NOTAT NR. 4 – 2009

TONE VOLD AND SIMON MCCALLUM

Use of Game Based Technology at NAMA

A Study Using Steel Beasts Professional

Høgskolen i **Hedmark**

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Fulltekstutgave

Utgivelsessted: Elverum

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Notat nr. 4 – 2009

ISBN: 978-82-7671-773-0
ISSN: 1501-8555

Høgskolen i Hedmark

Tittel: Use of Game Based Technology at NAMA			
Forfatter: Tone Vold og Simon McCallum			
Nummer: 4	**År:** 2009	**Sider:** 40	**ISBN:** 82-7671-773-0 **ISSN:** 1501-8555
Oppdragsgiver: Krigsskolen			
Emneord: Spillbasert teknologi, rollespill, trening, læring, evaluering, evaluerings verktøy, 3D visualisering, simulering			

Sammendrag: Målet med prosjektet er å teste effekten av å bruke Steel Beasts Professional (SB) i taktisk trening på Krigsskolen. Aktivitetene i prosjektet var:

1. Forberede scenario
2. Bruke scenariet som en taktisk øvelse for kadettene – med en kontrollgruppe som bruker kart og en testgruppe som bruker SB (dag 1)
3. Teste gruppenes terrengforståelse og deres løsninger ved å bruke Taktisk Øving Uten Tropper (TØUT) (dag 2)
4. Vurdere bruken av tekstbasert rollespill som et formativt evalueringsverktøy (dag 3)

Prosjektet har to mål: 1-3 tester effekten av broken av 3D visualisering og simulering i forbindelse med planlegging og 1,2 og 4 tester bruken av rollespillsimulering som et formativt verktøy for å evaluere læring.

Kadettene er delt i en kontrollgruppe og en testgruppe. Kontrollgruppen ble gitt et scenario og fulgte standard prosedyre og papirbaserte kart, når de laget sin taktiske plan. Kontrollgruppen fikk bruke SB og alle tilgjengelige views i dette verktøyet/spillet.

I TØUT'en ble begge gruppene testet for terrengforståelse. Spørsmålene ble designet for å vurdere hvordan kadettene svarte på spørsmålene og tiden det tok dem å svare på spørsmålene. Hensikten var å finne ut om det var en signifikant systematisk forskjell på måten kadettene utviklet en forståelse for terrenget i scenariet.

En del av testing av rollespillsimulasjonen (RPS) var for å studere brukermedvirkning i utvikling av scenariet. For å unngå at resultatene fra RPS skulle forveksles med

resultatene fra SB, ble halvparten av kadettene som hadde brukt SB og halvparten av de som hadde brukt papirbaserte kart satt til å gjennomføre en workshop for å utvikle script for RPS. Etter workshoppen utviklet Wold og forskerteamet det endelige scenariet for RPS'et. Deltakerne ble delt inn i fire roller: to SB–og to kontrollgrupper. MS NetMeeting ble i RPS'en brukt for å kommunisere.

Rapporten viser resultatene fra denne studien.

Hedmark University College

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Financed by: NAMA			
Keywords: Game based technology, role play, training, evaluation, assessment tool, 3D visualization, simulation			

Summary:

The aim of this project is to test the impact of using Steel Beasts Professional (SB) in tactical training at the Norwegian Army Military Academy (NAMA). The activities in this project were:

1. prepare the scenario
2. provide the scenario as a tactical exercise for the cadets with a control group using maps and an test group using SB (day 1)
3. test the two groups understanding of the terrain and their solutions using a Tactical Exercise Without Troops (TEWT) (day 2)
4. assess the use of text based role play as a formative assessment tool (day 3)

This project has two objectives: 1-3 test the effect of the use of 3D visualization and simulation on planning, and 1, 2 & 4 test the use of role play simulation as a formative assessment tool for learning.

The approach to testing the use of SB was to divide the cadets into a control group and a test group. The control group was given the scenario and followed standard procedure for developing a tactical plan using paper maps and manuals on operating procedure. The test group was given the same task, but with access to SB, and could use the tool in whichever way they chose.

In the TEWT the two groups were tested on their geographical awareness. The questions were designed to assess how the cadets answered questions and the time it took for them to respond to questions. The intent was to establish if there were any significant systematic differences in the way in which the cadets developed an understanding of the terrain in the scenario.

Part of the testing of the RPS was to investigate user participation in the development of role play situation. To avoid confounding the RPS with the SB results, half of the group using SB and half of the group doing the paper exercise took part in a workshop developing the script for the RPS. After the workshop, Wold

and the research team developed the final scenario for the RPS. The participants were divided on four roles: two SB groups (one took part in workshop) and two control groups (one took part in the workshop). MS NetMeeting was used as the communication system for the RPS.

Content

Abstract

1.1 Description:

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1.2 Executive summary

1.2.1 Findings

There are two different sections for the findings - the effects of SB and the use of RPS. The primary concern for the NAMA is “what effect will using SB have on tactical training”.

1.2.2 Steel Beasts Professional

Positive outcomes for the SB are:

- The cadets developed a better plan than the traditional map only group – 3 independent instructors confirmed this evaluation.
- Terrain related questions were answered more quickly.
- Better and more consistent estimates of potential “blue force” losses.
- Better understanding of enemy position and line of sight.
- Greater motivation to create a successful plan.
- Different solutions (plans of attack) actively tested and plans changed accordingly.

Negatives outcomes

- Geographical questions “where is town Y” where answered incorrectly by some of the SB group.
- Standard Planning procedure – Terrain, Enemy, Own forces was not followed completely. An iterative cycle of red/blue/red/blue planning was used.
- Potentially incorrect assumptions about results of engagement – SB incorrectly restricted the firing of some antitank units based on forest density.
- Potentially incorrect assumptions about some terrain details such as: tree density, accuracy of line of sight information and specific placement of buildings.

