "a task"? "You are supposed to stay hydrated as well" + a health bar + "that's why I though my tas was to load tubes and remain hydrated". This would have easily been missed with predetermined questions about the software. This realization hit me like 1000 volts: the reason he failed the test could be because he was playing the game of "keeping his character hydrated" as the environment directed that action and behavior.
49.	I: So is there anything that indicates that you are staying hydrated? C: Aa yeah, there's a little bar. To say… that you, you're not hydrated. And then when you have a drink, it goes blue to say you are hydrated.	When asked if there is anything that indicates that he is staying hydrated, C says there is a little bar to say that you are not hydrated. Then when you have a drink, it goes blue to say you are hydrated.	When asked if there is anything that indicates the state of his character, the user says there is a bar shape that communicates it with different colours.	When asked what indicates the status of his character, a shape [health bar] in the user interface changes colour to indicate you are not hydrated. When you take a drink, the bar turns to blue.	When asked if there is any other part that indicates his state in the VE, the user says there is a shape [a little bar] in the user interface that communicates it with different colours: it turns to blue when you perform the right action [have a drink].	
50.	C: Now I thought that was my task, you know, just… stay hydrated. Then, then I failed because my work colleague collapsed and I thought, "OK what's happened there?" so, because I had already gone… and done one… umm… response or taken a person to the shade I thought, "OK, maybe that's what I'm supposed to do is take him to the shade". And that was exactly what was supposed to happen then. Umm, it took me two goes I think to… to figure that out that, that's what I was supposed to do, but then, like I say, once I had figured that out it was just a matter of… take two scaffold tubes,	C thought this was his task, just to stay hydrated. Then he failed because his work colleague collapsed and he thought, " OK, what's happened there?". So because he had already gone and done response or taken a person to the shade he thought, "OK, maybe that's what I'm supposed to do is take him to the shade". And that was exactly what was supposed to happen then. He thinks he took him two goes to figure that out that that's what he was supposed to do, but then once he had figured that out it was just a matter of take two scaffold tubes, take him over and put him in the shade, give him a drink. And just stay hydrated himself and that was it.	The user had an idea what his task was, but then to his surprise, he failed because of another event took place which he was not aware of. As this event made him fail, he realized it was connected to an earlier activity where he had practiced the right response to a similar situation. It took him two goes to figure out the right performance sequence, and adding this new part to his previous performance, after which everything was easy.			

	take him over and put him in the shade, give him a drink. Yeah, and just stay hydrated myself and… And that was it.					
51.	I: So it's almost like a game in a way. C: It is. It's exactly like a game. Yeah. [laughter]	When asked if it's almost like a game, C says, it's exactly like a game.	Interviewer notes that it sounds almost like a game, to which the user says, it was exactly like a game.			

MUs: Gerrard (G)						
Original transcript *(Discriminated meaning units in their original form – passages clearly unrelated to the experience of VE were removed)*	**Transformation 1** *(Discriminated meaning units expressed as much as possible in the subject's language and based upon perspective that description was an example of the experience of a virtual environment)*	**T2** *(Discriminated meaning units expressed more directly in HCI language and with respect to relevance for the phenomenon of virtual environment. Also the nickname is changed to 'the user' for easier analysis with the other accounts.)*	**T3**	**T4**	**Reflection/notes**
1.	I: So and and… if you… you know, can go back to when you did the training with the environment, or if you've done it several times… G: Yep. I:…Umm, Can you describe how you, you know, started using the environment and what did you do there? G: As in, working with it or as in the first day of my training sort of thing? I: Using the actual virtual, like, the computer training environment. G: Yeah, the computer training environment.	When asked to describe how he started using the environment and what he did there, Gerrard asked as in, working with it or as in the first day of his training. When specified as the actual virtual, computer training environment, Gerrard acknowledges, the computer training environment.	The user tries to make a distinction about the interviewer's question if with using the environment he meant the work environment or the VTE. The interviewer specifies, "that actual computer training environment" which the user affirmed, the computer training environment.	The interviewer's question regarding how the user began using the environment does not automatically signify the VTE to the user, and he needs to ask a clarifying question what the interviewer meant.		This is somewhat vague if Gerrard compares the actual working environment to the VE or using the VE to the training as a whole. What's important here is that 'the environment' does not automatically signify the VE to him.
2.	I: So, what did you do there? G: Basically sat down,	When asked what he did there, Gerrard said he basically sat down,	When the interviewer asks what the user did there (meaning the VE), his reply refers to his action in real life.			
3.	G: and it works almost like a… like a computer game. Err, where s[word breaks], like, you know, sort of, as if you're someone's eyes	and it works almost like a computer game. Where you sort of, as if you're someone's eyes.	How the virtual training environment works resembles a computer game, but is almost instead of just like one. The fact that as if you are someone's eyes constitutes this recollection.	The user describes that the VE worked almost like a computer game, more specifically from the perceptual aspect [as if you are someone's eyes].		
4.	G: And it just basically takes you through step-by-step process of how exactly you would… do the job. So starting from, in the control room, going through the permit system. Getting on to a permit to get everybody a PPE [Personal Protective	It takes him through step-by-step process of how exactly he would do the job. So starting from, in the control room, going through the permit system. Getting on to a permit to get everybody a PPE [Personal Protective Equipment], working his way out, and then, opening certain valves and stuff like that, for the machines to work with the press. Then	The training environment takes him through step-by-step how he would do the job. It begins from the beginning where you need to get the right permit and the gear, as you would in the actual environment. Then it shows more particular job-related tasks and details such as opening certain valves. Then it takes him to set up the	The virtual environment takes the user through step-by-step process of how he would do the job. This does not include only one main task, but it is connected with other smaller tasks, and also objects related to those tasks. Different tasks are spatially and temporally in sequence.	The VE takes the user through step-by-step process of how exactly he would do the job. He begins from a certain location where he goes through a work-related process [the permit system]. Then he proceeds to getting the right objects [Personal Protective Equipment] that are used in the job, finds his way out from the location, and then operates controls that	Although he says step-by-step in the beginning, the rest of the description is him actively doing specific things. Also BD used the word 'you' to describe the process and how "it" takes or does something to "you". Is this an important detail? Also in this the 'step-by-step' is important.

	Equipment], working your way out, and then, opening certain valves and stuff like that, for the machines to work with the press. Then going to the computer part of it. And, basically setting up… the machinery there from there.	going to the computer part of it. And, basically setting up the machinery there from there.	machinery with the computer.		are particular for that job.
5.	G: So, yeah it's quite sort of in-depth, the, umm… G: Are you talking about the actual computer test itself, the… I: Ummm G:…the training test itself…? I: So there's a test? G: Yeah, there is a test, yeah, absolutely. Yeah, umm…	It's quite sort of in-depth the… Gerrard asks a question to specify if the interviewer is talking about the actual computer test itself. Interviewer asks, so there's a test? To which Gerrard replies, yeah, there is a test, yeah, absolutely.	The user first says it's quite sort of in-depth, but then goes to specify what the interviewer is actually asking about, the actual computer test itself?	The user describes the training as in-depth, but then asks if the interviewer is actually asking specifically about the computer test, which to him seems to be separate from the induction part.	
	I: I'm, I'm more interested in, in, you know… like after you now, you've done the training and you do that same work… G: Yep I: So… how did you feel umm… what, what made it similar to the actual work, in that environment? G: Aaa, well, everything really. Umm… Yeah everything in that training sort of covered exactly what I needed to do, so when I went to start the job, I was pretty, sort of confident in the sense of what I was doing. And for the first day or two, I had umm, my [word?] who has worked with the stuff, years, and he sort of showed me how it works as well.	When inquired, what made the experience similar to the actual work, Gerrard replies, everything really. Yeah everything in that training sort of covered exactly what he needed to do, so when he went to start the job, he was pretty, sort of confident in the sense of what he was doing. And for the first day or two, he had [a word is missing, perhaps "a person"?] who has worked with the stuff years, and he sort of showed him how it works as well.	The experience as a whole made it resemble his actual work. It was a holistic learning experience. The training sort of covered exactly what he needed to do which made him confident to do the job when he started it. Also another person during the first days complemented this.	The user experienced that the training covered everything and exactly what he needed to do in his work, and that made the user confident in what he was doing.	When asked what in the training resembled doing the work in the actual environment, the user replies to this everything really. As the training covered exactly what he needed to do, when he began his work, he felt pretty confident in what he was doing. During the first days he also had an experienced person showing him how everything works.	Familiarity and confidence come up also with BD and C.
6.	G: So, yeah no it was very sort of hand[word break], everything was fine, very comfortable how it all works and stuff like that. There wasn't an issue at all there. Umm…	So yeah no it was very sort of hand[word break], everything was fine, very comfortable how it all works and stuff like that. There wasn't an issue at all there.	The user is saying that he was comfortable how everything worked when he started.			It's almost as if he might think in the beginning that the interviewer might be evaluating him.
7.	G: Yeah, I'm, I don't really know how, yeah, is that what you were sort of…? I: Yeah, anything… [talking at the same time with Gerrard) G: Yeah, yeah,, yeah, that's it basically, I mean, on my first day, still very nervous and stuff like that, still trying to learn so, but there's	He does not really know what the interviewer was trying to ask. The interviewer specifies, "anything", to which G replies, yeah that's it basically. On his first day, still very nervous, still trying to learn, but there was nothing in his training that was missed out, or that he felt like when he came to the job, he didn't know how to do that. No, he knew, full understanding exactly everything that was involved.	The user is not sure what the interviewer wants to know. To an open question, he continues about the first day and how he was still very nervous… still trying to learn. Still, he underlines that his training was complete and there was nothing that was missed out, or that when he started, he didn't know how to do that. He affirms, no, he knew, full understanding exactly			

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	nothing in, say, my training that was missed out. I: Mm. G: That, you know, I felt like when I came to the job I didn't, umm, know, say, how to do that. So yeah, no I knew, full understanding exactly everything that was involved so…		everything that was involved.		
8.	I: So how, because I haven't seen the environment myself… G: No, of course not I:…so can you describe like, is it like, does it have all the sounds and stuff? G: [talks over] Aa, OK, I'm with you, no it's the thing called the press, umm, basically, these packs are on a ram, and, all sorts of pipe work coming off and leading from the plant to this bit of machinery I work with, and then leading to another tank. Aa, basically… one time set up. I'll open this thing and push this ram together with the press, and that brings the FSA [Hydrofluorosilicic Acid] through, and turns it into… basically a liquid sort of sense and pumps it straight in to a big tank. So, I'll operate that from my control panel and… that's basically what my will job consist, then once that's finished, I'll keep getting samples… of the stuff, as this is pressing in through, it's called the press. Every five minutes I'll get a sample… of the FSA, and… I'll got a little lab there where I'll be checking certain levels, and that will give me an understanding of when I need to stop pressing. Aa, when I hit that level, I'll stop through my computer, basically clean off, get ready to start again, and start again from there. So… That's basically what the job sort of entails really, so…	When the interviewer mentions he hasn't seen the environment himself, and asks Gerrard to describe it, and does it have all the sounds and stuff, Gerrard acknowledges OK, I'm with you. It's the thing called the press, basically, these packs are on a ram, and all sorts of pipe work coming off and leading from the plant to this bit of machinery he works with, and then leading to another tank. Basically one time set up. He will operate this thing and push this ram together with the press, and that brings the FSA through, and turns it into basically a liquid sort of sense and pumps it straight in to a big tank. So he will operate that from his control panel and that's basically what his job consists. Then once that's finished, he'll keep getting samples of the stuff, as this is pressing through, it's called the press. Every five minutes he'll get a sample of the FSA and he'll got a little lab there where he'll be checking certain levels, and that will give him an understanding of when he needs to stop pressing. When he hits that level, he'll stop through his computer, basically clean off, get ready to start again, and start again from there. So that's basically what the job sort of entails really.	The interviewer asks the user to describe the environment, which gets the user to understand what the interviewer might want to hear: aa, OK I'm with you. He then continues to describe the actual work environment and the process.	The interviewer asks more about the 'environment' and asks the user to described it, to which the user describes what the actual work process is like.		The interviewer's intention here was to know more about the virtual training environment. Might this show that 'environment' for this participant just did not have the same signification?
9.	I: And that, everything in that was basically in the environment?	When asked if everything in that was in the environment, G replies absolutely, in the training. There was two,	To the user, everything from the real environment was in the training. He divides the VE into two parts. The	The user categorises the VE in two parts, of which the training part was a step-by-step process that resembled		This is related to the earlier MU where he compared the VE to a computer game and described how it takes

