Licentiate Thesis

Coaching by Gaming
An Instructor Perspective of Game-based Vocational Training

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Information Technology

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Abstract

Military organisations have a long history of using games for training. Over the years, they have developed training practices involving role-play, simulations, puckstering and gaming. Most researchers in serious games, i.e. games used for non-entertainment purposes, focus their studies on the learners. This licentiate thesis, instead, takes a closer look on the roles of instructors in game-based training situations, specifically at the Swedish Land Warfare Centre. Through a mix of theoretical and empirical studies, training practices were scrutinised, resulting in a framework for game-based vocational training. A key element of this framework is the coaching by gaming perspective in which instructors give un-intrusive, formative feedback through role-play and gameplay. Another important aspect of the framework involves dynamic debriefing. These insights points to specific needs for system support for instructors involved in game-based training. They also emphasise the fact that serious gaming is a highly contextualised activity made up of more than the game and the players.

Keywords: Coaching cycle, debriefing, game-based training, instructor roles, player roles, puckstering, serious games, serious gaming, system support.

Acknowledgement

When I dove into this project, I had very little knowledge of military organisations, including military training. The task to study game-based training in a setting where serious gaming has a long history was intimidating, to say the least. What could someone like me, who has a background in cognitive science and human-computer interaction, contribute to an organisation with years of fine-tuning training practice using simulations and games? What I have found is that I *can* contribute, not only to the advancement of game-based training within the military arena, but also to act as a bridge between the good practices of military training and other contexts that are about to adopt a game-based vocational training paradigm into their curricula.

Research is never done in a social vacuum; it is dependent on other people to comment on and criticise your work, to collaborate with, and to encourage and support you during the whole process. First and foremost, I would like to express my gratitude towards my supervisor Per Backlund, who always finds time to give honest feedback and reassurance whenever that is needed. Keep up the good work! I would also like to thank my other supervisors: Lars Niklasson, who taught me not to be afraid to 'stick my neck out' when presenting my ideas, and Lars Karlsson, who spent time reading and commenting on this thesis. A thank you is also due to my opponent, Martin Castor, from FOI, and my examiner Fredrik Karlsson, from University of Örebro, for their work and critical comments.

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I am also indebted to my InGaMe Lab colleagues at the University of Skövde, especially Henrik Engström, Mikael Johannesson, Mikael Lebram, Marcus Toftedahl and Urban Carlén, with whom I have cooperated on various projects related to serious games. Doing other projects 'on the side' of my own PhD project has helped me see new perspectives and widened my view of serious gaming. Special thanks also go to my cognitive science colleagues at the University of Skövde, especially my good friend Jana Rambusch, who shares my enthusiasm for games, Jessica Lindblom, who is an invaluable source when struggling with qualitative methods, and Beatrice Alenljung, Paul Hemeren, Madeleine Kanderud, Maria Nilsson, Charlott Sellberg, Tarja Susi and Henrik Svensson, for their encouragement

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List of Papers

Alklind Taylor, A.-S. & Backlund, P. (2011). Letting the students create and the teacher play: Expanding the roles in serious gaming. In *Proceedings of the Academic Mind Trek conference (MindTrek'11)* (pp. 63–70), Tampere, Finland, September 28-30, 2011.

Alklind Taylor, A.-S., Backlund, P. & Niklasson, L. (submitted). Introducing the coaching cycle: A coaching by gaming perspective of serious gaming. Manuscript submitted to the *Simulation & Gaming* journal.

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Acronyms and abbreviations

BTA	Virtual platoon trainer for tanks and combat vehicles
LTA	Command and control training facility
SCCA	Swedish Civil Contingencies Agency
SG	Serious games
SLWC	Swedish Land Warfare Centre
STA	Mobile combat training centre
StriSimPC	Virtual command and situation trainer

1 Introduction

Picture a group of cadets, each seated in front of a computer and deeply immersed in gameplay. They are playing a first-person shooter game designed to help them understand the workings of warfare through first-hand experience. Their instructor has given them an objective, to protect a village from hostile terrorists, and their task is to come up with a strategy that will achieve that objective with minimal loss of resources and human lives. The cadets who have been assigned platoon commanders pore over their maps, talking in hushed voices to their second-in-command. After a while, each of them calls for their group commanders, who leave their computers to huddle together while receiving their orders. Some ask questions, others take notes. Then everyone returns to their computer. Tension is raised as soon as one of the groups encounters its first enemy. One cadet's avatar is killed and has to wait in silence (dead soldiers cannot tell others that they are dead) for one of the other cadets to notice so that it can be dragged to the nearest shelter and 'revived' (or 'respawned', to use a gamer word). A bit further away, all of the soldiers in one of the groups are taken out by a mine. They quickly huddle together to think of another strategy before their avatars are respawned outside the village.

What does the instructor do during all of this? Monitoring the cadets' progress on a separate screen? Walking around in the room, peering over the cadets' shoulders and taking notes? Acting as a company commander, giving further instructions as the game progresses? Playing alongside the cadets, with their own avatar? Playing the enemy, controlling the enemy avatars? The truth is that the instructor, or rather instructors (because they seldom work alone), do all of these things, to a certain degree. What they do not do is sit back and watch the game unfold. This might seem like a mistake; will not cadets' flow and immersion in the game be broken, giving the exercise a tint of falseness and, in effect, have a negative effect on learning? I would argue no, and this thesis will give you my arguments for that conclusion.

Games and simulations have been employed by the military for a long time, first to represent and visualise a battlefield and later to train abilities such as strategic thinking, leadership, combat tactics and so on (Smith, 2009). Now games are even used to learn how to approach people from different cultures during peace keeping missions (see e.g. Raybourn, 2009). Serious games, as an academic field, has had an upswing over the past ten years or so, along with the increasing sophistication of game technology (for a lower price) and the increase in popularity of games and gameplay (Bryant & Fondren, 2009; Michael & Chen, 2006). As a highly multi-disciplinary field with countless numbers of application areas (from learning and training, to

policy making and advertising, just to mention a few), the research projects are very dispersed in terms of focus, methodology, theoretical bases, etcetera.

While game-based training practices often are described from a learner's point of view, few have ventured to describe them from an instructor's perspective. Using games efficiently for training requires a well thought-out teaching model grounded in both theory and current practices. As previously mentioned, military organisations have a long history of using simulations and games and are, therefore, appropriate as study objects when looking for good practices. This is what I have endeavoured to do. The result is a framework for game-based training in which the instructors are central to the training cycle, from planning and preparing the training scenarios, carrying out the actual simulation or gameplay, to assessment and debriefing afterwards.

My focus on the instructors' roles during serious gaming is motivated by an almost nonchalant treatment of teachers in serious games literature, as if their work in all of this is insignificant or, rather, will-sort-itself-out-by-itself-in-the-end. This is problematic for two reasons: (1) introducing gaming into a curriculum is not a trivial task, and (2) if researchers continuously overlook teachers' roles in game-based training/learning, it will ultimately affect teachers' confidence and acceptance of the concept (Alexander, Brunyé, Sidman & Weil, 2005; Jenkins, et al., 2009). One of my first inspirations for this work was Angela Brennecke's doctoral dissertation (Brennecke, 2009), in which she introduces the concept of a 'teacher player'. However, whereas she comes from a technical background, my perspective is more related to socio-technical issues, including cognitive science, human-computer interaction and educational sciences. Consequently, this means that I prefer the term *serious gaming* before serious games, because it stresses the point that there is more to this than just technology; serious gaming is about the players and their meaning making activities in a physical, social and organisational context (Egenfeldt-Nielsen, 2007; Gee, 2007; Jenkins, et al., 2009; Rambusch, 2006). With players, I here mean everyone that participates in that activity, including students, instructors, designers and so on. Thus, serious gaming is more than just the activity of playing a serious game.

1.1 Research aims and objectives

It is difficult to find sources that, in depth, examine the role of the instructor in game-based training or learning. Some might mention teachers, but do not delve into an examination of the teaching practices surrounding game-based learning and training. The roles of the instructor seem to be implicitly assumed to be known; they are either based on traditional teaching practices, or expected to fall into place by themselves as serious games become more ubiquitous in educational settings.

There are a few exceptions, apart from Brennecke, as mentioned above. One of them is Egenfeldt-Nielsen (2007, 2008) who has studied the use of games in education, including the role of the teacher. He found that there is a resilience to change teaching practices to accompany the use of games, despite the need for "a changed teaching practice that engages more closely with students' interpretations and assertions from their learning experiences" (Egenfeldt-Nielsen, 2007, p. 167). Furthermore, he considers teachers' knowledge and skill in using a specific game to be an important factor for the successful integration of games in schools' curricula (Egenfeldt-Nielsen, 2008). As a consequence, he takes a clear stance against teacher-less educational games.

Another exception is found in the works of Raybourn (2007, 2008, 2009). She has developed the Simulation Experience Design Method in which different roles (for both instructor and trainee) are integrated. In the model, the instructor is described as someone who, among other things, provides the game-based simulation with dynamic content, either "in real-time or a priori through a scenario authoring interface" (Raybourn, 2007, p. 208). Additionally, she has also developed a game in which peer-assessment is a fundamental feature; students learn by reflecting upon and evaluating other students' performance in the game (Raybourn, 2009).

There is also work on the enhancement of artificial intelligence in games (e.g. virtual agents) and human behaviour modelling that tries to alleviate the need for human controllers (or 'pucksters') in serious gaming or simulation. For instance, Colonna-Romano, et al. (2009) describe a system where a single human puckster controls a group of virtual agents, instead of controlling every individual avatar. Similarly, Sycara and Lewis (2009) examine multiagent systems where the virtual agents support human teams in carrying out their tasks. The challenge for these projects is to create agents that model human behaviour as closely as possible, to make human-avatar interactions natural to the point of being almost indistinguishable from human-human interaction.

Furthermore, there are efforts into intelligent tutoring systems and automated assessment of individual learners' performance in serious gaming, in order to make assessment more objective and less intensive for the instructors. To give an example, Ekanayake, Backlund, Ziemke, Ramberg and Hewagamage (2011) created an algorithm that assesses driving behaviour in a driving simulator. The algorithm is not only based on behavioural evaluation of achievement goals, but also accounts for the player's conscious effort towards achieving those goals. Another example is AutoTutor (Institute for Intelligent Systems, autotutor.org), a system that employs natural language to support students learning such subjects as Newtonian physics, computer literacy and

scientific reasoning. According to the web site, the system acts as a dialog partner with the learner and encourages students "to articulate lengthy answers that exhibit deep reasoning, rather than to recite small bits of shallow knowledge".