Neutral observations

- The SB group looked up when asked questions about terrain while the control grouped looked down first, indicating that the SB group found it easier to place themselves with reference to the environment.
- The SB group spent more time working in pairs and groups compared to the map group.
- Cadets who had never used SB before were able to learn the tool and use it for planning within 30 minutes of the session starting.
- Students exhibited greater ownership of the plan developed in SB, they were more willing to defend it as a good plan.

1.2.3 Role play simulation

The initial findings for the role play simulation are:

- Cadets were generally negative about the RPS.
- The instructor Roar Wold was positive about the potential for the text based communication to be used in assessment and after action review (AAR).
- There was a large expectation gap between what the students thought they would be doing and the exercise. This created problems as some of the cadets just wanted to play SB.
- User participation in the role play simulations do not fit well with the current organizational culture of the NAMA. Military cadets are less comfortable with open specifications.
- MS Net Meeting worked well as a communication tool and the instructor could follow all messages and see the progress. There was little moderating needed as the communication between the roles was active.
- Cadets did not see learning potential in RPS, however recognized it when it was pointed out in the AAR.

1.2.4 Preliminary conclusions

Based on fieldnotes, observations and recordings (audio and video), we have reached the following preliminary conclusions:

- SB in combination with TEWT is a recommended training form.
- SB can be motivating to use and gives a different way of testing possible solutions.
- Due to current constraints within SB, such as inaccurate terrain details, TEWT should not be excluded from the training.
- When training in SB, different views can be locked during simulation. This is useful during advanced training, however, we recommend that during the first training sessions all views should be available so student develop a better overview of their situation.
- Part of a new training system including SB must include emphasis on naming of places, as students using SB had very poor knowledge of place names.
- Role play simulations using MS Net Meeting can be used to replay cadets' solutions. A template for this use is under construction.

2. Introduction

Hedmark University College (HIHM) was invited by the Norwegian National Military Academy (NAMA) to do a study on a newly purchased game based simulation tool called Steel Beasts Professional. We investigated how performance changed when using the game based simulation tool (GBST) as opposed to traditional paper based training. The training situation was to make an action plan given a map of the area of combat. The plan of action was then be discussed during an exercise in the actual terrain (Tactical Exercise Without Troops – TEWT). This was followed by an after action review (AAR) process. Game based simulation tools have been used for many years for education. In Camp Rena, they use many different simulators for tasks including shooting, driving, staff and leader trainer, and gunnery. These simulators have been specifically designed for military use, and are very expensive to develop or purchase. The computer game industry has started to develop simulations of combat situations that are on par or better than these custom solutions. These "off the shelf" applications offer a cheaper alternative to specifically designed software, but they also come with some alignment and customization issues. The aim of this report is to investigate the use of one of these Commercial Off the Shelf (COTS) games in a military training situation, and to advise about the potential benefits and challenges of using commercial games in Norwegian military training.

2.1 Games and Simulation in Military context

The use of games has a very long history in military training. Games have been used to improve officer training and specifically to improve their planning skills. Games by definition are environments that allow for experimentation and play. The decreased consequences of failure are an essential part of the separation of simulation and games from real world activities. At a very abstract level this experimentation can be seen in chess, where the player experiments with various strategies. At a very concrete level this is full troop exercises without live fire. See Roger Smith's article "The long history of gaming in military training" for a well written review of the tradition of games as part of military training (Smith, 2009).

The ability to transfer experience from a simulation or game to a real situation depends partly on the veracity of the simulation (Shannon, 1998). The more accurate the model used in the simulation, the easier it is for users to transfer skills learnt on the simulator to real world situations. This has been shown in fields as diverse as colonoscopy(Haycock et al., 2009), education, as well as military simulators. Modern warfare simulators trace their ancestry back to the 19th century when Helmuth von Moltke the Elder, Chief of the Prussian General Staff, developed a board game called 'Kriegspiel' designed to improve the ability of officers to plan for various potential battle situations. This game introduced many war gaming conventions including the use of "blue" for friendly forces and "red" for the enemy. von Moltke is also credited with the quote "No battle plan survives contact with the enemy." This observation is not dismissive of planning, but designed to emphasize the need to investigate multiple potential situations, and have worked through many potential scenarios.

One of the limitations of the early simulators is that the complexity of the rules and calculations was limited by the players understanding and time. Automation of the mathematics of simulations has allowed computer simulations of military engagement to become much more accurate. Initially these simulators were very large and expensive however, with the increase in the power of consumer level computers there has been a massive increase in the use of simulators as part of training systems. The main benefits of an accurate simulator are:

- Danger associated with real situation removed.
- Lower costs for training. Cost per unit improvement in performance is lower. For example the Canadian military saved 40% on training costs while improving soldier performance from 70% to 100% pass rate.
- Decreased environmental impact.
- Students motivated by providing more tangible examples in a shorter timeframe.
- Increased range of potential training situations. Hard to test situations in the real world can be simulated.
- Ability to learn through repeated failure.
- Accurate recording of performance for later analysis.
- Improved transfer of knowledge when compared to lectures and reading.
- Improved access to learning material as the simulator can be run at any time.

These benefits have motivated most military organizations to invest heavily in simulators for training.

2.2 Current Situation

The use of computer games and more generally simulation has become widespread internationally. The United States Military have purchased an enterprise license for Virtual Battle Space 2 (VBS2) and Steel Beasts Professional (SB). NATO has decided to work with the makers of VBS2 to create VBS NATO which is specifically designed for the NATO countries. This product will have a focus on IED identification and decision making. SB is also used by many of the NATO forces as well as the US and Australia.