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	G: Yeah, yeah, yeah, absolutely, in the training. Yep, yep. Umm… G: There was two, there was a training where I obviously, was like a gaming step-by-step sort of… show how to do it,	there was a training where he obviously, was like a gaming step-by-step sort of… show how to do it,	first part of the training environment that showed him how to do it was like a gaming step-by-step,	gaming and showed him how to do it.		him through a step-by-step process. This and the next MU were originally one, but were separated because this MU refers more to the gaming step by step and "it" showing you how to do it. The next MU describes more how it made him do it as if there. Still note, once again, it made him do it.
10.	G: and then like I said there is a sort of like a virtual training, so as if you were like out there sort of… on… the, the equipment, doing it itself. Umm…	and then like he said there is a sort of like a virtual training, so as if you were like out there sort of on the equipment doing it itself.	then the second part, sort of like a virtual training, made him do it himself as if you were out there on the equipment doing it yourself.	The user describes the second part as virtual training, where he was sort of out there on the equipment doing the work himself.		
11.	I: So you were… using it with a mouse and keyboard, or…? G: Yes, in this room in fact. I: Aa, OK. How did that feel like? Like, umm… G: Yeah it was good, really good. It was quite a good idea really. Umm… Since most training I've done is a lot of… paperwork and stuff like that, as you know, it's very hard to… get an idea of things unless you're very hands-on. And you know… Things are very different in practical to what they are… you know, in theory. So umm… So that computer test gave, you know, a lot more of an understanding…	When asked if he used it with a mouse and keyboard, G says "yes, in this room in fact. For G, it was really good, he thought it was a good idea really. Since most training he's done is a lot of paperwork and stuff like that, as you know, it's very hard to get an idea of things unless you're very hands-on. And you know, things are very different in practical to what they are, you know, in theory. So to him, the computer test gave a lot more of an understanding…	The user thought the training was a good idea. Most of the training he has done has lot of paperwork, and it is difficult to get an idea of things in theory unless you are trying them out in practice, it's very hard to get an idea of things unless you're very hands-on. Things are different in theory than in the actual situation. The computer test part of the virtual training gave the user more of an understanding.	The user evaluates the training environment as a good idea by comparing it to some other training that he has done, which has been too theoretical. Things are different in practical than what they are in theory, and it is difficult to get an idea of things unless you practice them hands-on. As such, the VE gave him a lot more understanding.		This is quite an interesting comment with more depth than one might first imagine. This is a comment almost everything would probably say about learning and then actually doing the work. Does he connect this with the other parts, implying the VE training was closer to actual practice? What is 'practice', 'hands-on' and 'theory'? Also the part on giving an understanding is filled with lots of meaning. He talks about understanding instead of overwhelming with theory. Understanding is practical? Understanding comes from "hands-on"? Once again, what doe 'hands-on' signify?
12.	G: I must admit prior I got handed a piece of paper… and had all the step-by-step exactly what to do. It was a little bit overwhelming: when I saw it I was god that's a lot of steps. And then you jump on this computer thing and it shows you exactly what to do and you're "Oh no, this is not very much to it at all" so… So yeah, that computer test really did help out a lot, in that sense. Definitely.	He must admit prior he got handed a piece of paper with all the step-by-step exactly what to do. It was a little bit overwhelming. When he saw it, he was 'God that's a lot of steps'. And then he jumps on this computer thing and it shows him exactly what to do and he's "Oh no, this is not very much to it at all". So that computer test really did help out a lot, in that sense. Definitely.	To the user, getting all information at once in paper made the job look like it was very complicated with a lot of steps. Then VE, which showed him exactly what to do, made him feel the job was much simpler, and in that sense helped to make it appear less overwhelming.			Familiarity, but also reducing anxiety that comes from seeing too many parts of the whole at the same time.
13.	I: Yeah I can really understand that because I scuba dive myself… G: Aa, OK, yeah. I: And safety is quite important [laughter] G: [laughter] Of course yeah. I: And when you read the books, you don't actually learn scuba diving. G: No, no.	The interviewer relates his scuba diving learning experience to G's previous description, to which G says, Yeah no, you can't really go wrong really with the hands-on training or anything like that. And then, like he said, from there, pretty much hundred per cent confident with how the machine works.	To the user the computer training was hands-on training, and it gave him pretty much hundred per cent confidence how the machine works.			

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	I: You perhaps remember some information, but… G: Yeah, exactly right. I: It's the point when you actually jump in the water and start learning there… G: Yeah, absolutely I: It's, it's the thing. G: Yeah, no, you can't go wrong really with the… hands-on training or anything like that so… I: Yeah… G: So yeah. And then, like I said from there… pretty much hundred per cent confident with how the machine works. Umm…				
14.	I: Was there lots of umm… like information in the system or was it more like doing the processes… G: The pretty, yeah, the process itself as opposed to information. I mean I got all the information what the FSA is. I've got MDMS, umm… MSDS sheet material, safety data sheets, umm… I've got JSAEs, I've got everything that tells me what the stuff does to me and what the dang[br], what the hazards are, and all that sort of stuff. So most of it is process sort of system… I: So, those are like hazardous chemicals that… G: Yeah, that's it… I:…that have different effects? G: Yeah, of course yeah. I: OK. G: Yeah, I've… I keep all of that on me at all times, it's always sort of next to me when I'm working with the stuff.	To the question, was there lots of information in the system or was it more like doing the process, G replies that the process itself as opposed to information. He got all the information what the FSA is. He's got MDMS, MSDS sheet material, safety data sheets, he's got JSAEs. He's got everything that tells him what the stuff does to him and what the hazards are, and all that sort of stuff. So most of it is process sort of system… Interviewer specifies if those are hazardous chemical that have different effects, to which G replies yes, that's it. He keeps all of that on him at all times. It's always sort of next to him when he is working with the stuff.	The virtual training environment was more of a process itself as opposed to information. He has all the information about the hazardous materials as information sheets, which he has always with him in the actual work.			
15.	I: So what was, what do you think was the primary like the aim of the environment? Was it like, umm… to teach you how to use the equipment or the process or both? G: Both, definitely both. I felt like I got told what the stuff does as well as opposed to just… do this, make mix and that's that, and I got very much informed of what	To the question what might have been the primary aim of the environment, for example to teach how to use the equipment or the process or both, G replies definitely both. He felt like he got told what the stuff does as well as opposed to just 'do this, make mix' and that's that. And he got very much informed of what the stuff is used for, like he said, the damage it can cause to him, the environment and stuff like that. Very much was made aware	To the user, instead of just information of what the stuff does or learning to perform the work task, the virtual training environment was a holistic learning experience that informed him about several aspects of the hazardous materials and made him aware of every sort of aspect.	When asked what might have been the aim of the VE, for example to teach to use the equipment or the job process, the user says definitely both. Instead of just simply showing how to do his work, he was made aware of every aspect of the hazardous materials, such as how they affect him and the environment.		

	the stuff is used for… err, the like said, the damage it can cause to me, the environment, and stuff like that. Very much was made aware of every sort of aspect of it, so… I: Okay G: Yeah, definitely both aspects there.	of every sort of aspect of it. G concludes, definitely both aspects there.			
16.	I: You used it by yourself only, so there was no group work or anything…? G: No, it's not a group work, it's individual job. And that role's on to it. Runs 24/7. So, if you can imagine… [noise outside the room] Is that my name? [laughter] G: A handover, so 12 hours I'll handover it to the next guy. He'll do it, then I'll come in after his 12 hours, he'll hand over it to me. And it's just an individual job, so yeah, you just run up on your own.	When asked if G used the environment by himself only or if there was group work or anything, he says it's not a group work, it's individual job, and that role is on to it. The job runs non-stop. There is a handover: 12 hours and he will handover it to the next guy. He will do it, then G will come in after his 12 hours, he will hand over it to G. G reaffirms, it is just an individual job, you just run up on your own.	Working in that role is an individual job and not a group work. A single person will work 12 hours and hand over to the next guy. This was captured well in the training environment: the role was on to it.	When asked if he used the VE in a group situation, he says no; the job is individual job and how he used the VE corresponded to that role [that role is on to it]. He then explains the details how the work runs and how the handover is made to his colleague.	
17.	I: Yeah… So after like… umm, now when you're doing the work… is there any, this kind of like… how would you say like, exchange of information with the other guys? Like… G: Emm, yeah say, on the handover, are you talking about? Yeah, to, yeah with the certain degree I mean… When this machine almost [word missing] sort of does tend to run itself, it does not seem to be too much of an issue once you're up and going. G: So is a case of just… hand over to the next guy and [word missing] say "yeah, there hasn't been any problems today, everything's running good" and… You might be in the middle of that press I was telling you about when he comes in. 'Cause that goes off a basis of how the temperature of the product as well as an SG, the umm, Specific [Gravity ?], so… that will depend on when you start pressing, you're getting samples every 10 to 15 minutes. Basically that will dictate when you start pressing. You start	The interviewer asks if there is any exchange of information in the actual job environment, now that G is doing the work. G asks if the interviewer means on the handover? He says with the certain degree. The machine almost does tend to run itself, it does not seem to be too much of an issue once he is up and going. So it is about handing it over to the next guy and explaining there hasn't been any problems today, everything's running good. He might be in the middle of the press when the other person comes in. There is a specific process that goes off based on certain parameters that will depend on when he starts pressing. So the other person might come in when you are in the middle of pressing and he will handover to him saying, "we're on the middle of one now, you'll be finished in an hour". As G said, the machine generally will run itself, so it's more about explaining how the day has been. Sometimes when there's issues and it has been a bad day, there's a lot of problems with the machines he'll explain that to him: "It's been a slow day, we haven't got much done". More a production side of it. When asked if such things were in the training environment, G says the game covered all aspects of if there	When asked about the exchange of information during the actual work, the user explains that the increasingly automated machine they use tends to run itself, and thus does not commonly require a lot of sharing of information during shift handovers. In the training, the game covered all aspects of problems and the handover situation.			

	pressing, get samples again at the other end of that press, and that will dictate when you stop. So, you'll basically just tell him when he comes in, you might be… halfway through one. Just handover to him, "we're on the middle of one now", you'll be finished in an hour. Then you'll clean up and set up for the next one. I might have just finished one, and I'll say "yeah you've got an hour now before it maybe start back up again", so… G: Yeah so… There's not a great deal in the sense of… Like I said, that machine generally will run itself, so it's just more… a case of just basically explaining how the day has been. Sometimes there's issues and has been a bad day. There's been a lot of problems with the machines and stuff like that and I'll explain that to him "It's been a slow day, we haven't got much done" and stuff like that, so… More I suppose a… production side of it. I: So, were these in the training environment, like, anything like this? G: What could go wrong or…? I: Yeah G: Yeah, yeah, yeah, in the training, the game covered all aspects of if there was problems and, the handover and stuff like that as well. I: OK.	was problems, the handover and stuff like that as well.				
18.	G: So yeah, like I said, the training's quite sort of… in-depth. It does sort of cover just about most of everything… I: If there was something you could change in that training environment, based on your work now…? G: Yeah, ummm… I: Anything to add or remove from the environment…? G: [lp] Ohh… I: Anything… G: [jumps in]: Yeah I'm trying to think, yeah I'm, I mean…[lp]	G says the training is quite in-depth. It does sort of cover just about most of everything. When asked if G would like to change anything in the training environment based on his work experience, he can't really think anything, as he thinks they really do cover everything that is in that training.	The in-depth nature of the training that covers just about most of everything makes it a holistic learning experience. To the user, he cannot think what could be changed in it because of this.	The user describes the training quite in-depth and that it covers just about everything. When asked if there would be anything he would like change in the environment, the user cannot think of anything as he feels they really do cover everything.	The user describes the training quite in-depth and that it covers just about everything. When asked if there was something he could change in the environment, nothing comes to his mind based on the fact that he feels the training covers everything.	