To complicate matters, there is a drive within military and other training organisations towards more distance learning (Frank, et al., 2003). The most obvious reason for this is cost-efficiency: if learners train at home, cuts can be made in terms of facilities, expensive equipment (e.g. computers, simulators), technical staff and educators. However, as pointed out by Wood, Douglas and Haugen (2002), the reduction in costs might not be as great as it seems, especially at the start-up of e-learning programs. Yet, distance learning also has advantages that makes it a preferred solution over classroom lectures, such as flexibility (learners can learn wherever and whenever they want)(Abell, 2000) and accessibility (opportunity for learners who live far from the training facility and/or cannot travel due to economic or personal issues)(Wood, et al., 2002). But even in distance learning, students cannot be left to their own devices; instructors "must continually work on approaches to making the course interesting, timely and relevant" (Wood, et al., 2002, p. 673). Considering these qualities of distance learning, an intelligent tutoring system would be preferred over a 24/7 active human instructor.

Nevertheless, despite these efforts of replacing parts of the instructor's tasks, we are far from a system that has the same flexibility as a human instructor. This is especially true for training complex behaviours such as teamwork, leadership skills, complex decision making and communication skills (Prensky, 2001; Thorpe, 2010). This is why we, in parallel of investigating artificial intelligence in serious games, have to look for solutions in how to carry out game-based training sessions with human instructors. Serious gaming is different from classroom learning, field exercises and other more 'traditional' training practices in that learners get feedback on their performance not only from their instructors and their peers, but also from the game. Instructors have to change their approach in setting up and executing training scenarios, as well as how they interact with students and the gaming system.

The overall aim of this thesis is:

To propose a model for expanding the role of the instructor in game-based vocational training.

To achieve this, several objectives need to be fulfilled:

- *Objective 1*: Do a literature survey on the roles of instructors/teachers in game-based learning and training. I use the term instructor as an umbrella term for all kinds of teachers, trainers, coaches, tutors and so

on. I use the term teacher to refer to instructors working in an educational setting.

- *Objective 2*: Identify and describe phases in current practices of game-based (military) training.
- *Objective 3*: Identify and describe instructor roles in the different phases.
- *Objective 4*: Create a framework for game-based vocational training based on theoretical and observational data.

1.2 Research contributions

The knowledge contributions of this thesis are:

- Documentation and characterisation of *current work practices pertaining to game-based training* at the Swedish Land Warfare Centre (SLWC). As these practices are seldom documented, a more general description will benefit a larger serious games community. These practices have been described in chapter 4 and in paper 2.
- *Analysis and interpretation* of the work situation concerning game-based training. The general serious games community gain from this, since it augments the view of serious gaming as being more than simply technology-enhanced learning. This analysis and interpretation is presented in chapters 4 and 5, as well as in paper 2.
- Development and presentation of the *coaching cycle* framework, in which instructors are the focal point of inquiry. The main contributions of the framework are those related to (1) the coaching by gaming perspective and (2) the adjustment of less classroom lecturing and more thorough debriefing. The coaching cycle is the main focus of paper 2.
- Identification of *four player roles* (student player, student author, teacher player and teacher author) that emphasise the interdependence of authorship and gameplay. By urging SG designers to consider these roles, serious games can be more effectively utilized to promote learning. The four player roles are presented and discussed in paper 1.
- An up-to-date *literature review* of serious games (SG). As a fairly new field of study, SG has gained the attention of researchers from different disciplines and with different agendas. Part of this thesis aims to bring relevant pieces of this interdisciplinary field together into a coherent whole and to position myself within the field. This is presented in chapter 3.

1.3 Overview of thesis and included papers

This licentiate thesis is organised as follows: chapter 1 gives a brief introduction to the research problem and its rationale. It also includes the main sources for descriptions of instructor roles in the serious games literature (objective 1). Chapter 2 presents the research approach chosen and the steps taken to implement it. It also gives a brief account of the case, i.e. game-based training at the Swedish Land Warfare Centre. Chapter 3 serves as a frame of reference and provides a theoretical background to the area of serious games and serious gaming. It is also in this chapter that I position myself within the field of serious games. Chapter 4 provides the reader with empirical material that has been used to form the coaching cycle framework (presented more theoretically in paper 2) and also offers some preliminary requirements for system support in serious games for training. Consequently, chapter 4 relates to objective 2, 3 and 4. Chapter 5 functions as an introduction to paper 1 and 2 and also discusses how they relate to chapters 3 and 4. Finally, the implications of the results are discussed in chapter 6, in which I also outline some suggestions for future works, i.e. the road ahead in completing my PhD.

Table 1-1 summarises the main contributions of this licentiate thesis. Paper 1 mainly contributes to objective 2 and 3, while paper 2 contributes to all four objectives.

Table 1-1 *Overview of contributions.*

Contributions	**Publications/Chapters**			
	Paper 1	**Paper 2**	**Chapter 3**	**Chapter 4**
Documentation and characterisation of current work practices pertaining to game-based training		X		X
Analysis and interpretation of the work situation concerning game-based training		X		X
Development and presentation of the coaching cycle framework		X		
Identification of four player roles that emphasise the interdependence of authorship and gameplay	X			
An up-to-date literature review of serious games			X	

2 Research approach

This chapter explains the road taken to gain understanding of the problem and the development of the coaching cycle framework.

2.1 Case study

My research is built around a case study at the Swedish Land Warfare Centre (SLWC). The SLWC educates cadets and response units in ground warfare for national and international missions (forsvarsmakten.se). It is organised into three main training faculties:

- Combat training
- Tank and combat vehicle crew training
- Command and control training

Training is conducted on different unit levels: individual (1 soldier), group (4–8 soldiers), platoon (3–4 groups), company (100–300 soldiers) and battalion (500–1500 soldiers). Normally, training is concentrated to one or two of these levels, that is, when training battalions, focus is on strategic thinking in commanders and individual soldiers are simulated by the training system. A full-scale simulation with trainees on all levels would be costly, complicated and involve long periods of time of inactivity for those training to be commanding officers (e.g. when troops move long distances in real-time).

Training is a mix of physical training, theoretical coursework, field exercises and simulation training. As already made clear, my work has been centred on simulation training, specifically game-based training. How much of an individual cadet's education is made up from simulation and game-based training is very much dependent on his or her instructor's buy-in of the concept of game-based training, and, consequently, differs from group to group and from year to year.

Simulations also differ in terms of technology used. The SLWC has a wide range of training practices, from live role-playing to high-end simulation facilities. PC-based serious games (my main focus) fall somewhere in the middle of that range.

2.2 Methodological considerations

The first step in doing research is finding a problem to study. Within this step lies the question 'Is this really a problem?' Once this has been established, a researcher looks in the toolbox of methodology to find the best way to study the problem. Thus, the first question to ask when conducting a scientific study is not *how* but *what*. A part of this is determining the *structure* of the problem and its *unit of analysis* (Patton, 2002). Looking back at the previous chapter, we see that the problem aims to describe, categorise and understand,

rather than answering a questing with a simple yes or no. This means that qualitative methods such as observations, interviews and document reviews are more suitable than a purely quantitative approach. Because qualitative approaches are contextualised and holistic, in that the problem is studied in its natural setting, the design is emergent rather than constructed (Lincoln & Guba, 1985). While this can seem messy and unordered, it is a necessary step before conceptualising a problem down to its core components. Hence, my study encompasses no controlling variables and I am both the inquirer and the instrument of inquiry.

The approach chosen is abductive rather than merely deductive or inductive, that is, "the original framework is successively modified, partly as a result of unanticipated empirical findings, but also of theoretical insights gained during the process"(Dubois & Gadde, 2002, p. 559). An abductive approach makes use of a combination of empirical fieldwork, case analysis and established theoretical models, where the researcher is constantly going back and forth between empirical observations and theory (Dubois & Gadde, 2002). Obviously, my methodology has not been a straightforward path, since many activities have been done in parallel or in an iterative fashion. Making use of theoretical material has both strengths and weaknesses. Although it can guide inquiry, it can also impede seeing novel aspects of the phenomenon. However, as Lincoln and Guba (1985) argue, no researcher is without preconceptions. To ensure trustworthiness, I have strived for *transparency* in description of how data were collected and analysed, as well as being open about my interpretations and ideas towards those participating in the case study. The main ideas presented in this thesis have been discussed with several case study participants as well as other researchers, resulting in ideas being both refined and validated. The results have also been *theoretically grounded*, another measure taken to ensure credibility and transferability of the results (equivalent to internal and external validity, according to Lincoln & Guba, 1985).

Furthermore, the reader should be aware of the unit of analysis in the study. Unit of analysis "is a way of conceptualizing research to focus on some level of actors within some system" (Williams, 2005, p. 454). In my case, the unit of analysis is instructors within the context of game-based military training. The unit of analysis is not on an individual level, nor on the entire organisation of military training. I will come back to this issue in section 2.4.1 when I talk about sampling.

2.3 Data collection

Figure 2-1 and Figure 2-2 summarise the road taken and I will now explain the rationale behind it. The funnel shape in Figure 2-2 represents scope or focus during each step as the research design emerges from a broad and open-

ended focus in the beginning to a more specific focus towards the end. The 7-shaped literature study activity, running parallel to the empirical fieldwork, represents the abductive approach, where established theories are used as both initial background knowledge and as a guide to understand phenomena encountered in the field. At the same time, empirical data are used as a selection tool in finding relevant literature (Dubois & Gadde, 2002).