In Norway simulators are used regularly. Games are also used as part of training, including the Air Force Training Centre at Kjevik which has a commitment to include games in learning. They have successfully used "Battlefield" in training[1]. The Norwegian Defence Research Establishment (FFI) have been researching and using games as part of training for several years.

Military focused computer games share many of the benefits of traditional simulation based training. There is an overlap between computer games and simulation as shown in Figure 1. The application studied in this report, SB, is a hybrid between a military simulation and a computer game.

[1] Contact Captain Morten Hougen mhougen@mil.no, for more information

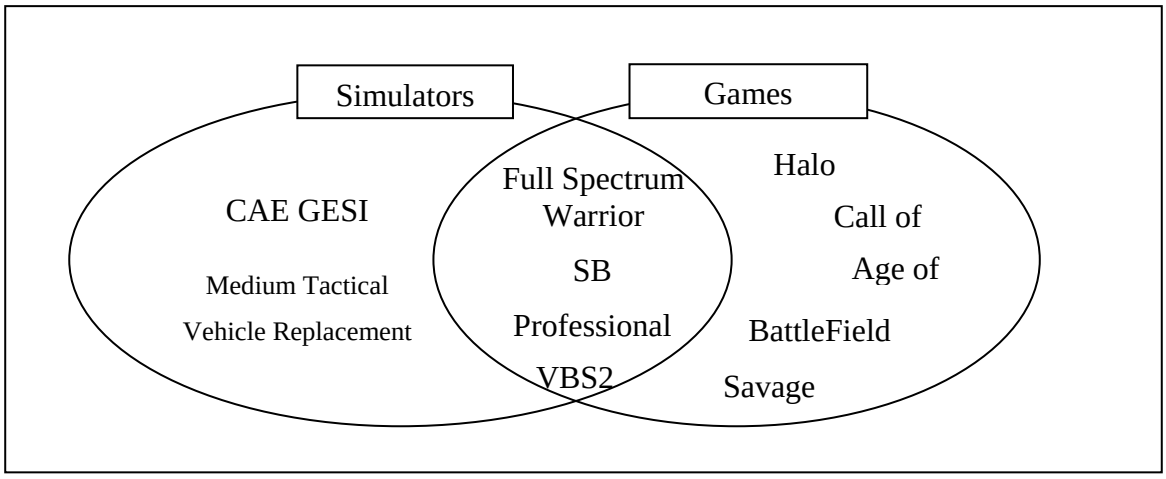

Figure 1: Venn diagram of the overlap between military simulators on the left and entertainment focused games on the far right.

This combination of simulator and game has specific benefits:

- User Interface: the user interface in games is designed to be intuitive and easily learnt. Cadets who were completely new to SB were able to use it to discuss tactical positions within 40 minutes with minimal instruction. This is very important as time spent learning the interface would decrease the time available for teaching tactics.
- Motivation: Games are designed to give motivating feedback to the player. Seeing an explosion in the distance, or smoke rising from your crippled tank is an integral part of the engagement of the player. By comparison, it is not important in a simulator to model explosions if they do not alter the results of combat, merely showing a text message is sufficient.
- Return on investment: The cost of game based simulators is generally much lower than that custom made simulations. The economies of scale where much of the cost of development can be covered by commercial release.
- Familiarity: 53% of Norwegian teenage boys play computer games every day (Vaage, 2009), and 100% use a computer every week. This exposure familiarizes them with gaming conventions and game technology. Thus when they approach the game based simulator they are more comfortable and learn the controls much more quickly than previous generations of students.

SB is a good example of a crossover product in the area between pure games and pure simulations. This makes it a particularly good choice as a testing platform for the NAMAs investigation into game based technologies.

2.3 Games are for entertainment?

There are some very valid concerns related to the use of computer games for military training.[2] Military computer games and training simulations often share many similar elements. Home PC's now have the computational power to run complex simulation code and model large combat situations making it possible for commercial computer games to be as complex as military grade simulators. Given that the computational power is not an issue, what are the main differences between military computer games and military training simulators? Games have some specific features which could cause potential concern for use as training tools:

- Entertainment Focus: Commercial computer games are focused on entertainment. Part of that entertainment is escapism, where the individual gets to be someone who they could never be in the real world. Main characters are often given inflated powers and health. This matches well with a teenager's feeling of invulnerability, but runs directly counter to the need for accurate assessment of risk in military scenarios.
- Individual focus: Many computer games focus on the player as being the hero or antagonist. The "minor" roles are played by the computer's artificial intelligence. This focus on the importance of an individual does not fit well with the need to work in teams and collaborate with other forces.
- Feedback: The role of feedback is very important in games, and score is often used as a motivation for players. A single number is a very coarse way of evaluating the results of a complex military action. Games used by the military need to provide information about performance that goes beyond simply giving positive points for killing "bad guys" and negative points for "civilians". Killing 50 more enemy soldiers does not mean that it is now okay to kill a few civilians.
- Faking it: Computer games often fake various aspects of reality, such as physics or interactions, to make the player feel more powerful and in control. For example, the standard jumping mechanism in games allows the player to change direction while in the middle of a jump. This is an accepted standard in games which is extremely unrealistic.

[2] Even the title "serious games" has come under a great deal of criticism for including the word "game" which many people see as frivolous and childish, and certainly should not be associated with serious activities like training soldiers. The current generation of students has grown up with computer games as part of everyday life. Games are not childish activities, and are part of lifelong learning and entertainment.