	G: I suppos[br]… well, no really umm… [lp]. No, I think to be honest, they really do cover everything, that is in that training.				
19.	G: Umm… I can't really think, like you said even when aspects when it was going wrong, I mean it didn't really go wrong often. But like I said, I had the training there, so I knew I'd handled it.	Even when aspects when it was going wrong, he means it didn't really go wrong often. As he already said, he had the training there, so he knew he could handle it.	The training made the user confident he could handle even situations where something might go wrong.		This is very vague and based on other MUs, "aspects when it was going wrong" could refer to scenarios that show what takes place if the machine does not function properly. Furthermore, the training made him feel he could handle it even in a situation where something might go wrong, so at least there seems to be confidence here once again.
20.	G: And… if there wasn't anything there, which like I said never happened often, you've got operators next to you. So… Who have got extensive experience on this as well. So you're always within… vicinity of someone who has got a [sense ?] excessive knowledge of this machinery, and everything else that is going on. So if you did for some reason come across an issue where you "Hand on a second, what's going wrong here?". You, could quite easily just go to them then… they'll take, they'll take the matter from there.	And if there wasn't anything there, he has got operators next to him who have got extensive experience on this as well. So he is always within vicinity of someone who has to an excessive knowledge of this machinery, and everything else that is going on. So if he did for some reason come across an issue where he is asking "Hand on a second, what's going wrong here?", he could quite easily just go to them and they'll take the matter from there.	If for any reason the training hadn't prepared the user to every possible problem he might encounter, he could always rely on other people who have more knowledge about the machinery and can help him.		
21.	G: So yeah, but through, like I said, I worked with it for I think it was six months… would be six months I think, emm… Close to every day, and yeah I never really thought of anything where I thought it was missing or something like that, emm… I: So it's been six months from using that training environment? G: Yes. I: OK, cool. G: And I could go back on to it now, I haven't actually touched it now I've been still here 'cause they haven't been running… for another three months I think.	He has worked with it close to six months almost every day and he never really thought of anything where he though it was missing or something like that. It has been six months to Gerrard from using the training environment, and he could go back on to it now. He hasn't actually touched it now, he's been still here because they haven't been running for another three months he's guessing.	Reflecting back to the time span if six month the user has now worked with the machine close to every day, he cannot think about anything the training was missing.	The user says he has been working in the job six months now, and he never thought of anything the VE training might have missed.		Note about Imaginative variation (IV): In practice, it means writing different drafts of what a person experiences and how it took place (noesis-noema). This is never explained very well in literature. IV is not a technique as such, but active testing of the meaning through writing different transformations that capture [the essence]: the researcher will know when he "comes across a description that fits precisely the intentional act he or she was seeking to fulfil. The fulfilling expression is then precisely described" (Giorgi 2012, 8).
22.	G: And just, I learned from that training that I could straight back	He learned from that training that he could go straight back on to that machine now knowing	The training prepared the user to quickly start to work with the machine, knowing		

	on to that machine now I know exactly what I'm doing and stuff like that, so… Yeah like I said, it was pretty good.	exactly what he's doing. So as he said, it was pretty good.	exactly what he was doing.			
23.	G: I do remember the computer test did tend to freeze up a little bit. Which… I mean, I don't know… again that's nothing really to do with the job, suppose that might not have anything to do with the computer work or anything like that. But I do remember that. Emm… Yeah, that actual computer test where you are… sort of… going for that hands-on bit of an experience…	G does remember the computer test did tend to freeze up a little bit. He says that's nothing really to do with the job, and supposedly might not have anything to do with the computer work or anything like that. But he remembers that actual computer test where he was going for that hands-on bit of an experience.	The computer test that was the hands-on experience to the user, had problems of freezing up. Speculating the possible reasons behind this behaviour, the nature of them is still unresolved and open to him to this day.	Eventually the user remembers that during the hands-on experience, the computer test tend to freeze up a little bit. He follows this closely by explaining what it might not be related.		"Finding" this MU transformation once again shows how this method of analysis opens up to you only through doing it and exploring the meaning and fulfilling it.
24.	I: How was the test actually? G: How was it? I: Like, what sort of a test was it? G: Umm… In the sense of that… G: Yeah… The test, it was a test in the sense that… you'd have to, so it takes you for a walk, how you would set up the job, bit by bit sort of thing, and then you'd have to do that yourself by clicking on buttons. It was almost like a game. You know, those Call of Duty games or… something like that, you know, where you…	The test was a test in the sense that it takes G for a walk, how he would set up the job, bit-by-bit sort of thing, and then he'd have to do that himself by clicking on buttons. It was almost like a game, like those Call of Duty games or something like that.	What made it a test to the user was that it first shows him how to do the job in steps, and then he needs to perform that himself by clicking on buttons. It resembles video games, like Call of Duty games, but is not quite like it but almost like a game.	It is a test and a video game at the same time: the first part that takes him for a walk and shows him how to do the job is the test, but the doing, clicking on buttons, is almost like a game and resembles those Call of Duty games.	When asked what sort of a test it was, the user explains that it was a test in the sense that it takes him for a walk to show step-by-step how he would set up the job, and then he needs to do it himself by clicking buttons. The user describes it was almost like a game, mentioning one of the popular first person shooter games.	Is he referring to the fact that clicking buttons made it a bit like a game or the whole "taking him for a walk"? I would say the doing as otherwise he could just say it was (almost) like a video, couldn't he? Still, why is it 'almost' like a game?
25.	I [interrupts]: So do you play them? G: So… No yeah I don't particularly much at home, I must, I've got kids so I got no time to play games, emm… [laughter].	When asked if G plays games, he says does not particularly much at home, he must, he has got kids so he has no time to play games, he says laughing.	Kids and playing games both take time. Kids surpass playing games at home in the order of importance.	Time-wise, having kids make playing games more difficult.	When asked if the user plays games, he laughs and he does not particularly much at home because he has kids and thus he has no time to play games.	This was an interruption on the interviewers behalf, G continues describing the previous MU in the next MU.
26.	G: But it was basically if you can imagine that, emm…so after it walked and went through the process with you, it take right at the beginning again, but this time you'd have to do it sort of thing, but of memory of how you would do it and then… I think you got one practice go and then you went back to the start again and that's your test. And you'd go through your process of how you would do the whole thing just on computer. And that would	G describes that after it walked and went through the process with him, it went right at the beginning again, but this time he would have to do it sort of thing, but of memory of how he would do it. He thinks there was one practice go and then you would go back to the start again and that's your test. And he would go through the process of how he would do the whole thing just on computer. And that would again, cover it.	A test was something that after it first had to watch how the [VE] showed him the process, and then he needed to perform that same process of memory. All of this would cover it.	The user describes that after it went through the process with him, it went back to the beginning. This time he had to go through the whole process on the computer from memory as if he was doing it himself: and that's the test. He would go through how he would do the whole process, which again would cover it.		

	yeah, again, cover it,				
27.	G: I sure remember it tend to freeze up quite a bit, so… I think other people had issues with it freezing up, so… Again, I don't know whether that was the software or what the [goal or go ?] was with it, so… Aaa, we got, we got there in the end so [laughter]	He sure remembers it tend to freeze up quite a bit. He also thinks other people had issues with it freezing up. Again, he doesn't know whether that was the software or what the goals was with it. G says laughing, we got there in the end so…	Problems with the software freezing up were common knowledge that the participants shared and knew about. The possible reasons behind them are still an open mystery to the user and he can only speculate possible reasons such as something to do with the software. Nevertheless, the problems did not prevent them from finishing the training.			Actively trying to make sense if the goal of the software was something that made it to freeze, if it was intentional from the design. Still, he is OK with it as "we got there in the end", they were still able to finish the training. The fact that people had problems with the software was common knowledge the participants shared (he has had to hear that from somewhere and I think the others also mentioned about them).
28.	I: Was there anything you wanted to do in the environment, but… that wasn't possible? G: Emm… [with a low voice] Come to think… G: Aa again, not really… Umm… I: Or based on your like, current understanding of the work, you would do it now? G: Yeah, as if in so… I: In the environment… G: Yeah, so… like… Could I… Is there anything I'd like to do now in the sense that say I am not allowed to do or I can't do? I: In, wasn't allowed to do in the training environment… G: In the training… Aa OK, I see what you mean. Emm…	When asked was there anything G wanted to in the environment but wasn't possible, or would he change something based on his current understanding of his work, G asks, is there anything he'd like to do now in the sense that he is not allowed to do or can't do? The interviewer specifies, wasn't allowed to do in the training environment, to which G says he sees what the interviewer means.	The user is not sure if the interviewer talks about his current actual work environment and what he is allowed to do there.			
29.	G: I mean in the training, I suppose to a certain degree there is an aspect called emm… the charcoal. Where you do change charcoal. Emm… Goes through like, again, sort of like a cylinder. It comes through and it comes through, and you change that charcoal on a regular basis… I [interrupts]: Was it like a filter or…? G: Filter, that's the one I was [word missing] for, emm… That wasn't actually covered in, excuse me [coughing] in the training emm… 'cause that's not an issue that comes up often, like I said, that's one of those things that you, you might get four or five weeks out of the charcoal you got in there and then it'll get	G says there is an aspect called the charcoal. Where he changes charcoal. He explains it goes through sort of a cylinder, something comes through and you change that charcoal [filter] on a regular basis. That was not actually covered in the training. G thinks because that is not an issue that comes up often: you might get four or five weeks out of the charcoal you got in there and then it'll get changed. So you might go sometimes with never having to do it on your shifts. It just depends on what shifts that happens to fall on. When it did happen, G got shown how to do that on the spot of it happening. That was never actually covered in the training, but he cannot see why it would need to either, because as he said, it's not a hard thing to do. That was just shown to him when it was sort of needed to be done.	When asked if he would change or add something to the training now after he has been working in the environment, he says there was one aspect, one machine-related procedure, that was not covered. He goes on to explain how it is part of the work process and what you need to do with it, but evaluates that most likely it was not covered in the training because it is not an issue that comes up often; you might never have to do it on your shift. Still, when it did happen to him, he got shown how to do it on the spot of it happening, when needed to be done. He once again estimates that he does not see why it should have been covered in the training, as it is not a hard thing to do.			