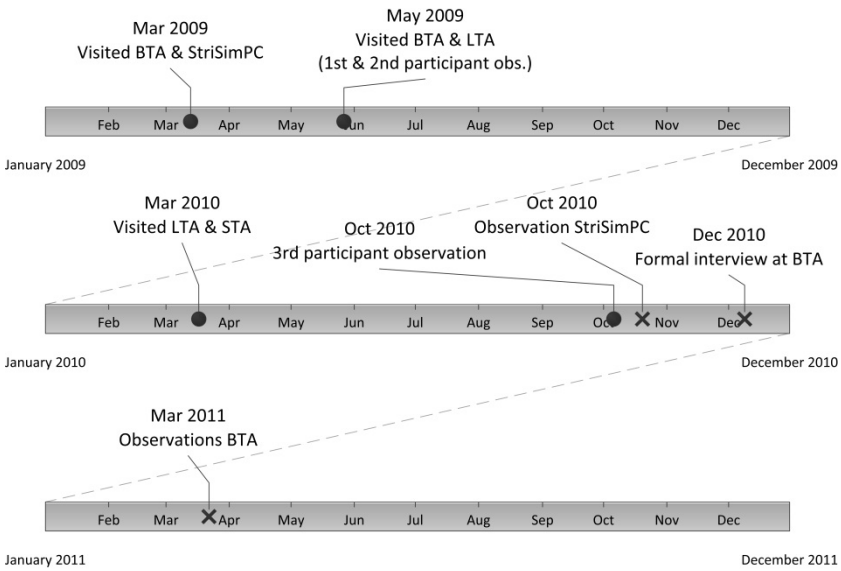

Figure 2-1 *Timeline representation of the research process. Explanations for abbreviations can be found in Table 2-2.*

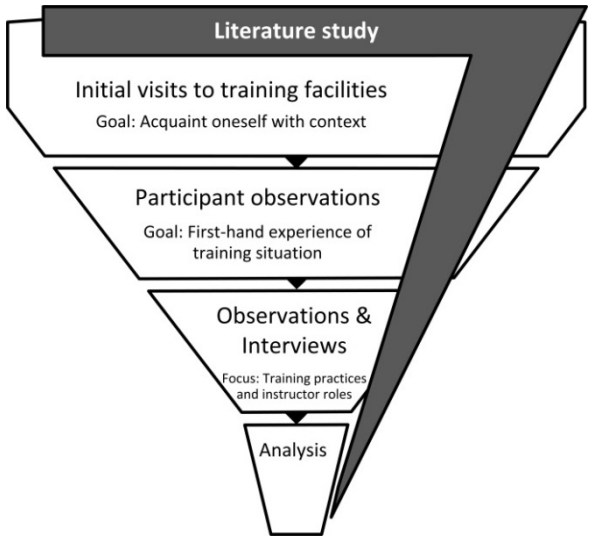

Figure 2-2 *Research approach, from identifying the problem to analysis of collected data.*

2.3.1 Initial visits to training facilities

The first step of doing research is identifying a problem, that is, a part of the accumulated work of the academic community in which knowledge is lacking or limited. This is not a trivial task and is only achieved by getting an idea of what others have done before and understanding the current situation. This requires insight into the research field itself as well as the context that will be studied (Lincoln & Guba, 1985). So the first step was two-fold:

1. Doing a literature study of the field of serious games
2. Visiting training facilities to acquaint myself with the Land Warfare Centre in general and the simulation facilities, including their training practices, in specific.

Table 2-2 gives a summary of the training facilities visited. Initially, I did not focus on a specific area, but instead kept an open mind and looked for aspects and clues that seemed interesting and/or important. I strove to become familiar with the 'culture' (thus being able to spot distortions within that culture), as well as establish trust between myself and the people studied, in order to increase the credibility value of later findings, as recommended by Lincoln and Guba (1985). I especially looked for aspects that were either confirmatory or contradictory when comparing field notes to the theoretical knowledge obtained through literature. This is similar to the work of the ethnographer, when he or she looks for 'rich points' (Agar, 2008), i.e. unex-

pected occurrences that leads to a deeper understanding of the phenomena. During the visits, I took field notes and talked to the participants. Dialogues mainly occurred with the instructors, due to the fact that cadets were deeply involved with the simulation and, thus, inaccessible during actual training. For instance, at the Virtual platoon trainer for tanks and combat vehicles (BTA), cadets were mostly inside a simulator cabin and, at the Mobile combat training centre (STA), they were out in the field, only visible to the instructors as symbols on a virtual map. This probably influenced my inclination to study the instructors instead of the cadets, later in the study.

Table 2-2 *Training facilities at the Swedish Land Warfare Centre*

Training facility and location	Swedish name and abbreviation	Group size	Simulation technology
Virtual platoon trainer for tanks and combat vehicles (Skövde)	Besättnings-tränings-anläggning (**BTA**)	Small groups (tank crew/platoon)	High-end tank simulators and PC-based simulators
Virtual command and situation trainer (Kvarn)	Stridssimulering PC (**StriSimPC**)	Varying (platoon/company)	PC-based serious games (e.g. Virtual Battlespace 2, Steel Beast Pro)
Mobile combat training centre (Skövde)	Stridsträning-anläggning (**STA**)	Varying (platoon/company/battalion)	Direct fire weapons effect simulator
Command and control training facility (Skövde)	Ledningsträning-anläggning (**LTA**)	Large groups (battalion)	A mix of live action simulation and low-end simulators

I spent approximately one day at each facility, slightly more at the Virtual platoon trainer for tanks and combat vehicles (BTA) and slightly less at the Mobile combat training centre (STA). Training was carried out during the majority of these visits, with the exception of the second visit to the LTA, which was part of a demonstration of the facility.

2.3.2 Participant observations

Once acquainted with the training facilities, understanding of the training practices emerged from more observations. Participant observations are especially useful for this purpose. In a participant observation, the researcher not only observes the situation from afar, but also partake in (parts of) it (Agar, 2008). This enables the researcher to gain access to knowledge only available to those that actually act within the setting. For instance, Williams (2005)

stresses the importance of game researchers actually playing games themselves. Of course, depending on the setting and/or people studied, participant observations might not be possible. Since I have no military background, I cannot step into the role of instructor or cadet without disrupting the training session. Fortunately, there were opportunities to participate in related activities. First, in May 2009, I was asked to step in as driver during one of the training sessions at the virtual platoon trainer for Leopard 2 tanks. This session was part of a training week for future instructors that needed to rehearse training procedures.

The second opportunity for participant observations, also in May 2009, presented itself when I was invited to join an event arranged annually at the Land Warfare Centre, in which Nordic military personnel and civilians (e.g. politicians, journalists, etc.) get together to learn more about the LWC organisation and to train in the virtual platoon trainer for Leopard 2 tanks. During this event, I got to 'play' several scenarios as crew commander and gunner. The last participant observation was during a two-day training-course, in October 2010, (in which I participated during one day) in Stockholm, directed at system operators going to Afghanistan to train soldiers on-site using the serious game Virtual Battlespace 2: Virtual Training Kit ("VBS2: VTK," 2008). A system operator is an administrative role given to an instructor that, for instance, entails creating new scenarios and running the system during simulation. None of the system operators had played VBS2 before so this gave me an opportunity to learn how to play the game, how to create a few simple scenarios and how to set up a training session.

2.3.3 Observations and interviews

Initial visits and participant observations were used to delimit the research problem. After that, more focused data gathering techniques were needed. Video recordings of training sessions complemented with interviews with instructors where chosen as appropriate. More thorough observations provided contextual data on training practices and the interviews served as further insight into the instructors' reasoning regarding game-based training. A total of 11 hours and 42 minutes of video material was collected during three observations (two at BTA and one at StriSimPC). From the beginning, observations were planned to take place in autumn 2010, but due to reorganisations as a result of Swedish military the same year converted from compulsory military service to voluntary recruitment, observations were delayed until winter 2010 and spring 2011.

Before every observation, I would write down key words and goals that would help me focus recordings on those details that were of main concern for the research problem. These 'sensitizing concepts' (Patton, 2002) are

needed because it is not possible to observe and record everything going on in the situation. Examples of the sensitizing concepts used in this study are: instructor roles, training procedures and habits, training phases, gaming behaviours. Occasionally, situations would arise that I had not anticipated in writing my list, but still found valuable to record.

Interview material was gathered both formally and informally. The informal interviews were conducted in connection with the observations, either before or during training, or during breaks. The latter was most common. Not all of these interviews were recorded, but notes were taken as soon as possible afterwards[1] instead. Questions asked were those that emerged from the immediate context, such as what was happening and why. Instructors where also asked to voice their opinion on game-based training in general and instructor roles in particular. A formal interview (approx. 2½ hours) was also done with the two heads[2] of the virtual platoon trainer, with whom I had gained rapport. The interview was unstructured; I steered the respondents toward a topic and then let them express their views. The main topics where: training practices relating to simulation training, their roles in relation to simulation- and game-based training, their views of the instructor's role, their views on feedback during training (both from instructors and automated) and their view of artificial intelligence in games.

During the interview, the respondents also provided me with examples of previous training plans to give me more insights into the kind of material system operators base their scenarios on. As a consequence, part of the data collection also included documentation.

2.4 Data analysis

The last stage was to analyse the data gathered in the previous step. Analysis was done using Transana 2, an open source software to transcribe, analyse and categorise data from audio and video recordings. Results from this analysis are presented in chapter 4. Not all recorded material was transcribed, only those parts that contained verbal information of direct interest for the research question. Interesting scenes and utterances concerning aspects related to training phases and instructor roles were sorted into categories. Once a clip

[1] Taking notes during the informal interviews disrupted the flow of the conversation, so only key words (e.g. specific military terms) were written down at the same time. Some interesting aspects were also brought up during times when note taking was not possible, such as during lunch or walks to and from the mess hall.

[2] Both have the rank of Captain. One is mainly responsible for the tank combat simulator and the other mainly for the combat vehicle crew trainer. They both have the roles of instructors and system operators during training sessions.

had been identified, it was allocated one or more 'collections' that group together clips that have some common theme. These themes arose from the analysis, but were similar to the sensitizing concepts described in section 2.3.3. Training phase categories that emerged were *preparation*, *renegotiation*, *briefing*, *training* ('offline' and 'in-game'), *break* and *debriefing* (in whole group and in separate groups). The emerging themes for instructor roles were *lecturer*, *observer*, *scenario author*, *in-game player* or *puckster*, *live role-player*, *technical support* and *debriefer*.

2.4.1 Sampling

The purpose of sampling is mainly to collect as much data as possible about a phenomenon in order to ensure trustworthiness (Lincoln & Guba, 1985). According to Agar (2008) a researcher can sample either people or events, depending on the research focus. In this case, focus was on game-based training in military settings (especially ground warfare training), i.e. the activity itself and not on the people performing the activity (even though they are closely linked) was at the centre of inquiry. As a result, sampling was done based on events rather than people. Furthermore, sampling can be made in a number of ways; Lincoln and Guba (1985) mention *random sampling*, *sampling extreme or deviant cases*, *sampling typical cases*, *maximum variation sampling*, *sampling critical cases*, *sampling politically important or sensitive cases*, or *convenience sampling*. In this case, sampling was a mix between typical cases and convenience, that is, typical cases was chosen wherever possible, but other, more deviant cases were not discarded.

Due to time constraints and a desire to focus more on serious gaming than simulation-based training[3], two facilities were chosen for further inquiry: BTA and StriSimPC (see Table 2-2). These were chosen due to their apparent connection to computer games and gaming, including game technology. This is not to say that no game characteristics are incorporated into the training at the STA and LTA. However, gameplay is restricted to roleplaying and the simulators mainly serve to monitor and control the simulation (e.g. keeping track on where groups are on the map, calculating damage during battle and so on). Both these facilities also conduct large-scale simulations, making data collection difficult for a lone researcher.

Most obvious is StriSimPC, in which PC-based games are played during training sessions. BTA was chosen due to the training activities' gameplay characteristics. Even if BTA use a more 'traditional' simulator, characteristics of play emerge in the way training is carried out. For instance, the instructors may include elements of competition and scoring (see Figure 2-3) as part of

[3] The difference between serious gaming and simulation is discussed in chapter 3.2.

the King-of-the-hill scenario, in which the crews play against each other in order to gain control over a small village.