- User interface: Computer games require user interfaces that are intuitive or at least easy to learn. The player must be able to play the game very quickly. Games that do not have simple interfaces are usually not successful. Game developers spend a great deal of effort getting the UI right, while developers of simulations often place a low emphasis on the UI as the purchaser of the simulator is usually not the end user.

- Simplification: Games generally present very clear objectives with very clear winning conditions. This is partly the appeal of games as they do not require negotiation and compromise. This focus on there being an obvious right solution which is achievable may cause problems when trying to train soldiers on situations where all choices are bad and you are trying to minimize loss.

- Good versus Evil (stereotyping): Most entertainment media use stereotypes to quickly convey a lot of information about characters. Games usually present very clear distinctions between things to kill, and things to save. Evil is obvious and easily identified. This kind of simplification could lead to incorrect assumptions about scenarios based on black and white interpretations of actions.

Many military simulation games avoid most of these problems as they appeal to a different type of player. Just as with other media the game market is diverse, historical documentaries have a different intended audience to reality programs. Given the wide range of games it is important to focus on the specific group and discuss the benefits and problems associated with that group rather than games in general.

In this report the game used for training is SB. This game does not suffer from most of the potential problems discussed above.

- Focus: SB is focused on the simulation end of the gaming market and so is specifically designed to simulate real combat environments. This sense of realism is part of the appeal for the gamers that play these games.

- Individual Focus: Although it is possible to run an entire mission single handed, this is extremely difficult as every unit needs to be controlled. The game is designed to have multiple players working together to issue orders and therefore a group of players will be more effective than an individual.

- Feedback: SB provides an AAR in which significant events are logged. There is no single score unless the designer of the scenario explicitly creates a scoring mechanism. Instead the AAR includes statistics about the outcome of the engagement.

- Faking it: The developers of SB are constantly striving to eliminate faked outcome and inconsistencies in the game engine. Blue forces are not equipped with unrealistic weapons or defenses. This means that balancing the red and blue forces is more difficult than artificially symmetric weaponry as NATO equipment is usually technically superior to most realistic red forces.
- User interface: SB allows players to control tanks from unrealistic viewing positions above the tank. This is one of the more game like features of SB. However there is the ability to lock the players views to being within the tank. This provides a more realistic view of the terrain and tank.

There are some potential problems that remain with using SteelBeasts and indeed most game systems.

- Simplification: Part of the goal of a simulator is to simulate the important aspects of a situation. What is defined as "important" and the level of detail of the model is determined by the developers of the software. Simplification has the benefit of allowing the student to focus on these "important" interactions, but comes at the cost of experiencing real world interactions. Some of these simplifications are unavoidable, such as the loss of physical sensations of movement, while others are made because of development cost and return on investment concerns. An example from SB was a cadet who drove his tank into a creek, which may have been avoided in a real tank by physical feedback of the tank tipping.
- Good vs Evil (stereotyping). SB is currently focused on red vs blue, and does not support a full range of independent (gray) forces. Allowing the students to spend too much time in a good vs evil mode of combat could have the effect of polarizing their view of potential combat situations. Modern warfare is generally more complex than simply good vs evil.

The issue of simplification can only be addressed by having full real world exercises. It is essential that these remain part of the cadets training when simulations are introduced. The number and duration of real world exercises can be decreased but they must remain so that the cadets are able to identify the simplification in the simulator.

For this report SB was used as part of tactical training. In this domain the issue of only showing red vs blue is less of a concern than for the curriculum as a whole. Recommendations on how to mitigate some of the potential problems of stereotyping by

integrating the simulations into the broader NAMA curriculum will be presented in the follow-up report.

3. Objectives

The main objective of the project was to assess if a COTS game such as SB could be used effectively as a tool for tactical training, and to give recommendations for use and how to adapt the instructor's role.

In order to assess the use of SB we used a standard tactics training exercise, with a map based and a TEWT component. To test the effect of using SB for tactical planning the project cadets were divided into two groups. Group one (control group) used standard military maps to develop an action plan given a standard training scenario. Group two (test group) were given access to SB in addition to the paper maps during planning. The hypothesis was that the SB group would have a better understanding of the terrain, given that they have had a more visual display even when taking into considerations the lack of accuracy regarding drawing of houses and the shape of forests. Also they participated in a RPS in order for the instructor to assess which group had a better understanding of the situation.

4. Description of the three activities

The first day of the practical part of the project was spent working with the map for the Map-group and playing SB for the SB-group. This involved learning the interface and how to control and work the program. Both groups were to come up with a plan of action based on the information given. They had opportunities to ask questions of the instructor, and collaborate within their group.

The TEWT was executed on the second day in the Nittedal area. The two groups were given coordinates from a map and were told to meet at the specified location. Both groups managed to arrive at the correct location. They were given some questions in order to test out their ability to orient themselves in the terrain. The questions would also showed if there were any differences between the test group and the control group

On day 3, the Workshop and RPS were completed. Day 3 is described in more details below.

4.1 The workshop

In order to test the effectiveness of the workshop, half of the Map-group and half of the SteelBeasts-group were dismissed, while the other half stayed and participated in the workshop.

The participants were asked the following questions:

- What of your previous experience over the past two days would you like to learn more about? Take as a point of departure the task you were given two days ago and your experiences from the TEWT.
- What in your opinion could be possible to use in a role play simulation using text-based communication. Imagine that you are sitting in tanks and only have access to the text-based phones.

The data collected from this activity were video and audio recordings, field notes and a questionnaire.