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	changed. So you might go sometimes with never having to do it bec[br], on your shifts so… It just depends on what shift that happens to fall on. So when that did happen, I got shown how to do that, on the spot of it happening. So that was never actually covered in the training, but I can't see why it would need to either. 'cause like I said, it's not a hard thing to do, that's just something that would… That was just shown to me, when it was sort of needed to be done.				
30.	G: So, apart from that, that's the only thing I can really remember that say wouldn't, wasn't covered in the training that I was… That I learned afterwards I suppose, so… What as far as wanting to do something that, say, wasn't in there… No, not really. Emm…	That's the only thing he can really remember that wasn't covered in the training that he learned afterwards he supposes. As far as wanting to do something that wasn't in there, no not really.	Based on a specific work task that was new to the user when he began working and which he learned afterwards, the user can't really remember anything that wasn't covered in the training.	When asked if there was something the user wanted to do in the VE but could not, the user reflects what he has learned afterwards as something that was not covered in the training. Outside of this he cannot think of anything else he would have wanted to do that was not part of the VE training.		
31.	G: I mean, there is in… aaah… What's the word I'm looking for…? At the PPE, that it says that we need to wear at the work, yeah… the equipment. It says, you need earplugs which… I don't think personally was right. Because it's not a high-level noise area. And you got to be in constant contact with the control room… the operators. Umm… and they got to be in constant contact with you, 'cause anything goes wrong… So if you got the earplugs in… Quite hard to hear exactly what's going… I [interrupts]: Do you basically shout to them, or…? G: Aa, no radio, we work through a radio, so contact, umm… So that's what I mean, so. You can miss, maybe sometimes when they have said something… with the earplugs. But again, that's… Yeah… I don't think that's too much of an issue or anything like that. I: But that's still like, something that is like, a vital part of the work?	G is searching words for the other thing he suddenly remembers. At the PPE, it says that they need to wear certain equipment at the work. It says you need earplugs, which he thinks personally wasn't right, because it is not a high-level noise area, and you got to be in constant contact with the control room operators. And they got to be in constant contact with you because if anything goes wrong and you got the earplugs in, it is quite hard to hear exactly what's going on. They contact through a radio and you can miss, maybe sometimes, when they have said something if you have the earplugs on. He does not think that's too much of an issue or anything like that. When asked if that is a vital and frequent part of the everyday work, he acknowledges that it is.	Based on working at the actual site, some safety instructions that were communicated in the virtual environment would actually inhibit real life work situation.	All of a sudden the user remembers one part about safety instructions, which he think was not right, as they do not correspond to the classification of the actual work space [not a high-level noise area] nor the work procedure that takes place there. Following those guidelines could actually inhibit perception [communication through the radio with colleagues] that is a vital part of the everyday work situation. The user is unsure about this development comment and its importance, although he acknowledges even he described is an important and frequent part of the job.		Interesting comment to say it's not a big deal if you miss communication, especially in a hazardous environment.

	G: Yes, yeah, yeah. I: You do that daily… several times, or? G: Yes, yeah.				
32.	I: OK, umm… I'm not sure if I need to bug you anymore… G: Ahaha, OK ([laughter] cool. I: That was very like… prompt [laughter] G: Yeah, no, I mean, luckily enough, like I said, I've been doing it for six months every day, so… I do know it quite well now.	The interviewer is running out of set time and is closing the interview acknowledging that G's answers were very prompt. G says luckily enough, he's been doing it now for six months every day so he knows it quite well now.	To the user, answering promptly to interviewer's questions is due to the fact that he feels he has been working in his job long enough, which makes him know it quite well now.	Time and knowing a job well have a causal relation.	Being able to answer the interviewer's questions is due to the fact that he has been doing the job actively for a duration [six months every day] that makes him feel he knows it quite well now.	If transformation 4 is correct, where do single training VEs stand? What can they achieve, and should we be more accurate about that achievement, instead of painting wild fantasies that cannot be fulfilled, and which are limited by time [of exposure to a VE?]
33.	G: But I do remember that first day at the training, the training was really good compared to other jobs that I've done. An overload you sometimes as well with things. 'Cause I've got my riggers and scaffolds tickets. 'Cause some of them, sort of training… obviously a little bit more in-depth, you know, goes for weeks and stuff like that. With certain days particularly some inductions at certain sites can get quite overwhelming with some of the information that they pour into you. Where this was quite sort of direct to the point, and… Covered what you needed to really cover.	G remembers that first day at the training it was really good compared to other jobs he's done. They overload sometimes with things. Cause I've got my riggers and scaffolds tickets. Because some of their training is a little bit more in-depth, goes for weeks and stuff like that. With certain days, particularly some inductions at certain sites get quite overwhelming with some of the information they pour into you. Where this was quite sort of direct to the point and covered what you needed to really cover.	Time and training depth have a causal connection: bit more in depth, goes for weeks. When too much information is poured into someone it can make training overwhelming. Too much information can suffocate or drown. Right amount of information is direct to the point and covers what is needed to really cover. VE was able to produce the latter.	The user remembers back to the first day of the training and judges it good by comparing it to training in other jobs he has done; they overload sometimes with the information they pour into you when he experienced the VTE direct to the point and covering what needed to really cover. That said, in those other jobs the training has been a bit more in-depth and lasts longer [weeks].		A sweet spot where the user feels the amount of information is just about right and it does not feel overwhelming. At the same time, he explains that the training in general has needed more in-depth and more time. Does this mean a VTE design can more easily simulate a simple process?
34.	G: And I just liked the way they did sort of tell me what the issues were if it could go wrong. What the stuff does to ya. Lot of places tend to not really do that, they'll say that this might be… hazardous, but that's it and it's up to you up your own back to find out what exactly it could cause where, like…	And he liked the way they did tell him what the issues were if it could go wrong, and what the stuff does to you. Lot of places tend to not really do that, they'll say that this might be hazardous, but that's it and it's up to you to find out what exactly could it cause.	Instead of neutral information that the user would've needed to research further to really understand what it means to him and his safety, the training explained what the stuff does to you.	Neutral information, this might be hazardous, is not enough to make on understand what hazardous materials can really cause you. This training was able to explain that.	The user liked the way he was told what the possible issues were in a case of emergency and what the hazardous materials do to you. Many places only give a general explanation, which puts you responsible for finding out the exact causes yourself.	
35.	I (interrupts): How did the environment like… did it tell it by text or did it show if something went wrong, or how, how did…? G: You know, yeah, you know by the computer test if there's something going wrong or it's a visual aspect as	The interviewer asks how the environment communicated something went wrong, to which G replies he knew it by the computer test if there's something going wrong or it's a visual aspect as well. And G repeats that when this machine is running, there should've anything as far as smoke or liquid or anything. If there were something going	Computer test told the user if something went wrong. In the actual environment, visual identification of the presence of additional matter will indicate if something is going wrong. The user of the machine is staring it while it's running. When the machine is running accordingly, no visual signs should be present. In the actual	In the VE, computer test made the user understand if something went wrong. In the actual work, assessing the situation perceptually while being in the environment lets one know when there's an issue.	When asked did the environment communicate to the user by text or showing that something was wrong, the user replies you knew by the computer test if something was wrong but adds that it is a visual aspect as well. Then he goes on to explain what it is in the real situation, where you know from the absence of certain things you	It is as if the virtual and the real get mixed up in this MU as he takes the question quickly to the real environment, although the question was about the VE.

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	well like I said, there's nothing… When this machine is running, there shouldn't be anything… as far as smoke or liquid or anything, so… If there was something going wrong, you'd start see liquid coming out of the machine, you would see smoke or… fumes or something like that. Fumes are another one… It does, it does get little bit fumy around there. But you got PPE to cover that obviously. But umm… You'll know when it's too fumy, there's an issue, like I said, most of the issues if there's an issue it will be from a visual… perspective, Because you'll stare at this while its running, so you're not gonna miss a thing. Umm… So yeah, most of it would be visual I suppose to a certain degree. Umm…	wrong, you would start to see liquid coming out of the machine, smoke or fumes, or something like that. Fumes are another one, it does get a little bit fumy around there. But you got your PPE to cover that obviously. But you'll know when it's too fumy and there's an issue. If there is an issue it will be from a visual perspective because you will stare at this while it's running, so you are not going to miss a thing. So G agrees most of it would be visual to a certain degree he supposes.	environment, the operator will know when it's too fumy and there's an issue.		might see that everything is normal. One of these, the fumes, is normally present to a degree, but you'll know when it's too much.	
36.	G: And then you'd just maybe add quick changes. You'd stop the machine, and through the computer, and… proceed to find the problem in there. I: Yeah. So you use the com… the… actual machinery with a computer? G: Yeah, yeah. Well, I've got a little, like, control bay next to me which's got all the buttons and stuff like that and… Again, very good description right next to that thing exactly what it does, and what button does what and… I got very profusely walked through that thing as well…	And then you'd just add quick changes: You stop the machine, and through the computer proceed to find the problem in there. Gerrard has got a little control bay next to him, which has got all the buttons and stuff like that. There is a good description right next to it that explain what it does and what button does what. He got very profusely walked through that thing as well.	The user uses another computer to find the problem in the machine. Visible instructions next to the control bay communicate what button does what. the user was profusely walked through also that thing.	In the actual environment, instructions next to the control bay remind him what controls do what in the actual machine. The main machine is operated with another machine, a computer.	After explaining the possible things that might indicate that something is going wrong, the user explains in detail how you will act in such a case. He also explains that he has good instructions on his workstation that explain what the controls do. He got very profusely walked through that thing as well, but it does not come through does this mean in the VTE or in the actual plant.	
37.	I: Yeah, I think everything is going that direction… G: Yeah, they do sort of cover everything that you need to cover. And if I, if I have any questions, I do ask straight away and they're always quite happy to sort of, do that. But like I said, there hasn't been many questions. [It almost ?] sort of run like clockwork for the last few months which…	As G affirms, they do sort of cover everything that you need to cover. And if he has any questions, he does ask straight away and they're always quite happy to sort of do that. But like he said, there hasn't been many questions. The machine has sort of run like clockwork for the last few months.	They have designed VE in a way that covers everything they need to cover. In case of open questions during work, the user can get answers from other colleagues.	VE covers pre-defined information designed by them, which assumes what the user needs to know before going to work in the actual environment. Compared to this, questions, such as ones about the machine, rise during the work itself, and can be answered by his colleagues.	VE has pre-defined information that covers what they assume is everything that you need to cover, when questions arising during ones work make the user go to other colleagues for information he needs at that time. VE information is pre-problem/work experience, actual environment information is post-problem/work experience.	Apparently open questions+asking colleagues weren't part of the VE training. At the same time, open questions are just-in-time by nature. They arise while working, as compared to the VE, which is predefined.

	Original transcript	Transformation 1	T2	T3	Reflection/notes
38.	I: I think I'll just thank you then, and… G: Is that it yeah, just carry on yeah. I: Umm… [pause, looking at the notes] You know, it's, I think. In many ways we've covered some of these you know. Umm… 'Cause it was more, more, you know, about… What my-my study tries to understand is what different factors of, like the real work process… [G: yeah] aa, should be in these kinds of training environments. G: Exactly right, yeah. I: I think, you know, lot's of that comes through in what you say… G: Yeah. Hands-on, definitely hands-on [I: yeah and…],	The interviewer thanks Gerrard who asks is that it, just carry on. The interviewer looks at the notes and says they have already covered most of the questions he has. He also tries to communicate what his study is about, which he currently sees as trying to understand what real work process factors should be in such virtual training environments. G understands this, and the interviewer confirms many such things come through in G's account, to which G replies, hands-on, definitely hands-on.	When the interviewer explains that his study examines how different factors from real work processes should be in these kinds of training environments, the user comments, definitely hands-on.		
39.	G: That said, that computer thing… fail 'n that, it would be better to just, you know, you training with just, spend one or two with someone by your side. [I: Mm.]. Pretty much them doing what the machine does, and you just basically shadowing them. And that would be the next way to do it.	G says that failing the computer thing, it would be better to just you spending one or two days with someone by your side. Pretty much them doing what the machine does, and you just basically shadow them. To G, that would be the next way to do it.	The user explains that learning through observing and modelling from another more experienced person would be the next, better, way to learn the job.	The user explains that compared to the VTE, the next best thing to learn the job would be to shadow a colleague that performs the job.		Vague.
40.	G: But like I said, that computer test was really good… Just a… froze up a couple of times [laughter] so… yeah. I don't know what the issue was [there ?], so… [coughing]	But as he said, the computer test was really good, it just froze up a couple of times and he doesn't know what the issue was there.	The user felt the computer test was valuable even if it had some problems. The reasons to these are still an open mystery to him.	The reasons behind the computer test freezing up are still an open mystery to the user. Despite of that, he enjoyed it.	