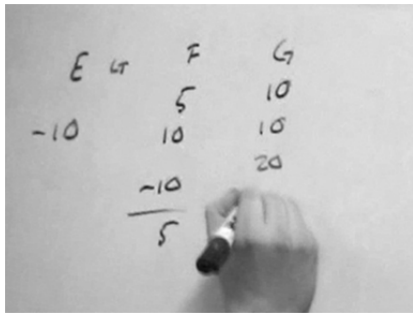

Figure 2-3 *Snapshot from one of the King-of-the-Hill scenarios observed at the Virtual platoon trainer for tanks. One of the instructors adds up the scores for each of the three groups (Echo, Foxtrot and Golf) on the whiteboard.*

3 Frame of reference

A significant part of research studies is learning and defining the field's central concepts. This chapter, therefore, provides an overview of the main concepts in serious games and serious gaming. It complements the background given in paper 1 and 2 by delving deeper into the notion of what a serious game is and how it relates to serious gaming. Because of the interdisciplinary nature of serious games as a research field, references are from a wide spectrum of sources, such as game studies, edutainment, cognitive science, computer science, information systems, just to mention a few.

3.1 Serious games

Serious games as a phenomenon can be traced back as far as the 1960s (Brennecke, 2009; Ruben, 1999). The term 'serious games', however, first appeared 1970 in Clark C. Abt's book *Serious games*, notably referring to mainly board and card games (Abt, 1970). It took a few decades for the term to be widespread and, probably as a consequence of the technical advances during this time, used mainly for digital games. The term 'serious game' is still controversial, even within the field itself, as, for instance, the re-occurring discussions on DiGRA's 'Gamesnetwork' mailing list (for game scholars) will show. First, the main controversy is that the term, for some, represent an oxymoron (Michael & Chen, 2006; Ritterfeld, Cody & Vorderer, 2009); games are for fun and play, and not serious activities. This (mis)conception also creates a problem for developers, since (some) clients will not buy a product categorised as a 'game'. Many developers, therefore, use terms such as 'simulation' when promoting their product (Wexler, 2008).

The other side of the coin is that gamers feel offended by the term; it suggests that not all games are serious (Klabbers, 2009). Considering the growing industry of e-sports (Rambusch, Jakobsson & Pargman, 2007), they might have a point. Bogost (2007) has taken this even further as he coined the term 'persuasive games', which he believes should replace the term 'serious games':

> Serious games are videogames created to support the existing and established interests of political, corporate, and social institutions. […] Such goals do not represent the full potential of persuasive games. If persuasive games are videogames that mount meaningful procedural rhetorics, and if procedural rhetorics facilitate dialectal interrogation of process-based claims about how real-world processes do, could, or should work, then persuasive games can also make claims that speak past or against the fixed worldviews of institutions like governments or corporations. (Bogost, 2007, p. 57)

Not everyone agrees with Bogost's definition of serious games, however. I would argue that serious games may very well be used to "speak past or

against the fixed worldviews of institutions" – it is all about how the game is used in a larger context. For instance, Raybourn (2007, p. 211) argues that one "important aspect of social-process simulation design is to challenge existing beliefs". Another solution to the name problem is offered by Klabbers (2009) who suggests that we call games by their function, e.g. games for educating, games for training, games for simulating, games for entertaining, etc. This solution is problematic because it creates a subset of serious games and none of the terms can be used as a hypernym to denote the entire field. It is probably for this reason that the term 'serious games' has persisted as an umbrella term within the academic community. I have chosen to keep the term in this thesis for the reason that it is a well-known term both within academia and within the military. I also use the term game-based training when I specifically mean serious games for (vocational) training (i.e. a subset of serious gaming). Table 3-3 gives a summary of common used terms instead of serious game.

Table 3-3 *Alternate terms for serious games and subgroups of serious games*

Alternate terms for serious games or subgroups of SGs	**Source**
Action learning simulations	(Aldrich, 2009)
Advergames	(Alvarez & Michaud, 2008)
Digital game-based learning	(Brennecke, 2009; Prensky, 2001, 2003)
Educational games	(Egenfeldt-Nielsen, 2007; Johnston & Whitehead, 2009; Kiili, 2007; Thomas, Schott & Kambouri, 2003; Wideman, et al., 2007; Virvou & Katsionis, 2008)
Educational simulations	(Aldrich, 2002, 2006; Ulicsak & Wright, 2010)
Edumarket games	(Alvarez & Michaud, 2008)
Edutainment	(Charsky, 2010; Egenfeldt-Nielsen, 2006, 2007; Habgood, Ainsworth & Benford, 2005; Johansson, Nählinder & Berggren, 2009)
E-learning simulation games	(Quinn, 2005)
Games for change	(Ulicsak & Wright, 2010)
Games for good	(Ulicsak & Wright, 2010)
Games for health	(Papastergiou, 2009)
Gamesims	(de Freitas, 2006)
Immersive learning simulations	(Caspian Learning, 2008; Wexler, et al., 2007; Wexler, Corti, Derryberry, Quinn & van Barneveld, 2008)

Alternate terms for serious games or sub-groups of SGs	Source
Instructional games	(Garris, Ahlers & Driskell, 2002; Habgood, et al., 2005; Kafai, 2006; Malone, 1980)
Newsgames	(Bogost, 2007)
Organisational-dynamic games	(Wikipedia, 2011)
Performance simulations	(Wenzler, 2009)
Persuasive games	(Bogost, 2007)
Practiceware	(Aldrich, 2009)
Sim games	(de Freitas, 2006)
Sims	(Aldrich, 2009)
Simulation games	(Hofstede, de Caluwé & Peters, 2010; Johnston & Whitehead, 2009; Klabbers, 2009)
Social impact games	(Corti, 2006; Ulicsak & Wright, 2010)
Synthetic learning environments	(Ulicsak & Wright, 2010)

In order to define serious games, it is first valuable to look at the common definitions of play and games in general. One of the most widespread definitions of play is that of Caillois (1961). He defines play as an activity that consists of the following qualities: freedom, separateness, uncertainty, non-productivity, rules and make-believe. Using this definition as basis, Järvinen, Heliö and Mäyrä (2002, pp. 13–14) defines digital games as (1) "a sequence of actions within formal and predefined rules and goals" and (2) having "definitions of winning or losing, or at least of gain and loss". Garris, Ahlers and Driskell (2002), who have done an extensive review on gaming literature, claim that any game can be described in terms of six dimensions: fantasy, rules/goals, sensory stimuli, challenge, mystery and control. Note that the definitions of both 'play' and 'games' lack the element of fun and enjoyment, something that we normally associate with the activity of play. However, as Michael and Chen (2006) mention, fun is a *result* of play, not an ingredient.

A serious game, then, is part game, part productivity system (or simulator). There are a number of definitions of serious games, such as "games that do not have entertainment, enjoyment, or fun as their primary purpose." (Michael & Chen, 2006, p. 21) or "a mental contest, played with a computer in accordance with specific rules, that uses entertainment to further government or corporate training, education, health, public policy, and strategic communication objectives" (Zyda, 2005, p. 26). More definitions can be found in Table 3-4.

Table 3-4 *Definitions of serious games in the literature*

Definition of serious games	Source
"Games may be played seriously or casually. We are concerned with serious games in the sense that these games have an explicit and carefully thought-out educational purpose and are not intended to be played primarily for amusement. This does not mean that serious games are not, or should not be, entertaining."	(Abt, 1970, p. 9)
"*Serious game*: a mental contest, played with a computer in accordance with specific rules, that uses entertainment to further government or corporate training, education, health, public policy, and strategic communication objectives."	(Zyda, 2005, p. 26)
"An interactive computer application, with or without a significant hardware component, which has a challenging goal; is fun to play and/or engaging; incorporates some concepts of scoring; and imparts to the user a skill, knowledge, or attitude that can be applied in the real world."	(Bergeron, 2006, p. xvii)
"[S]erious games are games that use the artistic medium of games to deliver a message, teach a lesson, or provide an experience."	(Michael & Chen, 2006, p. 23)
"Serious games are videogames created to support the existing and established interest of political, corporate, and social institutions."	(Bogost, 2007, p. 57)
"A serious game is defined […] as the use of interactive digital technologies for training and education in private, public, government, and military sectors"	(Raybourn, 2007, p. 207)
"[S]erious games is here defined as games games that engage the user, and contribute to the achievement of a defined purpose other than pure entertainment (whether or not the user is consciously aware of it). A game's purpose may be formulated by the user her/himself or by the game's designer, which means that also a commercial off-the-shelf (COTS) game, used for non-entertainment purposes, may be considered a serious game"	(Susi, Johannesson & Backlund, 2007, p. 5)
"A serious game is a game designed for a primary purpose other than pure entertainment. The 'serious' adjective is generally prepended to refer to products used by industries like defense, education, scientific exploration, health care, emergency management, city planning, engineering, religion, and politics."	(Wikipedia, 2011)

In paper 1 and 2, I have used the definition by Susi, Johannesson and Backlund (2007, p. 5): "games that engage the user, and contribute to the achievement of a defined purpose other than pure entertainment (whether or not the user is consciously aware of it). A game's purpose may be formulated

by the user her/himself or by the game's designer, which means that also a commercial off-the-shelf (COTS) game, used for non-entertainment purposes, may be considered a serious game". Although I agree with this definition, it is not unproblematic. According to the definition, COTS games are not by themselves classified as serious games, unless there is some *intent* to use a game for non-entertainment. Susi, et al. (2007) claim that this intent could be either the user's or the designer's, implying that the player can achieve a game's purpose without being made aware of it. While this might be true for certain types of purposes (e.g. improving basic cognitive skills), this part of the definition is problematic when discussing game-based vocational training. In order to get trainees into a state of deliberate practice, i.e. practicing in a specific and purposeful way, constantly stretching oneself beyond one's comfort zone and persistently striving for improvement, we must assume that the purpose is well-known and explicitly articulated with the gaming context.

Consequently, for the purpose of this thesis, I have reformulated the definition to: *serious games are games that engage the users, and contribute to the achievement of a defined purpose other than pure entertainment. A game's purpose is formulated by the users themselves, which means that also a commercial off-the-shelf (COTS) game, used for non-entertainment purposes, may be considered a serious game*. I have also chosen a narrow classification in which serious games have to have some gaming properties (such as scores and/or rules working beyond those pertaining to the game's physics engine) and the user must take active part in playing the game (not just steering a virtual camera in a static 3D environment).

As Michael and Chen (2006) point out, there are a few significant differences between games and serious games. For instance, playing a serious game is not always a voluntary activity, separated from the rest of life. This makes serious games not a subset of games, but rather pieces of technology with some fundamental traits in common with games (see Figure 3-4).