4.2 Result from workshop

The participants were confused and had problems understanding how to organize the work in the workshop. As this was probably unlike anything they had encountered during their training so far, the lack of orders and clear instructions resulted in a somewhat chaotic situation. However, after a few discussions among the group, they were able to reach a conclusion. The participants decided on using the Map-groups result from day 1. However, the instructor decided that they should use the SB group's result from day 1. In his opinion the SB group plan was more effective and had more potential to reach the proposed objective. The final result from the workshop was that the participants were to play the SB group's action plan.

4.3 The RPS

The participants were allowed to use SB as a supplement when playing, but all communication was to be conducted in NetMeeting. They were assigned 4 different roles (see table below).

Role 1: Participants in the Map-group Participants in workshop	Role 2: Participants in SB-group Participants in workshop
Role 3: Participants in Map-group Not participants in workshop	Role 4: Participants in SB-group No participants in workshop

In total there were 5 possible roles including the instructor. The instructor's role was to oversee and intervene if the RPS approached a dead end. The instructor would then engage in order to direct the students toward further engagement.

The data collected from the RPS were audio and video recordings, field notes and a questionnaire.

4.4 Result from the RPS

The role play simulation was conducted using eight computers connected in a LAN (local area network). The participants reported different initial levels of competence regarding the use of PCs and games. However, all of the cadets were able to understand the task and communicate with each other in order to test the plan of action from the SB group. The instructor interacted a few times, but most of the time was spent improving the initial plan.

The results of the RPS were promising. After approximately 70 minutes they came up with a new plan of action. This new plan was assessed as being "clearly better" by the instructor. He was also able to follow the communication and trace the changes that lead to the improved version. This shows potential for use as both an assessment and a learning tool.

In the AAR, the participants reported that they believed that there was "low or no learning outcome" from both the workshop and the RPS. However, when the instructor presented his point of view describing what he saw as positive learning outcomes, they agreed with him. It is still unclear whether they were negative because of the novelty of the workshop and the RPS, or if there is an inherent problem with using RPS in this situation.

5. Theoretical approach to the instructor's role

Authority is very important in all schools. Reinforcing feedback is necessary for learning, and in a classroom environment it is the teacher who provides this feedback. A clear authority can also provide a framework for collaboration and peer learning. In a military setting, such as within the NAMA, authority is very important as listening to and obeying superior officers is critical in combat situations.

Traditionally the instructor would determine the quality of a plan based on experience. Once a game based tool is included in the curriculum there is another authority declaring the "winner" of a scenario, and potentially the better plan. This should not be perceived as a challenge to the instructor's authority. The instructor can discuss in the AAR why he felt a particular plan was successful and discuss where the simulator may have incorrectly modeled the real world. This gives the students more insight into the analysis used by the instructor, and therefore potentially deeper learning.

If the simulator is considered to be suitably accurate, the role of the instructor changes to being a facilitator and an analyst. During the game the instructor facilitates the exercise making sure that the cadets know how to use the tools, and checking that things are progressing normally. Once the battle has ended, the instructor must be an analyst for the AAR. The AAR is vital to identify the significant learning outcomes. Without a skilled instructor to identify critical moments in the exercise, and to focus the students' attention to the important details, the exercise will not be as effective.

In a SB session, the cadets create a plan of action based on the instructor's input and the scenario presented. The scenario includes terrain and initial troop formation which are either designed or selected by the instructor to teach a particular aspect of tactics. The instructor can intervene during the students play to correct problems[3], change enemy forces, or pause to emphasize and discuss a particular situation. These interventions allow the instructor to moderate the session and ensure steady progress. Balancing the role of the moderator is

[3] For example breaching of a mine field which was simulated incorrectly requiring the instructor to move tanks using the instructor view.

important, as this is a way of stating authority. They should Intervene when necessary, but not distract too much from the play during SB session or RPS (Ip, Linser, & Jasinski, 2002; Linser, Waniganayake, & Wilkes, 2004).

Instructors who regularly use games often develop slightly different values to many of their colleagues. They have a tendency to emphasize the role of exploration and student centered learning (Gibson, Aldrich, & Prensky, 2007). With respect to the NAMA, the change in attitude of the instructors is very important as they are expected to be an authority as well as a facilitator. It is important that the cadets continue to regard their instructor as their mentor and "oracle". This can be done by starting out with the "ordinary" activities that will reinforce the instructor as a role model, mentor and "oracle", and then introduce the game (SB, Virtual Battle Space II, etc.) later. The games can be used as a 3D visualization tool initially and then later as the full game. Once the students have learnt to use the tool, the instructor can focus on more advanced tactics to solve more complex scenarios. The instructor can emphasize important lessons by combining the game with a TEWT and an RPS. This provides the student multiple opportunities to learn as well as different ways of presenting the lesson. The RPS can also be used to follow the learning development of the students.

Quinn (2005) describes a learning cycle and an instruction cycle with respect to instructional design. The learning cycle describes the process of implementing a potential solution and then reflecting on the outcome to improve the solution. SB provides an application and practice environment, with the AAR providing the reflection needed to improve the solution (or concept).