MUs: Linda (L)					
Original transcript *(Discriminated meaning units in their original form – passages clearly unrelated to the experience of VE were removed)*	**Transformation 1** *(Discriminated meaning units expressed as much as possible in the subject's language and based upon perspective that description was an example of the experience of a virtual environment)*	**T2** *(Discriminated meaning units expressed more directly in HCI language and with respect to relevance for the phenomenon of virtual environment. Also the nickname is changed to 'the user' for easier analysis with the other accounts.)*	T3	Reflection/notes	
1. I: And… Can you basically… I don't know anything about the environment. L: Uh-huh. I: Umm, so could you like, describe anything about that when you started using the environment? L: Well, coming from the training and using the virtual training… and the	The interviewer asks L to describe anything about when she started to use the environment, to which she replies, coming from the training and using the virtual training and the walkthroughs, she found quite easy.	When asked to describe anything about when she started to use the environment, the user names two parts of the experience [virtual training and the walkthroughs] and says she found it quite easy.	When asked to describe anything about the time when she started using the VE, the user describes finding the virtual training and the walkthroughs easy.		

	walkthroughs. Umm… I found quite easy.			
2.	L: And, I really think it helped with… umm… familiarizing yourself [someone comes from the door to talk to Linda] L: It really helped with familiarizing you with an area… that you haven't seen before. So after doing the training and then walking into the actual… the reality. Umm… It was quite comfortable. Because you, you had remembered it from the virtual training. Umm… That was, I found really helpful.	She thinks it really helped with familiarizing yourself with an area that you haven't seen before. So after doing the training and then walking into the actual reality was quite comfortable. Because you had remembered it from the virtual training. She found that really helpful.	She says using the VE helped to become familiar with an area you had not seen before. After the training when she walked to the actual reality she remembered things from the virtual training and it made it feel comfortable and helpful.		
3.	L: Umm… And there was some… umm… quite specific aspects of the training. Umm… that was still… held. In memory. After the training. That was something what I thought that may have dropped off a little bit. Because… It was quite fascinating moving myself through the virtual environment and I was little bit worried that my brain would be more interested in the actual function of the training rather than the information. But I think we had questions with the training as well as we went through. And I think that consolidated… the memory… of the virtual with what we needed to know as far as… umm… retaining the infor[br]… the actual information.	And there were some quite specific aspects of the training that were still held in memory after the training. That was something what she though that might have dropped off a little bit. Because it was quite fascinating moving herself through the virtual environment and she was little bit worried that her brain would be more interested in the actual function of the training rather than the information. But she thinks they had questions with the training as well as they went through, and she thinks that consolidated the memory of the virtual with what we needed to know as far as retaining the actual information.	The user was slightly worried if fascination with moving herself through the VE would have taken too much of her attention from learning the actual topic of the training. But she remembers they also had questions as part of that, which she thinks consolidated the memory of the virtual environment with the actual topic-related information they needed to know.	The user was slightly worried if fascination with moving herself through the VE would have taken too much of her attention from learning the actual topic of the training. Still, remembering quite specific aspects of the training that she thought she might have forgotten made her feel she retained the actual information. She evaluates that the questions in the training might have consolidated the memory of the virtual with what they needed to know.	What she is saying here is that she was afraid if she was too fascinated in moving in the virtual environment and if that had impacted her learning of the actual work-related information. Doesn't this mean she did not consider the moving part as learning?
4.	I: OK. So… what do you remember from the actual, like the training, you said you were walking through and then… L: Uhh-huh I: Like aa… You had a task or something that you had to do, or…? L: We actually went through the ta[br], from memory… and I hope this is correct. Umm… We went through the task umm, in segments, and then were asked questions. So, umm…	L is asked what she remembers from the actual training as she mentioned she had a task or something that she needed to do. She thinks they went through the task in segments and then were asked questions.	The user describes they had a task they needed to do, which they went through in segments, and then they were asked questions.		
5.	I: What was the task? L: The task was pressing umm… FSA, fluorosilicic acid from… umm… our plants' liquor. Umm, and purifying it so that we can	When asked what was the task, she replies it was pressing FSA from their plants' liquor and purifying it so that they can store that in a separate section of the plant. It's primarily to remove solids. It's a substance that isn't very good for you. You really shouldn't get it on	The user describes succinctly what the task was. Then she continues to describe real-life details on what the task entails. She explains how it is done, and how the materials dealt with are hazardous. When remembering how these were presented in the VE, she lists a		This is about what kind of an impact the VE had on her.

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	store that in a separate section of the plant. Umm… It's primarily to remove solids. Umm… It's… a substance that isn't very good for you. Umm… You can't get it, you really shouldn't get it on your skin. Umm… You shouldn't inhale it. Umm… So, it's important that people are doing it correctly, not only for… their own health but it's also for… the… for production. We need the acid… Umm, we need the acid to be on spec. And we also need to… kind of consume the acid out of the process, and the liquor. Umm… And we also recycle the solids. So… the whole process is important really. I: OK. And, that was… somehow in the environment? The training environment? L: It was. Umm, there was specifics in the training environment, as to… umm, from memory, different pHs… umm and the testing, the lab section of the virtual training. Umm, and as I said, probably the biggest part that I found was… the familiarity and walking out in, on to the plant. Umm… It didn't seem so foreign. It seemed like you walked through it before which I was quite surprised about, because I thought maybe… being virtual [lp]… you wouldn't… process it as well as what I think I did. So I thought it was good.	your skin. You shouldn't inhale it. So, it's important that people are doing it correctly, not only for their own health but it's also for the production. They need the acid to be on spec. And they also need to sort of consume the acid out of the process, and the liquor. And they also recycle the solids. So, the whole process is important really. When asked if that was somehow in the training environment, L says there were specifics in the training environment, as to, from memory, different pHs, the testing and the lab section of the virtual training. And as she said, probably the biggest part that she found was the familiarity and walking out on the plant. It did not seem foreign; it seemed like you walked through it before. Which she was quite surprised about, because she thought maybe being virtual, you wouldn't process it as well as what she thinks she did. So she thought it was good.	specific detail [pHs], a certain process [the testing] and a location [the lab section]. She follows up these details by emphasising that the most important part for her was the experience of familiarity. When she walked out on the actual work place, it did not seem foreign; it seemed like you walked through it before. The familiarity the user experienced took her by surprise because she had not anticipated the virtual having such an impact on her.		
6.	I: OK. Can you remember, that's quite interesting what you say, aa. Like… Can you remember what made you feel it was familiar, like… It can be so many things… L: Because… I suppose… umm the virtual program… was laid out in such a way that it made sense and you were familiar [br] It's like you'd seen it before, even though the graphics were different obviously. They weren't real time graphics.	When asked can she remember what made her feel it was familiar, she supposes that the virtual program was laid out in such a way that it made sense. It's like you'd seen it before, even through the graphics were different obviously. They weren't real time graphics.	When asked what created the feel of familiarity, the user explains that it was brought by how the VE was laid out in such a way that it made sense. Although the VE graphics were different from what you see in the real [weren't real time graphics], they made her feel like she had seen it before.		An important MU, could use as a highlight quote.
7.	L: Umm, and there was the novelty of actually moving yourself about in it which took a little	And there was the novelty of actually moving yourself about in it, which took a little bit of practice.	She also describes that actually moving yourself in the VE had a novelty effect and needed some practicing.	For the user, controlling her movement in the VE [actually moving yourself about in it] had a novelty aspect and took a bit of practice.	

	bit of practice, but… [smiling]			
8.	L: And, I was a lot better than my peer, which was quite funny. He could get in stranded on a roof, I remember. He couldn't get off; he had to keep starting again. I: So you could go on a roof? L: Umm, when we were doing the virtual… walkthrough. I had a colleague sitting beside me. And for some funny reason, I don't know what [br] how he was managing to do it, because I couldn't find a way of doing it. He kept putting his [lp] his… self. Like you're looking it at from a first person perspective aren't you? [I: yeah, yeah]. Well, he kept putting himself on the roof of the hut. And then when he tried to get off, he couldn't get himself off it. So he couldn't continue on with the… program. And it was absolutely hilarious because he was trying to get me to help him, because I was [laughter] moving through. And umm… That was quite funny so he had to start again a couple of times.	And she was a lot better than her peer, which was quite funny. He could get stranded on a roof. He couldn't get off; he had to keep restarting again. She is asked if she could go on a roof, to which she explains that when they were doing the virtual walkthrough, she had a colleague sitting besides her. And for some funny reason, she doesn't know how he managed to do it because she couldn't find a way of doing it, he kept putting his… self – like you are looking it at from a first person perspective aren't you? she asks – he kept putting himself on the roof of the hut, and then when he tried to get off, he couldn't get himself off it. So he couldn't continue with the program. And it was absolutely hilarious because he was trying to get her to help him, because she was moving through, she laughs. And that was quite funny so he had to start again a couple of times.	The user explains she was better than her colleague in using the environment. She describes a funny event in which she was using the virtual environment in the same room with another colleague who was using his VE on his own computer next to her. During a virtual walkthrough, for reasons the user does not understand, her colleague managed to use the environment in a way she could not even if she tried: the colleague kept putting his "self" [the first person perspective] to one location in the environment but could not get off from there. He was not able to continue with the program before restarting it. Her colleague tried to get her to help him, because she was moving through effortlessly.		A glitch.
9.	I: So is that something that you can actually do, or? No? L: No. No. You would get in trouble [laughter]. No. You wouldn't want to be getting up on the, on the lab roof, or any roof for that matter.	When further asked if that is something one can actually do, L says no, and that you would get in trouble, she laughs. No. You wouldn't want to be getting up on the, on the lab roof, or any roof for that matter.	When asked if getting to this location in the VE is something you could actually do in the real environment, the user laughs that you would not want to get to this location [the roof] in the real life, as it would get you in trouble.		
10.	I: So, some sort of an error in the software then? L: It's a gli [br]. It's kind of one of those funny glitches. I: Yeah. L: But, it, it was good. It was good. I found it useful.	The interviewer notes that it was some sort of an error in the software then, to which L replies that it was kind of one of those funny glitches. But it was good, she found it useful.	The user describes the problem her colleague had in the VE as one of those funny glitches, but despite of it says she still found it useful.		
11.	L: And as I said, the novelty of actually moving yourself through the virtual environment… umm [lp]… And it is a bit of a novelty. Because immediately, I don't play a lot of umm… computer games, I know a lot of the boys do,	And as she said, the novelty of actually moving yourself through the virtual environment – and it is a bit of a novelty – because she doesn't play a lot of computer games, but she knows a lot of the boys do,	As the user does not play a lot of computer games, she knows many of her male colleagues do [the boys], moving through the VE was a novel aspect in her experience.		
12.	L: and we also discussed that afterwards. Umm, there was some people who said that… umm… That the graphics and	and they discussed that afterwards. There were some people who said that the graphics and moving through the environment didn't make them feel well. It made them feel a bit, like, seasick.	The user experience was something she discussed with her peers. Some said the graphics and moving through the environment made them feel ill, similarly to being seasick. At the same time,		Interesting that sick and fun are the opposites here. This brings yet another aspect to think about when adopting VEs to training: their physical effect to users.