With this in mind, it is not surprising that game-based training with an educational context needs an active instructor to coach trainees, since being forced to play might not be as motivating as playing the same game on your own accord.

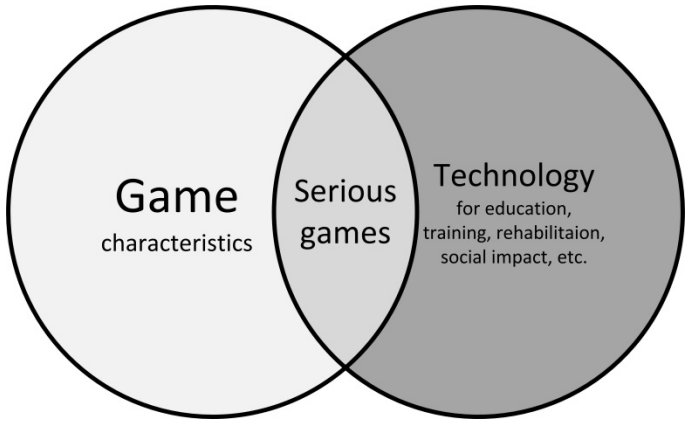

Figure 3-4 *Serious games are not a subset of games, but artefacts with game characteristics.*

3.2 Serious gaming and simulation

A serious game relates to serious gaming in the same way as a simulator relates to simulation. As articulated by Crookall, Oxford and Saunders (1987, p. 153), a simulation is "the actualization of the simulator, the operation or experience of it, the on-going, 'live' performance. […] Simulation thereby brings a simulator 'to life', and this can only be achieved by participants." The same can be said about gameplay or gaming, i.e. *gaming is the actualization of the game, the operation or experience of it, the on-going, 'live' performance*. Gameplay is also more than the here-and-now enactment of a game; it also constitutes cultural and social aspects outside the game, such as the involvement in online communities (Rambusch, 2010) and modding (Postigo, 2007). The difference between a simulator and a game is that whereas a simulator is trying to represent certain aspects of the real world, a game is a formalised system in its own right (Crookall, et al., 1987). Thus, high fidelity is more important in simulators than in games.

Having said that, I would still argue that within the realm of game-based training, the difference between simulation and gaming has more to do with the trainees' mind-set than the representativeness or fidelity of the game. For instance, a cadet playing a first-person shooter might do so to purposefully train a certain skill or to win the game (cf. 'gamer mode' in Frank, 2011). To win the game, the player might be tempted to use methods or strategies that are not appropriate in a real-world situation, and the question arises whether or not the trainee is actually learning useful skills. Of course, skills can be learnt 'by accident' even when in gamer mode, but this is far too unreliable to

be called serious gaming. For instance, even if surgeons can practice their eye-hand coordination by playing console games (Rosser, et al., 2007), anyone playing console games does not acquire the total skillset to become a surgeon. As a consequence, serious gaming for vocational training must incorporate aspects of reality even if that reality is created by the player reflecting upon how the game relates to the real world. So, while not all games for training are simulators, all serious gaming, in this context, includes some form of simulation.

4 Extending the empirics

The aim of this chapter is to give the reader an insight into the empirical data that have been gathered and to extend the material presented in paper 2. Thus, by introducing some new material, this chapter constitutes a knowledge contribution of its own.

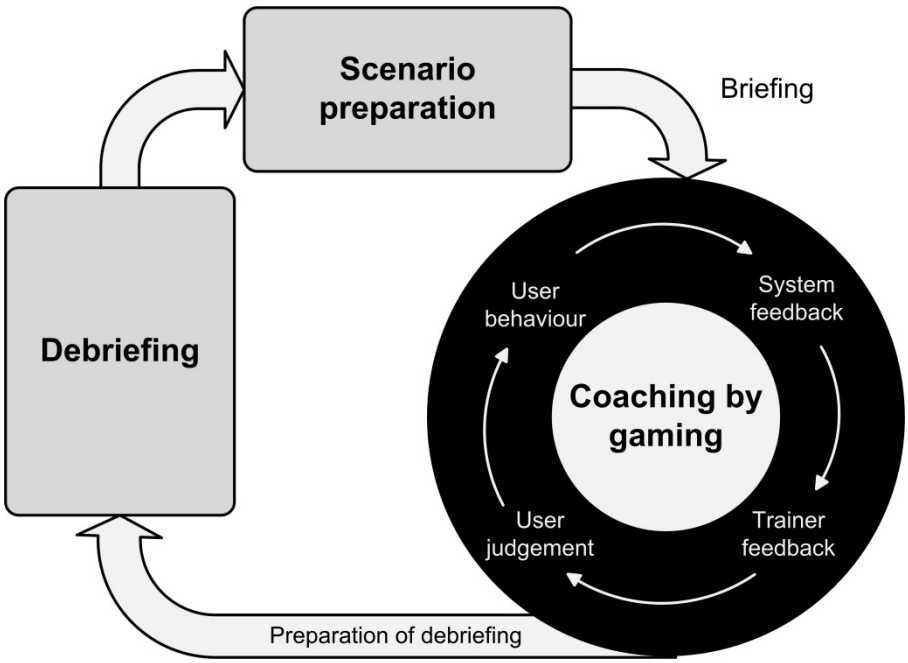

Figure 4-5 *The coaching cycle (with the lesson learned processes excluded).*

The framework presented in paper 2 consists of three phases: scenario preparation, gameplay and debriefing (see Figure 4-5). It differs from current training practices at the Swedish Land Warfare Centre in that it only includes minimal instruction or briefing before gameplay and promotes a more in-depth debriefing afterwards. Furthermore, it describes and encourages a coaching by gaming perspective, something that is present military training practices, but seldom seen in other serious games contexts. Coaching by gaming is an activity derived from the teacher player role described in paper 1. It stresses the point that the instructor is more of a coach than a teacher when playing alongside his/her students, i.e. not dictating the 'right' way to do things (Bolton, 1999). The simulation unfolds as the result of interplay between all participants, trainees as well as instructors. In-game feedback is

delivered through a mix between game mechanics, dynamic instructor content created moment-by-moment and puckstering (i.e. instructor controlling one or several avatars in the game).

Another important aspect of the framework is debriefing. Most serious gaming researchers agree that debriefing is an essential ingredient for experiential and game-based learning to promote transfer of knowledge from the simulation to real-world situations (see e.g. Greenaway, 2007; Kriz, 2010; Lederman, 1992). Based on this reasoning, a lot of effort should be spent on debriefing activities – not only in terms of time spent, but also in terms of different reflective exercises provided by the facilitators. In the case study, I found incongruences between the theoretical framework and the empirical data; by-and-large, debriefing is mainly carried out as a discussion between participants almost directly after training. Although a short timespan between training and debriefing is recommended for optimal learning effect, it leaves little room for instructors to prepare multifaceted exercises in which profound reflection takes place.

Both paper 1 and 2 favour the notion that the learning environment is more than just the game; it also encompasses the physical, social and organisational context in which serious gaming takes place. The physical context can be the simulator facility provided by the training organisation, but it can also be the trainee's home (as in the case of self-directed training in an Internet-based course) or the outdoors (as in the case of the Mobile combat training centre or serious games based on alternate reality games, ARGs). The physical context also includes the platform on which the game is played (e.g. PC, mobile phone, high-end simulator, etc.) and other physical constraints surrounding the game. Consequently, the physical context affects how the game is played.

The social context concerns verbal and non-verbal communications between the participants. No training is carried out in a social 'vacuum', that is, even if trainees play the game at home, by themselves, they will affect and be affected by others in their social groups, especially other trainees. The organisational context also plays a part in how training is organised, how instructors cooperate (or not), as well as sets the boundaries on how much training practices can stray from the educational council's rules and recommendations.

The next subchapters will give examples from the empirical data that contributed to the development of the coaching cycle framework.

4.1 Preparation phase – creation and re-negotiation

Preparation is done in several steps. First, about two weeks in advance, the unit instructor sends a training plan or order to the system operator at the simulation facility. The training plan usually includes information about the

extent, aim, objective and requirements of the training. The system operator then prepares the scenario using the simulation system or game. This generally entails choosing a virtual map or terrain and, to some extent, adding entities such as buildings, NPCs, vehicles and so on. However, most of these entities are created moment-by-moment during gameplay, to create a dynamic environment.

One difficulty when creating a scenario, as voiced by one of the system operators interviewed, is to anticipate how the trainees will interpret it. This calls for a skilled trainer, who is proficient in both the technical system and the domain of the profession, to make a scenario that is flexible enough to be played in different ways. Hence, a military scenario should not be designed by a civilian, nor should it be created by a military professional who is a novice in using the authoring tool. This might on the surface speak against the notion of student author presented in paper 1. However, student scenario authoring does not have the same purpose as the scenario creation described here. Trainees create scenarios in order to learn the mechanics of their profession (including terminology) and to be encouraged to discuss these experiences with their peers (Alklind Taylor & Backlund, 2011; Backlund, et al., 2011).

Furthermore, even the objective might be re-negotiated as a result of training progress. Figure 4-6 shows a situation in which the instructors have realised that the scenario took longer time to play than expected, with the results of not having all cadets getting to play the role of platoon commander (one of the main objectives for that day's training). During one of the breaks, they decided to change their plans for the next day's training and, instead, continue with the same scenario one more day. This sort of re-negotiation and prioritising is, according to the instructors interviewed, common practice, mainly due to time constraints.

Adam:	It will be about one session tomorrow too= We have (.) we don't have more time. So we have decided to train assault tomorrow. So= the upstart will be damn easy. We will run with the same scenario as we've run (.) today. And we'll run assault tomorrow too then. And then we'll have time to run more scenarios and more platoon commanders get to train (.) like the role of platoon commanders.
Bob:	The order is already written= they will recognise the order= it's like= we'll take the same as= as yesterday= the scenario= we'll run the exact same thing.

Figure 4-6 *Excerpt from the observation at the Virtual command and situation trainer (StriSimPC). The group of instructors use one of the breaks to plan the next day's training. Translated from Swedish. The names of the instructors are fabricated.*

Although the instructors might have some idea on what the general training objective will be, the precise details might not be formulated until the day of training (see Figure 4-6 for an example of this). About one hour before cadets arrive, instructors are familiarised with the basics of running the system (e.g. zooming and using audio). The instructors' computer skill varies a great deal, from not wanting to handle the game at all to being able to take over the system operator's role completely. This affects how the roles are divided up between participating instructors.