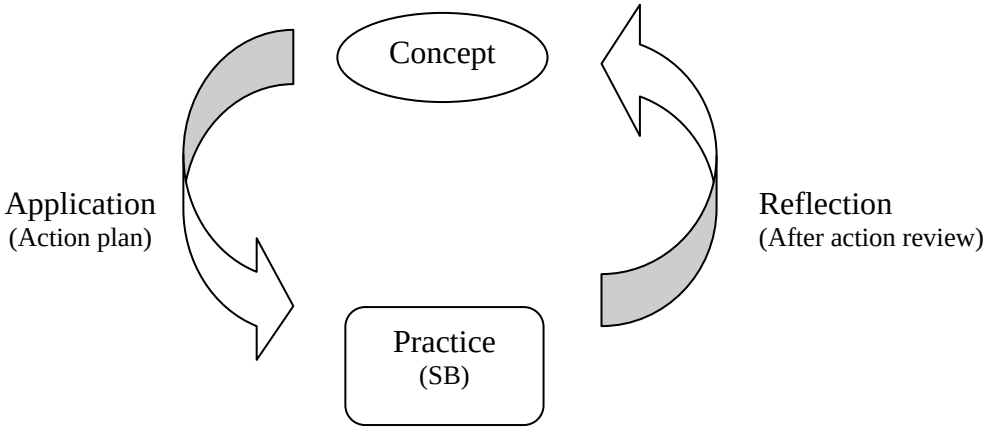

Figure 2 Learning cycle (Quinn, 2005) with associations to this project in brackets.

The instruction cycle starts with the concept and, through examples, gives the cadets the ability to practice and receive guidance and then restructure their concept of the task.

Bloom's taxonomy (Bloom, 1956), shown in figure 3, provides a means of comparing the aspects of cognitive development. Once a student has knowledge they can move up through the hierarchy of comprehension and application. This taxonomy suggests that instructors should focus on providing students with knowledge early in the curriculum and then move on to comprehension, application and analysis. SB provides a means to apply knowledge and then analyse the results.

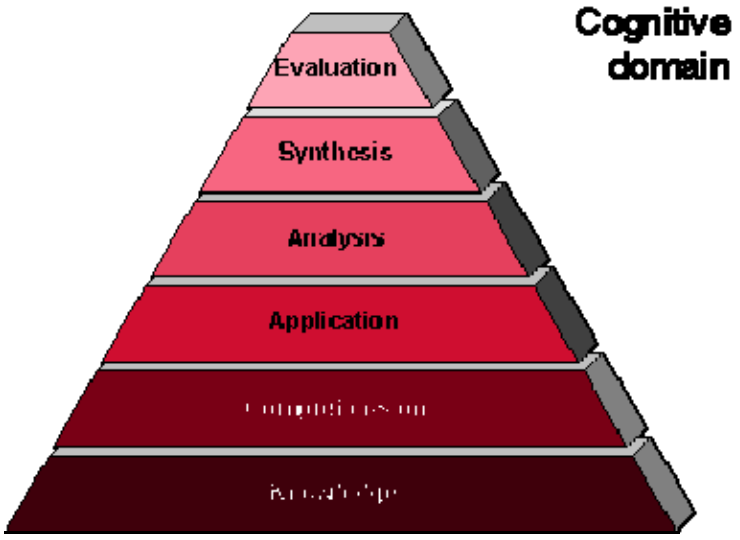

Figure 2 Blooms taxonomy

Four types of knowing are described both in Heron (1996) and in Coghland and Brannick (2005):

- Experiential knowing: The knowledge arising from interaction with the world, ie direct consequences of actions.
- Presentational knowing: The knowledge expressed in verbalizing this experiential knowing, through language, images, music, painting etc.
- Propositional knowing: The knowledge distilled from our experiential and presentational knowledge into theories, statements, and propositions(what the participants generate during the AAR)
- Practical knowing: the knowledge that brings the other three forms of knowing to full fruition as this is knowledge that can be applied to real situations (ie once the cadets know how to make a suitable plan of action)

To further enhance the learning processes Heron's (1996) "fourfold interaction" model is interesting. This model shows how reflection and action can enhance each other and how individual autonomy and group interaction can interact with one another.

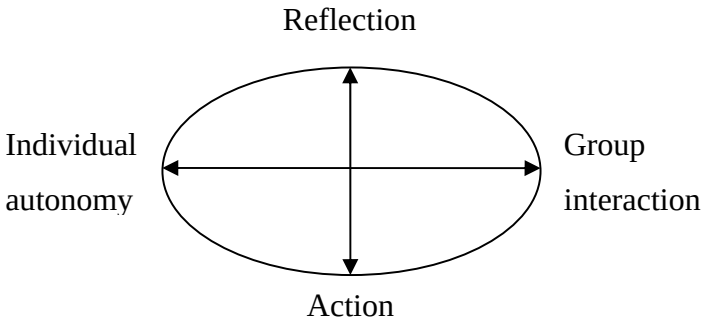

Figure 3 Fourfold interaction model from Heron (1996)

The individuals may supply their own experiences or own narratives from their own background or from what they have previously learned and bring this into the group. They may interact with each other to create scenarios or suggestions towards the plan of action. During this process a certain validation process will take place as the participants reflect on the solution.

Robert Mills Gagné made a major contribution to the theory of instruction with his model "Nine Events of Instruction".

- Gain attention
- Inform learner of objectives
- Stimulate recall of prior learning
- Present stimulus material
- Provide learner guidance
- Elicit performance
- Provide feedback
- Assess performance
- Enhance retention transfer

5.1 Application of these theories to NAMA

These theoretical models can be used to assist in the development of sessions involving SB for NAMA

- Gain attention: Introduce the lesson.
- Inform learner of objectives: introduce the task of making a plan of action using the game based simulation tool (GBST).
- Stimulate recall of prior learning: quick reminder of the learning prior to using the GBST using keywords and key events from prior training.
- Present stimulus material: display the setup in the GBST.
- Provide learner guidance: be available and supervise when necessary regarding start up, use and planning in GBST.
- Elicit performance: make sure that the cadets understand and are able to use the GBST, and play through the scenario and their plan.
- Provide feedback: feedback during GBST, both by giving feedback in the GBST and verbally during play session and as part of the AAR.
- Assess performance: assess during play session how the cadets are performing, how they work during making a plan of action
- Enhance retention transfer: by using an AAR and giving feedback on their performance, the instructor can enhance the possibility of making the cadets better at retrieving and transferring their gained knowledge through to the next exercises.