moving through the environment didn't make them feel well. It made them feel a bit, like, seasick. [I: Aa, OK.] Whereas others thought it was really good fun. I: Did you use a computer screen? L: Uhum. Our flats. I: So just a regular [talking at the same time]… L: Yeah. And it was a bit because of that, it was like that over there [pointing one]. I: Yeah, that's a small one. L: Umm… And… I didn't find it made me feel sick. I actually thought it was quite fun.	Whereas others thought it was really good fun. She is asked if she used a computer screen and she replies their flats, and it was a bit like that over there, she points out to one. L didn't find it made her feel sick, she actually though it was quite fun.	some experienced using the VE as good fun – this also included the user. She did not feel it made her feel sick, but in comparison she though it was fun.		Discussing and comparing the user experience with others is the social layer of user experience.
13. L: Umm… But, as I said, once I took it down to the real environment, I actually found it quite useful because I retained a lot more information… I think, from the questions and having the visual… The visual marks. When I got to the real world, I didn't feel… I felt familiar.	But as she said, once she took it down to the real environment, she actually found it quite useful because she retained a lot more information, she believes, from the questions and having the visual marks. When she got to the real world, she felt familiar.	When reflecting the time when she went to the real environment after the training, the user felt retaining a lot more information from the questions and what she had seen in the VE. When she got to the real world, she felt familiar.		The last sentence could even be a heading for one of the constituents.
14. I: Mm. Can you be even more specific, like, if you went to the, your, where you work here. Was it, like the sound, or what you saw, or the process or what…? L: I think it was… It's quite funny being a process tech, because you can feel quite isolated. You're wearing Monogoggles [certain brand of safety glasses]. You're wearing gloves. You're wearing hearing protection. You're wearing everything. And you're very reliant on the visual… umm, for just about everything. Umm… [coughing] In some instances, especially on that plant, umm, you'll have all of the above, and you'll have BA. So… really, you shouldn't able to smell anything, hear and[br], hear very little. Umm… You shouldn't be able to taste anything unless you are in terrible trouble, you can't feel anything… So you're ve[br] You're heavily reliant on your sense of sight. Umm, and I think it heightens that, you're always looking about to make sure that something hasn't failed or something isn't broken. You can hear to a degree.	When asked to be more specific, she begins by explaining it is quite funny being a process tech, because you can feel quite isolated. You're wearing Monogoggles [certain brand of safety glasses], you're wearing gloves, you're wearing hearing protection, you're wearing everything. And you're very reliant on the visual for just about everything. In some instances, especially on that plant, you'll have all of the above, and you'll have BA. So really, you shouldn't able to smell anything, and hear very little. You shouldn't be able to taste anything unless you are in terrible trouble, you can't feel anything. So you're heavily reliant on your sense of sight, and she thinks it heightens that, you're always looking about to make sure that something hasn't failed or something isn't broken. You can hear to a degree. But really, in certain environments if you're hearing something, it'll be because it's failed. So, you've got to react quite quickly. So she thinks, when she talks about the specifics of the environment, coming out of the virtual into the real, she thinks it would have to do with the placement of things, and where they were. And she thinks that was explained quite well in the virtual: the valves, the main part of the suction, the discharge of the press, where the lab sampling is connected from and things like that.	When asked to be more specific what created that experience, the user begins by explaining that in her job you can feel quite isolated based on all the gear you wear. This means that almost all aspects of the work depend on visual and your sense of sight: this heightens that you are always actively looking that nothing has failed or broken. When she reflects this to coming out of the virtual into the real, she thinks it is to do how the VE presented and explained the location of objects.	When asked to be more specific what created the experience of familiarity, the user explains that in her job you can feel quite isolated with all the equipment you wear. This means that almost all aspects of the work depend on visual perception: this heightens that you are always actively looking that nothing has failed or broken. If something triggers your other senses, you know something is wrong and you have to react fast. So when the user compares between the VE and the real environment, she thinks the placement of things in the VE had an important role.	She says 'visual'. How might other jobs compare to this? It's also interesting how she says that it heightens seeing, basically communicating the need for an active process of seeing. It does not matter if we have the sense of sight if we do not exercise it actively.

The difference between VE and the real. |

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Umm… But really, in certain environments if you're hearing something, it'll be because it's failed. Umm… So, you've got to react quite quickly. Umm…
L: So… I think… When I talk about the specifics of the [lp]… umm: environment: coming out of the virtual into the real. I think it would have to do with the placement of things, and were they were. And I think that was explained quite well in the… umm, virtual.
I: Mm.
L: You know, the valves and the main part of the umm… the suction and the discharge of the press, and… where the lab sampling, umm, is connected from and things like that.

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I: So, how do you make… How do you make like this, you said that… you hear something and then you know something is wrong, because… It's like the absence of sound is that everything's good. But, is that the only thing, like… How do you make decision or, or…? How do you make decisions?
L: Umm… Making decisions as a process technician, you still use those things, but you use them completely differently from what you do in everyday life. If you have hearing protection in,… umm… you're used to walking around the environment that you're in and hearing very muffled sounds. Umm, if a pump is not working regularly, if there's something wrong, if it's cavitating(?), umm or there's a blockage or something like that you may get an underlying, like a vibration. Umm, you can feel vibrations to your feet, if you walk past things. Umm, and you'll be familiar with the plant equipment and that [br]… And in a general running state, you'll actually feel… the vibration as you walk by it. And you'll hear what it usually… sounds like. And then you're… umm, be aware of when something is wrong. It'd change. Umm…

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The interviewer refers to L saying that if she hears something its wrong, and asks how does L then make decisions? She replies that making decisions as a process technician, you still use those things, but you use them completely differently from what you do in everyday life. If you have hearing protection, you're used to walking around the environment that you're in and hearing very muffled sounds. If a pump is not working regularly, if there's something wrong, if it's cavitating(?), or there's a blockage or something like that you may get an underlying, like a vibration. You can feel vibrations to your feet, if you walk past things. You'll be familiar with the plant equipment and that… And in a general running state, you'll actually feel the vibration as you walk by it. And you'll hear what it usually sounds like. And then you're aware of when something is wrong. It'd change. You do use your, even though your hands are a cloved, you can use your hands still to feel the vibration of liquor or something moving through a pipe [hitting the table at the same time with a hand when explaining it]. Or feel the vibration in the pump. Yeah, so there are all of those things. You do smell sometimes. But usually, if you smell something that's unfamiliar or you smell something like that's very very hot and shouldn't be. It's quite an accurate smell. And you won't have your BA [Breathing Apparatus] on then. But if you're working through particular areas, like the FSA area for instance on a very hot day. If there's vapours that rise up from the ground. And you have to wear your BA. Because it's just very unpleasant work in that environment.
As L says that she can evaluate many of the things in the

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The user replies no to a question that asks if things such as feeling how the machine works could be developed in a VE. She thinks things such as operating with feeling and listening comes from experience, actually doing them the way she does them in real life. She tries to imagine how these could be incorporated as part of the VE, and thinks for example where perhaps questions would be corresponding with a different sound. She thinks some users might feel this as a distraction.

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The user describes how wearing different safety gear in her work affects the senses: everything seems more reduced and her work senses are used differently from everyday life. For example, feeling the state of things with your body has a larger role in being aware of the machine process. She does not think such things could be implemented in a VE, as you learn to pay attention to them through experience. The user tries to imagine if for example changing sounds and matching them with questions in the VE might work, but she thinks it might be distracting to some users.

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One aspect of this MU is that to her, imagining a multimodal experience and how it could be developed in a VE seems impossible – it is not an objective fact, but when she reflects this idea to her real-world experiences, she finds something like difficult to be designed.

In the first part she is explaining how she experiences her work environment. This might be important for developing a virtual environment that better corresponds to it, but is not entirely related to the current user experience research question. The next paragraphs builds on this and explores an imaginative variation during the interview. The aim is to get L actively to imagine if her multimodal experience of her actual work environment could be developed in a virtual training environment.

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You do use your, even though your hands are a cloved, you can use your hands still to… feel the vibration of… umm, liquor or something moving through a pipe [hitting the table at the same time with a hand when explaining it]. Or feel the vibration in the pump. Umm… [lp]… Yeah, so there's all of those things. You do smell sometimes. But usually, if you're smelling umm, something that's unfamiliar or you're smelling something…, like… that's very very hot and shouldn't be. It's quite an accurate smell. Umm… And you won't have your BA [Breathing Apparatus] on then. Umm, but if you're work[br], walk[br], working through particular areas. Like the FSA area for instance on a very hot day. If… there's vapours that rise up from the ground. And you have to wear your BA. Because it's just very unpleasant work…, in that environment.
I: So, let's…
Hmm… [lp]… So if we, like, imagine for a second that somehow these could be, would it be useful to have these in the training environment? I'm not sure how it would even be possible, but…
Because you say that, lots of these things are… You know, you feel them. And I'm… I don't think you kind of, have them in training environments.
L: No you don't, and I think umm… I know…… I know when I've been put with good… trainers. With older… umm…they're usually gentlemen 'cause there's not really [word missing] women in this field. But when I've been put with… umm… more experienced operators than myself, and my last boss was invaluable. Where I used to work before. Umm… He… always said to me it's good to be inquisitive, it's good to… umm…… you know, feel things. And listen for things. So, I think that comes from

environment with touch, the interviewer reflects if it is even possible to get those things implemented in a virtual environment, and would she find them useful. No you don't, she says. She knows when she has been put with good trainers, they're usually gentlemen 'cause there's not really [word missing] women in this field, but when she has been put with more experienced operators than herself, and her last boss was invaluable where she used to work before, he always said to he it's good to be inquisitive. It's good to you know, feel things. And listen for things. So, she thinks that comes from experience. She doesn't think it comes from, she doesn't know how they can corporate into the virtual thing, unless they had, like a background noise of the actual plant, when they were doing the questions. And then the last one changed that sound, and then say, include that in the last set of questions. But she doesn't know if some people would think that's quite distracting. Because some of the people were using the training package, the trained operators, the contractors, who were just using that particular small section of plant equipment. She thinks it would be good for them to know that, and not take it for granted. But she doesn't know if you'd had to add another layer of understanding or another layer of … training to the video.