Another aspect of training that might be negotiated is the difficulty level. In all cases observed, instructors discussed the level of challenges that the simulation would provide, based on the cadets' prior experiences and skills. Figure 4-7 shows a situation in which two of the instructors are worried that the system operator has prepared a scenario that is too hard for the current trainees. As it turns out, it was all a misunderstanding based on different expectations on the training's aim and the instructors agree that while the difficulty level should be low, it should not be non-existent.

```
Frank:    ( We're thinking that it ) slowly becomes too difficult
Eddie:    That is, it should be characterized by plenty of time (.)
          It shouldn't be so hard an opponent
David:    (.hhh) (hhh) Have you (.) ever been involved with this process?
          Is this how it's supposed to be Frank?
Frank:    We see it as an experi=
Eddie:    =See it as a gunner-and-loader      [week]
David:                                        [Ha!]
Eddie:    =but eh:  [little more]
David:              [It's gunner and tank commander]
Frank:    Yes but I   [think that]
Eddie:                [Yes but-]
Frank:    =we have been able to step up [more-]
Eddie:                                  [Yes we might be able to do that]
David:    Yes I promise    [I] won't=
Eddie:                     [Yes]
Frank:    David won't even be here
Eddie:    No it's not you I'm worried about
David:    [But you're looking at me and=]
Frank:    [( inaudible ) to check up on us ] (( laughs ))
(( All three laughs ))
```

Figure 4-7 *Excerpt from one of the observations at the Virtual platoon trainer for tanks (BTA). Example of a negotiation of the level of challenges subjected to the trainees. Translated from Swedish. The names of the instructors are fabricated.*

Even if most preparation is done before the training session or during breaks, instructors might take some time during training to experiment with the game mechanics themselves, to learn more about possibilities and limitations in the system. For instance, during the observation at StriSimPC, one of the instructors and the system operator experimented with the physical simulation in Virtual Battlespace 2 by trying to blow up a car (see Figure 4-8).

Figure 4-8 *A system operator and an instructor at the Virtual command and situation trainer (StriSimPC) experiment with VBS2 by trying to destroy a virtual car by detonating a bomb on top of it (and failing because the simulation does not support that action).*

4.2 Lesson – traditional instructor role

Once the trainees have arrived, training starts with a lesson or briefing in a classroom setting (see Figure 4-9). What is included in that lesson seems to be dependent on the trainees' previous experience with that particular facility as well as on the individual instructors involved.

Figure 4-9 Snapshot from a lecture situation at the Virtual platoon trainer for tanks (BTA).

Unsurprisingly, if it is the trainees first time, greater time is spent explaining rules and regulations for that facility (including safety issues), plus getting the trainees acquainted with the game or simulator. For instance, during the observation at the Virtual platoon trainer for tanks (BTA), in which the trainees were entirely new to the simulator, the system operator spent a large portion of time explaining the graphics in the simulator (for an example of this, see Figure 4-10). At the same time as he explained how different terrain and objects in the terrain looked and worked, the other instructors steered the camera and, on occasion, vehicles in the virtual environment. The result was projected on two screens above the whiteboard.

```
George:   There you have a clear-felled area with stumps
          on the right picture.
David:    That's marsh, there you will get stuck. Most often it's in the
          vicinity of streams and so on too. There are three types of diff=
          stream sizes. You won't see the difference on the map. And
          that's almost as in reality then, on the map. There are three
          different sizes. The largest stream it's the one we're looking at
          now. You will notice that when you arrive ( that ) this one is big.
          You will get stuck there. The other two you can pass.
          That's streams. Water is not possible to drive into either (.)
          by the way. By the streams there is vegetation. So you should be
          able to look in the terrain and be able to read the terrain that
          damn, there it is a row of bushes. Winding away.
          Then it's a stream.
(( David points with his laser pointer on a tank in the stream ))
          Yes that's how you will end up. Then it's also simulated,
          collision simulation, here. If you drive too fast, down a causeway
          or somewhere it will be simulated ( inaudible ) damage outcome
          on the tank. If you ( inaudible ).
(( The right screen shows a tank driving in high speed straight through the
stream ))
          Yes.
(( David turns to the other instructors by the controls ))
          That's good. How pedagogical ( that ) is (( Everyone laughs ))
          presented here.
Frank:    Just to have something to document.
David:    Yes. (( clears his throat )) Exactly.
Frank:    But it did break.
(( The screen shows the tank in the middle of a marsh. ))
David:    Yes he did get stuck there anyway. That's nice.
```

Figure 4-10 *Excerpt from one of the briefings observed at the Virtual platoon trainer for tanks (BTA). The instructors show how the virtual world works and how the graphics look. Translated from Swedish. The names of the instructors are fabricated.*

Apart from facility practicalities, simulation characteristics and training objectives, instructors may also include theoretical material, such as what the regulations say are the correct methods in solving a task. The trainees might

also be quizzed about correct terminology and/or procedures. In the observations, this was more prevalent at the BTA than StriSimPC. On the other hand, the theoretical lessons connected to the StriSimPC training were conducted before and in parallel to the last-minute preparations in the game facility. As a consequence, these lessons were not included in the data collection[4].

At the StriSimPC, one instructor was also employed to role-play as company commander and he used a larger part of the briefing to relay the objective and orders for the different platoons. Most of this was done in the role of commander and the trainees assigned to play as platoon commander answered him as they would have, if the communication had been transmitted via radio.

4.3 Gameplay phase – teacher player and formative feedback

After briefing, trainees are allowed to acquaint themselves with the system before the actual gaming commences. The gameplay phase is complex; many things are happening at the same time. The SLWC has dealt with this by employing several instructors who distribute responsibilities between themselves. This is especially apparent at StriSimPC, were the different roles are more clear-cut compared to the BTA. For instance, at the BTA, it is not possible to directly observe trainees as they run the simulation. Instead, instructors assess progress through several screens[5] and audio output (see Figure 4-11). It is therefore more important for all the instructors to learn the assessment and feedback interface of the BTA system. At StriSimPC, instead, much of the technical issues are left to the system operator, while the rest of the instructors do their tasks 'offline', such as direct observation (see Figure 4-11 and Figure 4-12) and live role-play.

Feedback to trainees is given in a number of ways. In this section, I will focus on formative feedback (feedback given continuously during training), while examples of summative feedback are given in section 4.4 about debriefing.

The simplest form of feedback is the one given by the game mechanics. For instance, if a trainee shoots at an enemy, visual and auditory feedback will tell if (1) the weapon is actually fired and (2) the enemy was hit or not. In the systems used at the SLWC, this kind of feedback is made as close to real-

[4] Training was scheduled to begin at 8 am, but the cadets did not show up until 9:30. Unfortunately, I was not told in beforehand that they had a lecture in another building before coming to the gaming facility and could not attend.

[5] The screens show such things as simulator state (e.g. whether the canon is uncocked or not, vehicle speed, number of hits, etc.), the map and the 3D environment (either from one of the trainee's perspective or based on the 'camera position').

world feedback as possible (e.g. an enemy that is hit is seen falling down or, in the case of vehicles, smoke starts to arise from them) which makes it easy to understand with minimal instruction. Another form of in-game feedback, with a similar function as the one just described, is communication between players. In that way, each trainee knows how to proceed through the simulation.

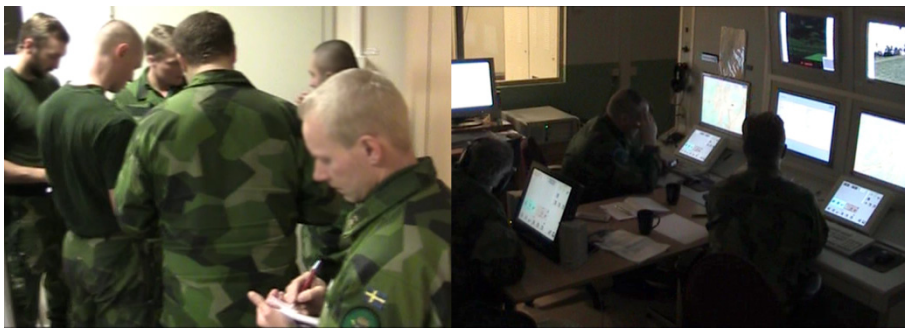

Figure 4-11 *Examples of two types of assessment: (left) instructor at the Virtual command and situation trainer (StriSimPC) takes notes as a group of trainees discusses their strategy, and (right) instructors at the Virtual platoon trainer for tanks (BTA) assess performance indirectly via information screens.*

Figure 4-12 *One of the trainees at the Virtual command and situation trainer (StriSimPC). In the background, one of the instructors is seen looking over the shoulder of another trainee.*

Feedback more directly related to the learning goals are mainly given by the instructors. Here, one can distinguish between explicit feedback and feedback conveyed as part of the game. By explicit feedback, I mean feedback

were the instructor talk directly to a trainee or a group of trainees by, for example, asking them to explain why they are doing something or correcting their behaviour. The roles of instructor/coach and trainee are in this situation clear. Another form of feedback is the one emerging from puckstering (see Figure 4-13). From the trainees' point of view, this resembles game feedback in that it is conveyed through the game interface in the same manner as the scripted feedback. The underlying (pedagogical) aim, however, is different. When acting as a puckster, the instructor (usually, but not always, the system operator) controls one or several avatars within the game. By playing the opponent, instructors can create a more realistic and adaptive enemy compared to the AI system, but, most importantly, they can adjust the difficulty depending on the performance of the trainees. In other words, they can allow the ones that apply the correct methods (i.e. the methods most likely to work in reality) to win the game and 'punish' the ones that are careless, inattentive, and so on.

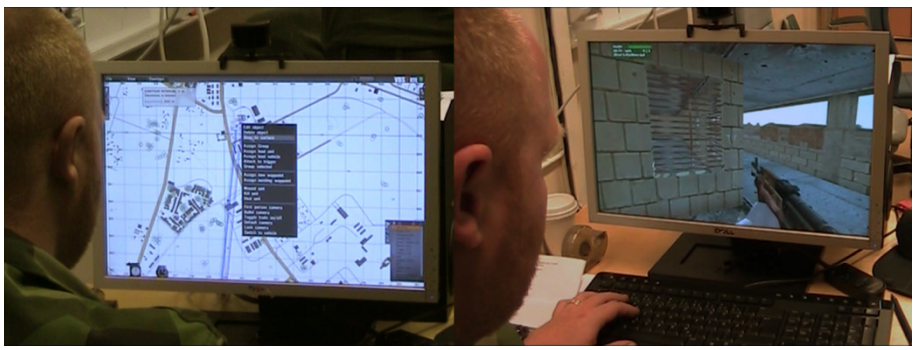

Figure 4-13 *A system operator at the Virtual command and situation trainer (StriSimPC) acts as a 'puckster' by (left) adding more entities to the simulation during gameplay and (right) controlling an enemy avatar.*

Puckstering can also be used to test trainees against certain learning objectives. At one occasion during my observations, the system operator was concerned that a group of cadets did not report enemy sightings correctly (or simply was not attentive enough). He, by controlling an enemy avatar, started to shoot just above the cadets' avatars' heads and then listened for the group's reaction. When noting happened, he repeated the procedure. After a while one of the cadets is heard shouting "Retreat! Retreat!" and the group commander reports "India Bravo is fired at". The system operator ceases firing and seems content with the cadets' reactions. The incident was later brought up during debriefing, to remind the cadets to report what is happening at all

times. Here, we clearly see the interplay between formative and summative feedback.