The table below depicts the learning structure for the TEWT and RPS:

"Nine events of instruction"	TEWT	RPS
Attention	Indicate start of session	Indicate start of session
Objectives	Present tasks and the reasons for the task	Present tasks and the reasons for the task
Recall	Quick reminder of previous use of GBST	Reminder of previous GBST and TEWT
Stimulus	Give coordinates and scenario	Present concrete task
Guidance	Focused questions from instructor	Instructor can play mentoring or moderating role
Performance		Instructor initiates as a moderator
Feedback	AAR	Feedback during play session and AAR
Assessment	Evaluation of answers and	Evaluation of communication and

	communication between the cadets	assessment of new plan
Retention	During the AAR the instructor gives feedback on the application of newly gained knowledge	Feedback during the play session can indicate how the new knowledge can be used in later exercises

6. Discussion

6.1 Instructor's role

One of the most significant changes caused by the use of simulators is to the role of the instructor. Traditionally instructors have been the oracles of knowledge and have given feedback on the success or failure of students solutions based on their personal experience and understanding. The introduction of an automated tool that provides feedback and a way of testing tactical plans changes the instructor's role from providing all the feedback, to reviewing results and discussing the lessons learnt.

6.2 Environment-friendly "exercises"

Using simulators and game based tools for training also saves the environment. Exercises can be repeated without causing damage to the environment either directly with wear and tear, or indirectly through carbon emissions. However, due to the nature of simulation and the constraints in SB regarding the accuracy of buildings and forests (in the version used for this project) we suggest keeping some TEWTs and live exercises as they will provide more accurate experience.

6.3 Trial and error

The students have access to the scenario in the computer lab, and so can play though various potential solutions as many times as the instructor deems necessary. This gives the students the ability to experiment with various plans and learn by trial and error. Learning from error is still something that students do not fully appreciate. There is a culture of failure avoidance, rather than acknowledging a mistake early and looking to learn from it in the AAR. Students want to be seen as performing well, and so try to hide errors. During one of the play sessions a student made a mistake and drove his tank into a stream. He was embarrassed about the mistake and was hesitant to announce his situation. It is very important for the instructor to identify this kind of behavior and use it as an opportunity to

talk to students about accepting responsibility for mistakes and giving accurate information to the company commander.

Given that the cost of re-running the scenarios is very small, students can be encouraged to experiment with their plans, and trial different options. Rather than just trying to get the "right" answer every time, students can create multiple plans and test each of them repeatedly. This type of experimentation helps students think about multiple potential solutions rather than being focused on making the first plan they developed work, no matter what the battle situation is like.

6.4 Games versus conventional training?

Game based and simulation training can focus the students training so that a greater percentage of time is spent actively learning. Games used in combination with conventional training can reduce the time required to train tactical skills. By reducing the number of TEWTs and live exercises, and replacing the time with simulation exercises, the students spend more time actively engaged with tactical planning. Students do not spend time travelling to locations, or waiting for the other groups to be ready.

The engagement of the students with the game technology also provides an opportunity to encourage students to work in their own time on scenarios and tactical planning. If the scenarios provide an appropriate level of challenge, some students will opt to play the training game rather than personal games. Games cannot and should not replace all conventional training. Real life experience cannot be completely replicated even with advanced simulators. However games provide an excellent tool for priming the students to get the most out of real world exercises. Much of the simple basic material can be learnt in the game and then refined with real world exercises.

The use of games and simulation can be seen as a form of problem based learning. The students are presented with a scenario and attempt to develop an action plan by following several iterations of planning, implementing, and reviewing. The instructor becomes a facilitator helping the students understand why parts of the plans failed, rather than telling them what will fail. This is an important shift in the role of the instructor as the students can see that the instructor is helping them to learn, rather than telling them what to do.

The motivation generated by using a game does not always lead to positive learning outcomes. Using a game based technology increases the student's motivation to "win" by providing feedback and a visually appealing environment. If the player becomes too engaged they lose the ability to reflect on their actions, and thus may actually decrease the amount learnt per session.

6.5 The instructor's attitude

It is also important to encourage all of the instructors at NAMA to have a positive attitude toward using game based technology. Even those instructors who will not use a game based tool must agree that the application has a valuable place in the general curriculum. Caspian Learning (2008) states that acceptance of "games" is a "cultural barrier" as there is currently a very instructor-led learning approach in military training, which may be very difficult to change.

The NAMA have started this process by including instructors in the "Friday war", which allows them to experience the game and see the similarity to real exercises. Instructors must be given time to conduct this type of activity, to become familiar with the tool, and to identify potential uses in other disciplines.

6.6 Transforming gaming experience into learning outcomes

Mammals use play as part of development and learning. Games have been used by the military for general physical training for thousands of years. Children who play games learn during play. What they learn varies depending on the games they play(Gee, 2003).

Many educators have tried to systemize the benefits from gaming and focus the learning in particular areas. Unfortunately designing games to be both fun and have a focused learning objective has proven to be very difficult. Most games are either "fun with little learning" or "learning but no fun". For simulator based games the learning is focused on understanding how the system that is being simulated actually works. For SB this involves learning

mechanized tactics. The game itself does not teach tactics, it is the AAR, directed by a skilled instructor that enables deep learning to occur.