	experience. It…, I don't think it comes from…… you know… I don't know how we can corporate into the virtual thing, unless we had, like a background noise… of the actual plant, when we were doing the questions. Umm… And then the last one changed that sound. Umm, and then say… you know, include that in the last set of questions. But I don't know if some people would think that that's quite distracting because… Some of the people were using the training package… Umm, trained operators, the, umm… contractors. Who were just using that particular small section of plant equipment. Umm… I think it would be good for them to know that. Umm, and not take it for granted. But… umm… yeah, I don't know… if you'd had to add… another layer of understanding or another layer of [lp]… Training to the video.			
16.	I: Did the, did the… the virtual environment describe this… kind of like, feeling the environment at all in any way? Or that there's a possibility for that? L: I think, I'm sure it went over the safety aspect. Umm… But… I don't know, and probably that's a very girl thing to say in this environment, because… You know, you might ask like I said you might ask an experienced operator and he completely agree, but… umm… I don't think it comes up… a lot as described as "a feel" [rising intonation]. I: mm-mm-mm. I just mean [lp] that was there anything in the, like the virtual environment that,… kind of conveyed that it's possible to… not just read that… the machine works like this, but actually like… [lp] What word can you use for that "feel"? Well… [lp] Mm… [lp] Well perhaps that [Linda interrupts] L: Was there a depth to the… There was a depth to the virtual… world. And if I remember	The interviewer asks did the virtual environment describe feeling the environment in any way or that there's a possibility for that? L is sure it went over the safety aspect. But she doesn't know, and she continues that probably that is a very girly thing to say in this environment because you might ask an experienced operator and he completely agrees, but she does not think it comes up a lot as described as "a feel" [rising intonation]. The interviewer tries to ask a further clarifying question if the VE conveyed somehow that instead of just reading how the machine works, you could "feel" it? L interrupts by asking, was there a depth to the virtual world? And if she remembers correctly, there as noise in it as well, wasn't there, she asks the interviewer who replies he does not know as he has not seen the VE. L says, she thinks there may have been sound in it.	The user is asked if the VE conveyed the possibility of feeling the environment, to which the user replies that she is sure it went over the safety aspect. Then she says that using the term "feel" might be a girly thing to say in this context – although some experienced colleagues would agree but it would not be usually described as "a feel". She is asked a follow up question to specify if the VE somehow conveyed that one could "feel" instead of just read how the machine works. To this the user notes that there might have been depth to the virtual world, and she is not sure, but thinks there might have been sound in it too.	When the interviewer asks if the VE discussed the idea of "feeling" the work environment, the user is not sure although she thinks it was related to a discussion on safety. Also to her, using the term "feel" in this context is not a conventionally used term and might be considered "girly", even if other experienced colleagues might agree with what it stands for. When further asked if the VE conveyed the possibility to "feel" the machine working, the user tries to remember if there was any such depth to the VE, and if it had noise and sound in it, but she is not sure.	See others about sounds, as there were participants who were not sure about the sound either. It is unsure what is the meaning of her responses. The interview question in itself might be slightly vague, but she replies to it anyway. In both cases, when asked if VE conveyed made her understand that the operation in the environment could rely on other senses as well as seeing, she replies unexpectedly. In the first reply she says, it went over the safety aspect and in the second, she reflects but is not sure if there was depth to the virtual world with noise in it.

	correctly, there was noise in it as well, wasn't it? I: I don't know, I haven't seen that [laughter], so that's why I'm asking. L: I think there may have been sound in it.				
17.	L: Umm… [lp] But… [lp] Yeah as I said I found it really useful… to put together with… the real plant. Umm… But I don't know how I would've gone if I'd done the virtual training and somebody blindfolded me and then put me on, in the real world. I think that would be a…… That would be difficult.	But as she said, she found it really useful to put together with the real plant. But she does not know how she would've gone if she had done the virtual training and somebody blindfolded her and then put her on in the real world. She thinks that would be difficult.	The user took the VE very useful when put together with the actual work setting, but is unsure how well she would have performed in the real world only with the VE training.		Vague.
18.	I: Was there something in the virtual training environment that… you [lp] Aaa… Would change? That you could be able to do, but couldn't? If you look back to it now. [lp] That would help you in that environment where you are now? L: Umm… [lp] Without complicating things too much I would like to see… some examples of when things… [lp] come out of… range. Like, not what we want. Umm… Maybe, examples of getting a… [lp] a bad test. Umm, like the liquor's too hot or… the pH has gone out of range. Or you've done this, and you've worked through what you'd ordinarily do, but the acid, umm, the pH isn't coming down or the strength isn't changing. Umm…… I think that. And…… L: Being a woman, I'd would also like something included in there, I don't know if we went over, have like house keeping. In the… umm… virtual world. [lp] Maybe it would reinforce… I: What do you mean with housekeeping? L: Housekeeping meaning keeping the area clean. Umm… Mm, especially if you're taking lab…… If you taking, things somewhere to test them. I don't really believe you can get really good… test. In… an environment where… everything's badly placed, but…	The interviewer asks if there was anything in the virtual environment she would change, something she could be able to do but couldn't, something that would help her in that environment where she is now? L says that without complicating things too much, she would like to see example of when things come out of range. Like, not what they want. Maybe examples of getting a bad test, like the liquor's too hot or the pH has gone out of range. Or you've done this, and you've worked through what you'd ordinarily do, but the acid, the pH isn't coming down or the strength isn't changing. Being a woman, she would also like something included there, she is not sure if they went it over, having like housekeeping in the virtual world. The interviewer asks what does she mean with housekeeping. She says, housekeeping meaning keeping the area clean. Especially if you're taking things somewhere to test them, she doesn't really believe you can get really good test in an environment where everything's [badly placed?].	When asked if the user would change anything in the VE, something that she was not able to do but would find helpful in her work environment, she says promptly that she would like to see example scenarios when things do not go as anticipated [bad test results] or when things go wrong even if you maintain the normal routine (the material is not responding to your normal actions). The user would also like something included that she calls as 'housekeeping', which might help to keep the work area clean and in order. She says her opinion might be because she is a woman, but explains that she does not think a certain procedure can be performed well if the environment where it takes place is not kept in order.		

#	Transcript			
19.	I: So how was that in, in, in the environment? The training environment. L: I… The training environment was very similar. They had I think, sure you [br] They had you going in to a shed. Umm, and they had a desk. With things on it. Umm, and that was fine. But… umm… It kind of umm…… Yeah…	When asked how was that in the training environment, she says the training environment was very similar. She thinks they had you going in to a shed. And they had a desk. With things on it. And that was fine.	When asked how the specific work process was done in the VTE, the user compares it as very similar; she was made to go to a location, which had a table with certain objects on it. That seemed fine to her.		It is based on her judgment that the testing was similar and she also approves that by saying 'that was fine'.
20.	I: So you did that test, in the virtual environment? L: Yes, I'm sure they showed you. They showed you beakers and things like that. I: OK. [long pause] L: And how you take your test, and I'm sure they showed you where the lab was. Umm… I'm not, I can't recall completely if they actually put you through the entire test, like two jobs of this or… Umm… To put the thermometer in the beaker, I think they actually did.	The interviewer asks if she did that test in the virtual environment, she is sure they showed you, they showed you beakers and things like that. After a pause she continues, and how you take your test and she is sure they showed you where the lab was. She cannot recall completely if they actually put you through the entire test, like two jobs of this or to put the thermometer in the beaker. She thinks they actually did.	When asked if the user performed the work process in the VE, she says she is sure they showed you certain things that are related to it, how you do it and the place where you do it. She is not entirely sure though if she was put through the entire process with all its details.		Two things here: only partially "it", the test, and the environment or "they" put her through things.
21.	I: Mm-mm. OK. And you used the environment with mouse and keyboard, or? L: Mouse, keyboard and a screen… I'm pretty sure. I: Yeah, yeah. How did you feel that, like? L: I think it was fine, I managed quite fine. I'd imagine some of the older… umm… gentlemen that are here… umm, may have struggled a little bit.	When asked if she used the environment with mouse and keyboard, she says mouse, keyboard and screen, she is pretty sure. When asked how she felt about that, she thinks it was fine – she managed quite fine. She'd imagine some of the older gentlemen that are here might have struggled a little bit.	When asked if she used the regular control devices with the VE, she is pretty sure she did. She describes the feeling of using them as managing quite fine. She would imagine some of her older colleagues might have struggled a bit.		The feeling of using the controls is specifically defined as managing, being able to. Also thinking how others might have managed.
22.	L: And I did hear that. Umm… The main things that I heard about the virtual training's feedback… umm, was that, in some instances it made people feel ill. Like, they were a bit seasick because they were having trouble [lp] umm… perceiving. You know. Walking it through, it was kind of making them feel like they were a bit seasick. Umm, others said they had… hard time coordinating the movement through the world and they were getting a little bit frustrated with it and then it would take them longer and then they would kind of… getting [word missing] an even more annoyed [laughing].	And she did hear that. The main things that she heard about the virtual training's feedback, was that, in some instances it made people feel ill. Like, they were a bit seasick because they were having trouble, she is trying to find the word, perceiving. You know. Walking it through, it was kind of making them feel like they were a bit seasick. Others said they had hard time coordinating the movement through the world and they were getting a little bit frustrated with it and then it would take them longer and then they would kind of getting [word missing] an even more annoyed [laughing].	The user also heard that using the environment was difficult to some. Because they had trouble of perceiving it while controlling [walking it through], it was making some feel seasick. Other problems that she heard was that the difficulty to control [coordination of movement] made some people frustrated as it took them longer to use the VE, which made them even more annoyed.		

#	Transcript	Column 2	Column 3	Column 4	Column 5
23.	L: Umm… Some people play a lot of video games. And my general impression was that they found it very easy. And I have children who play video games, quite a bit, umm… The likes of, like Assassin's Creed and stuff like that. So I've seen them play it, but myself I haven't played very much of it. Umm… It's usually only when they've asked me to and I can't… [laughter] I: [Laughter] L:…make any more excuses. But I actually found it quite easy. I though it, I found it quite fun.	Some people play a lot of video games, she says, and her general impression was that they found it very easy. And she has children who play video games quite a bit – the likes of, like Assassin's Creed and stuff like that. So she has seen them play it, but herself she hasn't played very much of it – it's usually only when they've asked her to and she can't make any more excuses, she laughs. But she actually found it quite easy. She though it, she found it quite fun.	With people who play a lot of video games, the user's general impression was that using the VE was very easy for them. She explains how she has sometimes had to play video games with her kids, although she does that only when they insist. She found the VE quite easy and fun.	The user felt that those who play a lot of video games found the VE very easy. Her children sometimes make her play although she is not too much interested in playing. Still, she found this VE as quite easy and fun.	When you are accustomed to the medium, you can enjoy it more easily?
24.	I: Would there be anything like, anything that comes to your mind that would make the training environment more like your real work environment? What would it be? [lp] Anything from the visual, the sounds, the process of the work…… people… objects…? L: In some aspects I wish I'd been able to sit through the virtual again before we had this interview. Umm, because as I said, I did do the virtual training, umm, quite some time ago. I: And that's totally OK. L: Umm, I think I found…… I don't, I don't know if this is absolutely correct, but I think I found, the order on the virtual was a little bit out. Depending on what result that you actually got at the… umm, from the samples. Umm… I: Can you explain, what do you mean order? L: Yeah, well… You go and connect your samp[br], you line up the plant. Ensure the plant's in the [br] and they are correctly lined up. And it's clean. Umm, then you go through the process of actually pressing acid. Umm… so you go to the control room. Oh, sorry… After you've checked the plant and everything else, you take a sample. Umm… Depending on what your sample comes back as, what readings that you actually get, after you've taken that sample to the lab [smiling]. Umm, you either press or you	The interviewer asks would there be anything that made the training environment more like her real work environment, things like visual, the sounds, the process of the work, people, objects… L says in some aspects she wish she'd been able to sit through the virtual again before they had this interview. Because as she said, she did do the virtual training quite some time ago. The interviewer says that's totally OK. She is not sure if this is absolutely correct, but she thinks she found the order of the virtual was a little bit out – depending on what result that you actually got from the samples. She continues to explain that, you go and connect your samp[br], you line up the plant. Ensure the plant's in the [br] and they are correctly lined up. And it's clean. Then you go through the process of actually pressing acid. So you go to the control room. Oh, sorry she says, after you've checked the plant and everything else, you take a sample. Depending on what your sample comes back as, what readings that you actually get, after you've taken that sample to the lab, you either press or you don't press. So if you are pressing, you actually bring the packs together. Mind you, you've gone through all your PPE [Personal Protective Equipment] that you are requiring things like that, because you've done a walk around in the environment, so you know what's going on. At this stage you don't really need to be in full gear. Until you actually start pressing the acid. The interviewer asks what's PPE, to which L replies, 'Personal Protective Equipment'. She further explains that's masks, monogoggles, glasses, gloves… Then she continues to explain that there's this sequence you actually go through, and she doesn't recall in the virtual world if they went through, depending on what lab results that you got, you got. They may have said "go and see your… next up… line…" you know, your lead.	The user is asked if any changes in the VE would make it more like her real work environment. She refers to a certain work process and says she is not sure but she thinks the order you had to do things was not entirely correct [a little bit out]. She continues to explain how the actual work process runs. She is not sure if the VE took into consideration a certain evaluation stage in the process that affects what you might do next. She is not sure if they went into details with what different actions you might take. She thinks it would have been good to go a bit more in-depth with that.		Interview imaginative variation question. Simplified version of the actual process.