Apart from acting as a puckster, the system operator also has to deal with technical problems that arise during training. These two roles can sometimes be in conflict with one another. For instance, at the StriSimPC facility, the system operator is seated in the same room as the trainees. His position is in one of the corners, with the screen turned away from the rest of the room. This makes it difficult for cadets to sneak a peek to see were the enemies are located. Yet, whenever there is a bug in the system or a cadet's avatar needs reviving, one of the trainees has to go over to the system operator to report the problem. The system operator must then quickly discontinue what he was doing to help the trainee, who now has full view of the screen. The system operator was often observed changing screen mode whenever a cadet came close, most likely to prevent peeking.

So what in all this constitutes serious gaming apart from merely simulation? In the case of StriSimPC, game technology is used; Virtual Battlespace 2 looks like and is, by and large, played like a traditional first-person shooter (FPS) game. It is considered a serious game due to the fact that it has been modified to fit military training needs, e.g. by adding more realism to both graphics and game mechanics. It also has no narrative, which instead is added by the instructors in terms of mission objectives during the briefing.

As mentioned in the section on sampling (chapter 2.4.1), the system used in the Virtual platoon trainer for tanks (BTA) is indeed a simulator, not a game (or a sim based on game technology). What makes training at the BTA fall under the category of serious gaming is the game characteristics created by the instructors – not just by adding a narrative and adapting the difficulty level, but also by incorporating a score system in certain scenarios (e.g. the King of the Hill scenario). The scores serve as a way to increase the level of stress and attention that the trainees experience during the simulation. Being pitched against one's peers also adds to this extra tension. The King of the Hill (KotH) scenario is often played towards the end of the day, when the cadets are starting to show signs of fatigue and/or boredom. In short, the idea of KotH is to defend a village (or 'hill') and be the last tank crew standing. The first challenge is to reach the hill intact (worth 10 points) and then to fight down all other enemies (including the other participants). Winning the game (i.e. defeated all enemies) equals 20 points. Neutralising an AI controlled tank is worth less (5 points) than fighting down one of the other group's tank (10 points). Being defeated gives negative points (minus 10 points). It is also possible (but extremely difficult) to win the game by receiving infinite points (e.g. shooting down a bird). From an observer perspective, the social 'atmosphere' changes dramatically when training goes from tradi-

tional simulation to one with aspects of competition. In the former, participants are overall calm and quiet, while in the latter they seem more excited, as if attending a sporting event.

4.4 Debriefing phase – summative feedback

Debriefing, or, as it is called within the military domain, after action review (AAR), occurs after training. This is when trainees reflect upon their experiences and performance during the simulation. Thus, debriefing is an essential ingredient for learning. Debriefing at the SLWC is carried out in different ways depending on the situation and the limitations of the simulation software. At the BTA, the system logs everything, from every button that is pressed to the communication within each simulator. The instructors have the opportunity to use these during debriefing, to make their point both visually and auditory (see Figure 4-14). This does not mean, however, that all logged data are used during debriefing; in the sessions I observed, only a small amount of the logs were used actively during the debriefing. In a PC-based platoon trainer for combat vehicles also used at the BTA facility, the trainees have access to the logged data and, to large extent, assess their own performance. That system is, however, more of a gunner trainer than anything else, making assessment (e.g. accuracy of aim) easy to automate. For the larger simulator system, assessment is more complex (e.g. measuring communicative skills) and, as a consequence, only available via the instructors.

Figure 4-14 *Debriefing at the Virtual platoon trainer for tanks (BTA) in a classroom with all trainees. The top right corner shows part of the assessment screens projected on the wall above the whiteboard.*

At StriSimPC, logged data in the form of 'filmed' sequences and audio are seldom used, due to limitations in VBS2. The instructors at the facility have previously tried to use the game with headsets, but could not solve the prob-

lem of the game picking up the utterances from trainees seated nearby. Their solution was to not use the microphones at all, with the consequence that no sound is logged in the AAR module. As explained by one of the instructors, moving pictures without sound take more time to extract than what they are worth during debriefing, so they at most use screenshots as visual aids.

During and directly after training, instructors take notes on what to put emphasis on during the debriefing (see Figure 4-15). They usually only have a few minutes to prepare between training and debriefing, so the notes are usually brief and written by hand (or as a bullet list in a presentation software). A 'trick' they use to give themselves more time is to give the trainees a routine task to perform that does not need the instructors' attention.

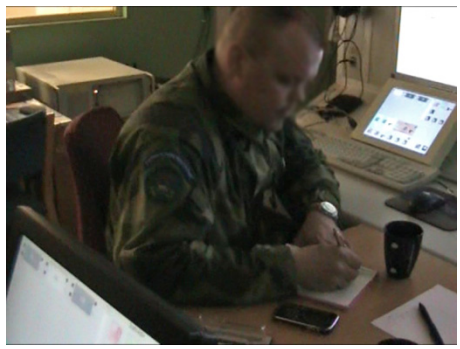

Figure 4-15 *One of the instructors at the Virtual platoon trainer for tanks (BTA) writing down notes for the debriefing session.*

Debriefing is usually conducted as a discussion between the instructors and the trainees. This can be done in a classroom setting (with all trainees present) or in smaller groups. The instructor usually starts by asking the trainees to give a summary of their own assessment and then gives summative feedback based on the notes made earlier. For shorter, iterative training sessions, trainees can also be asked to discuss their performance among themselves in between sessions (see Figure 4-16), and then a longer, instructor-led debriefing is held at the end of the day (see Figure 4-14). Occasionally, one instructor sits down with one or two trainees to discuss a specific matter only relevant to them. For instance, during the observation at StriSimPC, one of the instructors asked two of the cadets to remain after the main debriefing event had ended. The cadets were asked to reflect upon their assigned roles, how communication had or had not worked between them and how it could be improved.

Figure 4-16 *Examples of (left) debriefing in small groups and (right) individual coaching at the Virtual platoon trainer for tanks (BTA).*

4.5 Identifying requirements for system support

When developing new serious games, game designers must take the whole context of game-based training into consideration. Descriptions of current training practices can thus be used to infer requirements for how such a system should support both learners and instructors in their tasks. Table 4-5 gives a few examples of such inferences made on the present case study. The requirements show how instructors need system support on different levels of abstraction. For instance, they show that a serious game for vocational training needs several components of subsystems, such as an authoring tool and an AAR system. At the same time, they also show low-level needs pertaining to the user interface, such as being able to perform specific task efficiently and with only minor pre-training.

In sum, issues such as support for cooperative work, usability, flexibility and adaptability should be key issues for serious games designers. Instructors are a specific user group with different needs compared to trainees. To give a concrete example: trainees playing a game need challenges related to learning goals. Instructors, on the other hand, need to be able to play the same game without those challenges. An instructor who is 'stuck' on a problem will not be able to coach his or her trainees in an efficient and relevant way. Therefore, challenges related to coaching should not be linked to learning goals. The system should instead support, not hinder, the task of creating a dynamic learning experience, because that is a challenge in itself.

Table 4-5 Examples of system support features derived from the empirical data.

Training phase	Activity	System support
Preparation	Training plan written and sent to system operator, who creates a scenario	Being able to tag finished scenarios with keywords for easy search among previously created scenarios. Being able to quickly write an instructor guide to each scenario for easy reuse of scenarios. Being able to co-author a scenario online.
	Learning objectives or difficulty level re-negotiated	Being able to create open-ended scenarios. Authoring tool must allow for flexibility.
	Teaching inexperienced instructors how to use the game and experimenting with game mechanics.	Authoring tool should have high degree of usability. Being able to create a simple scenario within a few minutes without extensive prior knowledge of the user interface. Being able to quickly place new entities in game.
Gameplay	Assessment of performance by direct observation (offline)	Being able to quickly (or automatically) incorporate notes in AAR tool.
	Assessment of performance by indirect observation (online)	Being able to follow several trainees 'by a glance'. Monitoring tools should have a user interface that highlights changes in simulator/game states or important trainer performance measures.
	Explicit formative feedback to trainee(s).	Being able to convey information (through text or speech) in real-time to individual trainees or groups of trainees.

Training phase	Activity	System support
	In-game formative instructor feedback (coaching by gaming)	Being able to play the game from an instructor's perspective, i.e. being able to alter certain aspects of the game through gameplay to achieve specific pedagogical goals. Being able to quickly place new entities in game and to control them (cf. puckstering). Being able to switch between administrative mode and coaching by gaming mode. The user interface should give clues to help the instructor navigate in the game space.
	Adding a scoring system	Being able to add a customary scoring system based on simple game state rules.
Debriefing	Trainees assessing their own performance	A debriefing tool that enables trainees to access logged data. These data need to be organised and aggregated in a way that supports the activity.
	Instructors preparing the debriefing session	Being able to visualise the training session from different aspects. The debriefing tool should include visualisation software that aid instructors by pattern recognition and triangulation of data. The game should include built in scenarios for routine tasks that do not need human monitoring to give instructors more time to prepare.
	Running a debriefing session	Easy to use AAR tool with time stamps for video and sound clips.

5 Discussion

This thesis outlines an investigation into the roles of instructors in the context of serious gaming, in particular game-based vocational training. The common denominator for paper 1 and 2 is *instructor roles*, i.e. those functions that instructors take on in order to create a game-based learning environment. In sum, it broadens the perspective of serious gaming to include not only the game and the learners/trainees, but also the instructors. The results are based on an abductive approach in which theoretical and empirical material have contributed to the resulting framework.

Chapter 3, along with the backgrounds in paper 1 and 2, form the theoretical backbone of the thesis. In defining serious games and serious gaming, I maintained that serious gaming is more than just the actual playing of the game and this is confirmed by the empirical observations. For instance, it would not make sense to claim that gaming goes into a halt just because the participants are no longer in front of their computers, especially if they are still in the same roles as in the (digital) game (see e.g. left picture in Figure 4-11). On the same note, it would be erroneous to exclude any type of participant in the study of serious gaming; trainees and instructors all have a role to play in forming the actualisation of the game. Excluding instructors would take away at least one important factor from that experience, and critically affect learning. Unfortunately, many serious games researchers underestimate the impact of instructors; the instructors' roles are implicitly assumed to emerge on their own, without investigations into what works and what does not.