To transform the SB games into successful tactical learning there must be:

- A scenario that provides the opportunity to test multiple action plans
- An instructor to facilitate during the games and ensure that students remain aware of the situation and the objective of the session
- An AAR which focuses on understanding what the significant events were and why they occurred.

It is also important that the instructor actively points out where the game differs from his experience[4]. When the game differs from his own experience he can use this as an opportunity to talk to the students about real combat situations, and discuss how the simulator is a simplification. The students have to be reminded that the objective is to learn for the real world rather than just optimizing plans and behavior to beat the game.

To incorporate the learning into the wider curriculum we suggest that:

- Significant events identified in the AAR are recorded and made available to other instructors.
- Instructors play SB themselves to become familiar with the game and become comfortable using examples from SB in their lectures
- Instructors encourage students to have a broad view of the simulator and help them identify links between tactical training, leadership, ethics, English and the many other disciplines they are learning.

For example during the sessions we observed that there were the following potential learning examples:

- **Ethics**: the cadets accidently bombed a church during a play session in SB. This situation provides an opportunity to discuss the ethical and political consequences of damaging civilian buildings.
- **Communication**: Communication between vehicles is essential in SB. There were several times where communication caused problems for implementing the plan of action. These

[4] An example from the last SB session was that after the session was over, one of the cadets was playing SB, on his own to look at what the red forces were doing and why the anti-tank took so long to engage. He set up the scenario and then just followed the enemy anti-tank watching what it did. This showed that the tank could not find an open area to deploy. This was incorrect behavior from the anti-tank vehicle as there was a road that would have provided an opening, however the program did not represent the clearing caused by a dirt road and so could not "see" the break in the tree cover.

are ideal times to discuss why communication failed and how to improve accuracy and timeliness of communication in combat situations.

- **Military English**: For the benefit of one of the researchers some of the play sessions were conducted in English. This demonstrated that some of the cadets were not completely comfortable using military English. It may be beneficial to combine a class on military English with a tactical training session in SB so that the students learn to use English in an embedded situation.

6.7 Cadets with previous gaming experiences

There are both benefits and potential problems caused by the cadets familiarity with computer games. In most combat based computer games the player is a superhuman "fantastic" hero. First Person Shooter (FPS) games allow the player to be an individual who defeats an entire army. In the Halo series of games not only is the player much stronger than any other person, the player's aim is assisted by a magnetic aiming system which automatically draws near misses into the target. This assistance is carefully balanced so that the player does not notice the computer helping him/her aim. This kind of unrealistic activity and assistance devalues what is learnt in the game.

However, certain aspects of previous game experience can be useful. Most teenagers will say that it is better to beat a game on the hardest difficulty setting rather than using cheats or easy settings (Gee, 2003). This recognition that playing on harder levels is a greater achievement can be used as a motivation for students to play the scenarios as realistically as possible, so they can get a greater sense of achievement when their plan is successful.

Previous game playing experience can also be used as a source for analysis. Most cadets will have played games with military themes. The instructor can ask questions about these games and why and how the game simplified combat to make it more entertaining. Questions could include:

- How should the enemy forces behave differently to prevent the player progressing?
- What has been changed from real combat to make the game fun?
- How are the weapons similar and different to real weapons?

6.8 Error Management

Accepting that there will be "friction" is part of planning. Games and simulators are one way of demonstrating to cadets that their mistakes will affect the outcome of a plan. The connection is much more immediate when the student makes the mistake themselves, rather than being told that an error has occurred by an instructor.

7. Conclusions and Recommendations

From our observations of the use of SB at NAMA we believe that there would be significant benefit from including game training as a standard part of the tactical training curriculum.

This conclusion is based on several observations:

- The user interface in SB is easily learnt and cadets were able to use the tool quickly.
- SB provides students with different views of the terrain which helps in making more accurate action plans.
- SB motivated students to spend more time engaged in planning as they can test the plans.
- SB provides an arena for trial and error, and problem based learning
- Military grade terrain maps are easily imported into SB, allowing students to become more familiar with accurate terrain. This improves their ability to locate themselves in unfamiliar environments.
- Use of simulators and games also puts less strain on the nature and the environment.
- Students using SB produced a plan that was of better quality than the control group. This warrants further investigation with a larger sample to see if this is a consistent trend.

However there are some recommendations that we would add if SB is to be integrated into the curriculum. These are:

- Students using SB used a slightly different approach to planning as they were able to implement parts of the plan they were creating to test validity. We recommend an investigation into planning order given access to a simulation tool like SB. The current Terrain -> Enemy -> Own forces is not suited to an environment with access to fast and accurate simulators.
- SB should be introduced in the 2nd or 3rd semester. This allows students to familiarize themselves with the culture of the NAMA and gives them the background knowledge required to gain the most benefit from the game system.
- We suggest that most, but not all, of the map based planning exercises are replaced with SB exercises. It is also important to keep the TEWT to link exercises to real terrain.

The second part of this project was to investigate the potential of Role Play Simulation in conjunction with simulator based gaming. We believe that there is potential for RPS to be a part of the toolset used by instructors at the NAMA. RPS can be used for both training in communication and leadership, as well as for assessment of planning. We found that:

- MS NetMeeting on the LAN provided a suitable environment for communication.
- The instructor can monitor communication and direct students during plan execution.

- RPS gave the instructor an alternative way of assessing a cadet's understanding of a scenario and what was significant in executing a plan successfully.

7.1 Future project

The work with this project and the results from this research form the basis for a future project on the "evaluation of game technology for use in operations". We also believe this second project, based on our results from this project, will be important for the future use of game technology in the Norwegian military. Game based technology has the potential to improve both the cost and the time taken for training. The forth coming report will focus on how this technology can be used across the whole NAMA curriculum.

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