	don't press. Umm, so if you are pressing, you actually bring the packs together. Umm… Mind you, you've gone through all your PPE [Personal Protective Equipment] that you are requiring things like that, because you've done a walk around in the environment, so you know what's going on. At this stage you don't really need to be in full gear. Until you actually start pressing the acid, umm… I: So what's PPE? Short of? Bp, bp? [lp]The gear? L: Aa, sorry, PPE, PPE. I: So it is an abbreviation of…? L: It's umm… Personal Protective Equipment. I: OK, OK. L: Sorry. I: No, no worries. L: So that's masks, monogoggles, glasses, gloves… I: Protective equipment… L: Yes. I: Alright. [long pause] I: OK, sorry. L: It's alright. So there's this sequence you actually go through. And, I don't recall in the virtual world if umm… they… went through, depending on what lab results that you got, you got. They may have said "go and see your… next up… line…" you know, your lead. L: Umm… But… Depending on what result you had…… It would've been good that, there was bit of an explanation that went in to it a little bit more in-depth. Umm…	But depending on what result you had, it would've been good that, there was a bit of an explanation that went in to it a little bit more in-depth.			
25.	L: Because I think, again, like I said, the… virtual world consolidated itself once we got out into the real world. And I think, that may be… the same thing would happen with a little bit more… technical information. I: Yeah. L: Without being… too technical, without… going over the top.	Because she thinks, again, like she said, the virtual world consolidated itself once they got out into the real world. And she thinks, that may be the same thing would happen with a little bit more technical information, without being too technical and going over the top.	The VE experience became a more coherent whole once they got out into the real world [the virtual world consolidated itself]. The user thinks more technical information would have been useful and it would not had overladed the user [going over the top].		VE was experienced only as partial.
26.	I: Mm. [lp] OK. Just wonder how they… designed the environment in the first place in away that. Because… [lp] After talking to you and, and [name removed] before. It seems that it's	The interviewer reflects how the VE was designed in the first place because it seems quite precise to him based on the subject's description. To this, L replies that there's lot's of variables, because when you go out on the plant. there's lots of different things. You might have bulkies (?), like, with, for	As the interviewer reflects on how the VE might have been designed and how it captures the precision of the environment, the user says there's lots of variables. She explains how different variables might affect the work process and what you do next. During one example she says		

quite…… still quite precise. You know, in a way, description. As precise as you can perhaps in a sort of way. L: There's lot's of variables, because you, when you go out on the plant. Umm…… There's lots of different things. You might have bulkies (?), like, with, for instance on the FSA plant we used, we use hydrogen peroxide. The bulky might be half full. It may be nearly empty. There might be one there on stand-by. There may not be. You might have to organise to get another one. Umm… I don't think that was… that was in the virtual training. Umm… You might have a leak. You might have to transfer the tank over the road. Umm, the pH may have peaked… in the scrubber system. And it hadn't been picked up correctly. So… basically it's almost saturated. So then you got to rely on the… umm, lead. Your lead operator, to help you sort that out. Umm… Sometimes the samp is full, sometimes the samp isn't full. So depending on what situation you are there depends on what action you actually take to get to control of… the scrubber system. And the scrubber system is incredibly important, on all aspects. Important for production and support for the, the environment. It's important for a lot of things. Umm, so we are not just pressing acid. It's kind of got an… overview. It's got a lot of influence on a lot of things. I: So it's a complicated process? L: It's a very simple process[br] That particular little plant…… is… is kind of isolated. But… It's very important when it's put into the whole. But it's very, very, very simple little plant to run. Umm, compared to a boiler or… umm… you know, a little gas plant or something like that. It's incredibly simple. Umm… [lp] Yeah, incredibly simple.	instance on the FSA plant they used, they use hydrogen peroxide. The bulky might be half full, it may be nearly empty. There might be one there on stand-by, there may not be. You might have to organise to get another one. She doesn't think that was in the virtual training. You might have a leak. You might have to transfer the tank over the road. The pH may have peaked in the scrubber system, and it hadn't been picked up correctly. So basically it's almost saturated. So then you got to rely on the lead. Your lead operator, to help you sort that out. Sometimes the samp is full, sometimes the samp isn't full. So depending on what situation you are there depends on what action you actually take to get to control of the scrubber system. And the scrubber system is incredibly important, on all aspects. Important for production and support for the, the environment. It's important for a lot of things. So they are not just pressing acid. It's kind of got an overview. It's got a lot of influence on a lot of things. To this the interviewer notes that it is a complicated process. L says it's a very simple process. That particular little plant is kind of isolated, but it's very important when it's put into the whole. But it's very, very, very simple little plant to run, compared to a boiler or, you know, a little gas plant or something like that. It's incredibly simple. After a pause she repeats, yeah, incredibly simple.	she does not think it was in the virtual training. She concludes that they are not just doing one thing in their job: their part is an important part that has an influence on the whole. To this the interviewer queries that it is a complicated process then. The user says it is actually a very simple process. Their section might be an isolated unit, but it is very important when put in the whole.		
27. I: So you, you said that you used the	The interviewer reconfirms that L used the environment	When asked about if she used the environment alone or was		Interestingly, although it is a bug or a glitch as she says, she

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environment alone? In a way that… There wasn't a collaboration aspect? L: No, we had a really good laugh about my colleague. Because I know him quite well. He was my lead operator. Umm, he kept, getting stuck on a roof somewhere. And I remember that being terribly funny. And we did talk about that as we went round, because we were both enjoying it. But… umm… [lp] Yeah, I think I gave a couple of… I said…. To the guys about a couple of things. Umm… About the program. Because there were a number of us doing it at the same time. Because they asked [word missing] how was it? And, maybe, umm, gave them a couple of tips and kind of said it was really good. But… umm, besides that, no, not really. Umm… I: Like, I mean, directly in the environment, like the virtual environment. Because… you have colleagues that you work with… L: Mm-hy. I did the training with one other gentleman. Umm, his name is [name removed]. Umm… He's been operating a lot longer that what I have. Umm, and I suppose there was talk between us…. Umm… While we were actually doing the… things, but we were doing quite, kind of independently. Umm, at one stage I was going a lot quicker than what he was and then he got the hang of it and then he was going really, really quickly. So… umm… there wasn't, we weren't kind of waiting each ot[br], for each other as we were going along.	alone and that there was no collaboration aspect. L says no, and that they had a really good laugh about her colleague. Because she knows him quite well. He was her lead operator. He kept getting stuck on a roof somewhere. And she remembers that being terribly funny. And they did talk about that as they went round, because they were both enjoying it. She thinks she said to the guys about a couple of things about the program. Because there were a number of them doing it at the same time. Because they asked [word missing] how was it? And maybe, she gave them a couple of tips and kind of said it was really good. But besides that, no, not really. The interviewer clarifies, directly in the virtual environment. To this, L says she did the training with one other gentleman. He's been operating a lot longer that what she has. She supposes there was talk between them – while they were actually doing the things – but they were doing quite, kind of independently. At one stage she was going a lot quicker than what he was and then he got the hang of it and then he was going really, really quickly. So there wasn't, they weren't kind of waiting for each other as they were going along.	there a collaboration aspect present, she says there was not, but she had a good laugh on her colleague while he was getting himself in trouble in the VE. When asked more clearly if they collaborated directly in the VE, the user says she did the training with a colleague. Although during the training they were aware of each other's performance, they were doing it independently. She also reminds giving some feedback to some people after using the VE.		is still referring to it as if the VE navigational problems were an active achievement of her colleague. Although she helped her colleague she did not feel collaborating as such, presumably because they used the VE on their own computers alone.
28. I: Yeah, yeah. How about like… Because I understand that… the… when you are in the environment, you're kind of the only person. So how, you know I mean like, as the computer character. L: Yeah, you are the only person I'm pretty sure. I: Yeah. So how does that kinda	The interviewer asks that based on his understanding, you are the only person in the environment: How did that reflect her work situation, does she have lots of exchange of information with different people? L says that the only person really that you would exchange information with is your lead operator in the control room… and in some instances your engineer. But basically while you're pressing the acid, there shouldn't be a lot of people coming back and	The user is asked if she is the only person in the VE, and the user says she is pretty sure. When asked how does it correspond with her actual world situation, she says there are two persons she might occasionally exchange information. While doing the actual work process means there should not be other people moving in the same space. There are signs that exclude people from the area when doing the work process.		There are specific work-process related aspects that are similar between the VE and the actual environment, and then social and behaviour aspects outside the direct work experience that are not.

reflect your work situation where…… Do you have lots of like exchange of information with different people or…? L: Umm… You, the only person really that you would exchange information with is your lead operator in the control room. Umm…… And…… In some instances your engineer. But basically… while you're pressing the acid, there shouldn't be a lot of people coming back and forth. And… being near the equipment while it's working. Umm, so we have gates and signs, and we kind of… we generally exclude people from the area, when we're pressing acid. So… no. There shouldn't really be… I: So it's basically quite authentic in a way then? L: It is. I: That you… you're alone there. L: Yeah. I: The whole day [smiling]. L: We umm… we… Obviously, umm… Once we've done a press, and the pH is how we like it. And the strength is fine for the… for moving the acid. We can go and talk to other people. But we… you know, we're not just kind of standing there like this [making a stiff gesture] Like the virtual se[br], your virtual self. Kind of… But… Or that's how I imagine my virtual self to stand [laughing]. You don't go and stand in the lab and going like this [gesturing stiffness and laughing]. Umm… So you do get to speak to other people throughout the day, but… Generally if you're pressing acid, you're in your gear, you are isolated because you're wearing acid gear and it can be extremely hot. Umm, it can be extremely fo[br], you know how your glasses fog up? Your Monogoggles fog up. You got your suit on, your helmet on, your Monogoggles, your BA, your gloves on… And umm… It can be extremely hot. Umm… But yes, that how it is.	forth… and being near the equipment while it's working. Umm, so they have gates and signs, and they generally exclude people from the area, when they're pressing acid. So no. There shouldn't really be… The interviewer then says, it's basically quite authentic in a way then? L says it is. The interviewer continues smiling, that you are alone there, the whole day. L sees the joke and says obviously once they've done a press and the pH is how they like it and the strength is fine for moving the acid, they can go and talk to other people – they are not just kind of standing there like this – she is making a stiff gesture – like your virtual self. Kind of… But… Or that's how she imagines her virtual self to stand, she laughs. You don't go and stand in the lab and going like this – gesturing stiffness and laughing. So you do get to speak to other people throughout the day, but generally if you're pressing acid, you're in your gear, you are isolated because you're wearing acid gear and it can be extremely hot. Umm, it can be extremely fo[br], you know how your glasses fog up? Your Monogoggles fog up. You got your suit on, your helmet on, your Monogoggles, your BA, your gloves on… And umm… It can be extremely hot. Umm… But yes, that how it is.	She confirms that in that sense the VE is quite authentic. Still, the difference is that during some parts of her work she can go to talk to other people during the day; she laughs that she does not have to stand idly in her work location like her avatar [virtual self] might stand stiffly in the VE.		