Furthermore, serious games developers must consider instructors' needs and to do so, we must understand what it is instructors do today. Military organisations have come a long way in establishing simulator- and game-based training practices, which make them a good target for case studies. This does not mean, however, that their practices are infallible or possible to incorporate directly in other domains that want to use games for training. Military training practices, just like many training practices in other contexts, are mainly based on tradition, not through careful examination of learning theories. This indicates that they have the prospect to be improved.

By studying what instructors do and what current learning theories say, I have found good practices worth incorporating in a framework for game-based vocational training. These insights can be used to infer requirements for system support in serious games within this domain (see Table 4-5 for examples of this). In sum, I have found areas in which military serious gaming practices can be improved and other areas where their practices can be used to inform and improve serious games development.

Paper 1 titled *Letting the students create and the teacher play: Expanding the roles in serious gaming* (Alklind Taylor & Backlund, 2011) has a focus on two specific roles that instructors and/or trainees can enter when playing a serious game; players and authors (see Figure 5-17). Typically, the instructor creates the scenarios that students or trainees are to play, but there are sound pedagogical arguments that suggest that those roles could be swapped. First, meta-gaming such as modding (creating modifications to a game, such as interface customisations, new levels/scenarios or new games) can be seen as a learning experience in which students actively experiments with and co-creates the learning content (Hedberg & Brudvik, 2008). To be able to do this, students must not only learn how to play the game, but must also gain insights into the mechanics of both the game and the real-world skills that the game is designed to train.

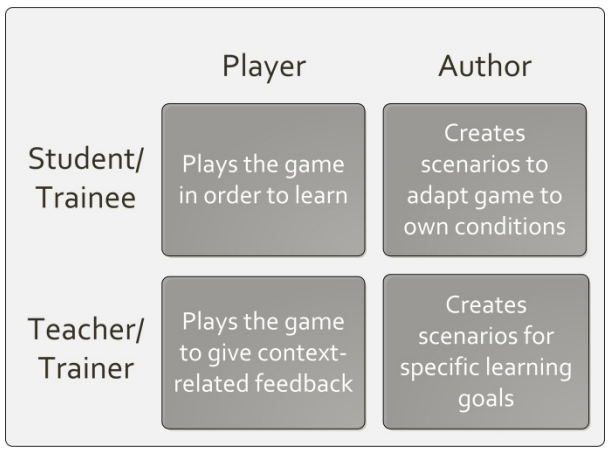

Figure 5-17 *The player role matrix in which instructors and trainees can take on either a playing or an authoring role during game-based training.*

Second, even if instructors are known to role-play in exercises such as military and rescue training, this is often overlooked in serious games research investigating digital game-based training. Both paper 1 and paper 2 challenge this notion that this role is not transferred when moving from non-digital simulations to digital ones. By playing, the instructor can create contextual formative feedback, i.e. in-game feedback that does not interrupt gameplay and the trainees' immersion in the game. Paper 1 gives a few examples from the empirical findings of all combinations of teachers and students as players and authors: student player, student author, teacher player and teacher author.

Paper 2, titled *Introducing the coaching cycle: A coaching by gaming perspective of serious gaming* (Alklind Taylor, Backlund & Niklasson, submitted), represents the main bulk of research that this thesis is based upon. It presents a framework (see Figure 4-5) that has been derived from a combination of theoretical and empirical material. The coaching cycle characterises training from the instructors' perspective, grounded in theories concerning deliberate practice (e.g. Ericsson, 2006), game-based learning (e.g. Garris, et al., 2002; Raybourn, 2007), experiential learning (e.g. Kolb, 1984) and debriefing (e.g. Lederman, 1992).

In adding an instructor perspective to game-based training, the activity of serious gaming is problematized and shown to be a complex machinery of several factors contributing to learning and skill acquisition.

6 Concluding remarks and future work

The purpose of serious gaming is to enhance training by adding characteristics that increase motivation and make trainees strive towards improvement. In this thesis, I have sought to bring forward the role of instructors in the context of serious gaming. In chapter 1, I stated that the overall aim of this thesis is *to propose a model for expanding the role of the instructor in game-based vocational training*. To achieve this, I have looked into the current serious games literature concerning this issue (objective 1). Although many researchers acknowledge the fact that instructors play a significant role in game-based learning and training, few have endeavoured to explore this matter in depth. Additionally, I have conducted a case study at the Swedish Land Warfare Centre in order to identify and describe instructor roles during different phases of their game-based training practices (objective 2 and 3). The outcome is not only a description of the practices, but also a framework for game-based vocational training (objective 4) that should be applicable to other contexts other than the military.

Expanding the role of the instructor in serious gaming has the disadvantage of bringing about tasks that are highly strenuous on the instructor. Of course, one can, as in the case described in this thesis, employ several instructors who distribute the responsibilities among themselves, but while this might work well in certain organisations, managers worrying over cost-effectiveness might be put back by such a solution. Besides, more instructors might not get to the core of the problem, i.e. that instructors need more system support to carry out their work. A consequence of the results of this research, then, is to lay the foundation of future work in serious games design, especially concerning interface and interaction design adapted for facilitating coaching by gaming and in-game assessment. For instance, the list of requirements for game-based training systems can be further elaborated and improved, and these requirements can then be used by those who want to incorporate ubiquitous assessment where both instructor feedback and system feedback are integral parts of the system. By ubiquitous assessment I mean making use of wearable and ubiquitous computing technology to monitor what is happening, both within as well as outside the game, i.e. the whole gaming situation. Ubiquitous assessment is important in intelligent tutoring systems, but in those situations where learning goals are complex and difficult to formalise, the system needs to work in collaboration with the human instructor.

6.1 Limitations of this work

Promoting an active instructor role usually generates three objections that I will deal with one at a time. The first objection is: *What's new? This is how*

the military already carry out their simulator training. Yes and no. The primary source of information for this research has been observations and, as a consequence, the framework is inspired by their current practices. On the surface, it resembles what the military already do; the improvements are subtle, but significant. Furthermore, even if this is how the military carries out game-based training, it does not follow that this is the practice in other organisations. Maybe they can implement (parts of) the framework to improve learning outcomes?

The second objection is: *It's not feasible. Having an active instructor is too demanding for the instructor or, if the burden is distributed among several instructors, too expensive*. This seems to contradict the first objection; if the framework is by and large already in use by the military, it must be feasible. It is not that simple, however. If you come from an organisation that is used to having only one instructor present during each training session, then this framework is a huge step, both in terms of workload and costs. My focus has always been on improving the training situation so that learning is, if not optimal, at least facilitated in terms of creating a good learning environment. That is why I discuss automated and ubiquitous system support for instructors, in all phases of the cycle (see paper 2). However, cutting costs has not been on the agenda, since that would impede creativity (i.e. taking all ideas into account) at this stage of the research process.

The third objection is more of a practical concern: *It will require too much bandwidth, especially if we want to get involved in distance learning*. Yes, this is a problem. Many organisations, including the military, are looking at distance learning as a way to train more people, at lower costs and in more flexible ways. The framework would definitely need some tweaking in order to accommodate a distance learning situation, something that I have, so far, deliberately ignored in order to keep the project from growing into unmanageable proportions. It might be something to look into in future studies.

6.2 Future work

The current work has primarily had a focus on current training practices using games. Although inferences have been made based on a mix of theoretical and empirical material, some ideas are still to be tested and validated. Since the research presented here constitute the first half of a PhD, future work includes *testing (parts of) the coaching cycle in an organisational setting* and, thus, further verifying the results. There are, however, many ways in which this can be achieved. Next, I outline four possible roads to take, in priority order, where those with most potential for my own PhD are presented first. The deciding factors will ultimately be a mix of my own interests/

background and factors outside of my control, such as whether or not these ideas are possible to implement in practice.

A potential problem in implementing the framework is making changes to work practices and/or to the technical systems used for game-based training. This involves careful examination into what changes are feasible and relevant in order to validate the framework. This is why future work might focus mainly on one segment of the coaching cycle. The issue that I find most intriguing is, not surprisingly, puckstering – the very essence of coaching by gaming. Puckstering can, however, be studied from many perspectives. For instance, a logical continuation of current work would be to further investigate system support for coaching by gaming. This entails looking into user interface design and interaction design for serious games, especially solutions for visualising trainee performance for formative assessment. Thus, a possible research aim could be *to develop and evaluate part of the system support relating to in-game formative assessment*. Different interface solutions could be overlayed with current systems and evaluated against specific criteria, such as how well it facilitates in giving the instructor an overview of what is happening and who is doing what. From this, design guidelines for in-game formative assessment could be inferred.

Debriefing is another part of the framework that could be examined further. In paper 2, I asserted that more time should be spent on debriefing (and less on initial lessons). I have also brought up the problem of instructors not having enough time to prepare such an in-depth debriefing. As a consequence, there is a need for system support for summative assessment, i.e. a system that aids the instructors in both preparing and conducting dynamic debriefings. A research aim could be *to develop and evaluate part of the system support relating to summative assessment and debriefing*. This is also an example in which different interface solutions could be designed and integrated with current systems, in order to perform an evaluation of their effectiveness as assessment tools. A possible outcome could be a list of design guidelines for debriefing tools in serious games.

Another aspect to investigate is how to facilitate instructors using games in distance education. Technical issues (e.g. bandwidth limitations) aside, instructors still have problems in figuring out how to utilise games in ways that are both pedagogical and time-saving. Within this problem lies issues such as how to increase instructor acceptance, how to communicate pedagogical recommendations and establish new practices, and how to convey a game's possibilities and limitations to instructors. A possible research aim could therefore be *to further explore good practices in game-based training in distance education*. This would entail more case studies in different domains where serious games for distance education have been or are on the verge to be

adopted as part of the curriculum. One possible approach would be to use action research to also explore the effect of different interventions to change instructors' perceptions of game-based training, and, by extension, their training practices.

A fourth potential road to take is to look at learning effects from following the coaching cycle and to compare those with other frameworks. Measuring learning is, however, far from straightforward, especially in a domain where there are great difficulties in measuring whether or not a learning goal has been achieved. In order to do a comparative study, different degrees of performance outcomes (i.e. grades) need to be measured, which further complicates such a study. Controlling variables to such a degree so that statistical significant differences in learning effects is found would result in an artificial training situation that no longer resembles the framework described in this thesis. There is, however, a need for more rigorous research into the potential of serious games (Watt, 2009), which means that this question might be of interest for someone studying educational sciences. For myself, however, being in the field of information technology, this issue lies beyond the scope of my PhD.

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PAPER 1

LETTING THE STUDENTS CREATE AND THE TEACHER PLAY EXPANDING THE ROLES IN SERIOUS GAMING

Paper 2

Introducing the Coaching Cycle
A Coaching by Gaming Perspective of Serious Gaming