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The Use of a Tactical Simulator as a Learning Resource at the Norwegian Military Academy

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***Abstract*—**The Norwegian Military Academy (Army) has been using a tactical simulator for the last two years. During this time there has been some discussion concerning how to use the simulator most efficiently and what type of learning one achieves by using the simulator. The problem that is addressed in this paper is how simulators can be used as a learning resource for students concerned with developing their military profession. The aim of this article is to create a wider consciousness regarding the use of a simulator while educating officers in a military profession. The article discusses the use of simulators from two different perspectives. The first perspective deals with using the simulator as a computer game, and the second perspective looks at the simulator as a socio-cultural artefact. Furthermore the article discusses four different ways the simulator can be looked upon as a useful learning resource when educating students of a military profession.

***Keywords*—**Learning, military, profession, simulator.

I. Introduction

THE pressure to make the educations of professions more directed towards specific targets is an ongoing process. Several educational institutions have implemented new methods or learning resources in order to meet the new demands that have been imposed upon them. Simulators have traditionally been used to educate pilots and a few other professional groups, where errors during education are connected to large risks or high costs. Now several educational instances of different professions use simulators in order to try to build a bridge between the education of a profession and the practice of the same profession.

The Norwegian Military Academy (henceforth referred to as NMA) has had a tactical simulator for a little more than two years. During this time there has been an ongoing debate as to how the simulator can be used most efficiently. In addition there has been a debate concerning what learning benefits the NMA achieves by using the simulator.

This discussion has been focused around the supplier's point of view on how to use the simulator, how it has been used in other countries, as well as the individual instructor and his experiences with the system after about two years of using it. The discussion has to a very little degree focused upon pedagogical perspectives or taken as its starting point research that has been conducted within this field. In this article we therefore wish to illustrate this by focusing on the use of computer-based teaching materials as a learning resource – in this case the use of a simulator.

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II. The Problem to be Addressed

We want to use the tactical simulator at the NMA as a case study in this article. There are a lot of pedagogical challenges to be addressed that are intertwined with this, but we will limit ourselves to focus on how simulators can be used as a learning resource during the study of a profession.

In our discussion we want to touch upon which learning goals one may focus upon and which learning situations one may plan to accommodate for. The purpose of this article is to create a larger pedagogical consciousness around the use of a simulator while studying a profession.

The article will shed light upon the use of the simulator from two principally different perspectives. We will start by discussing the simulator as a computer game. Here we will use James Paul Gee´s concepts and research as a starting point [1], [2]. Thereafter we will consider the simulator in a socio-cultural perspective. We will focus on the learning situations that are created by the simulator. More specifically we will focus upon the learning situations that occur between the students in the classroom. During our discussion we will expand on four different perspectives from which we believe that one can regard simulators as a useful learning resource in the education of the practitioners of a profession.

III. A Description of the Tactical Simulator

Because the article builds upon a definite case, we will first describe the tactical simulator and under which conditions it is used.

NMA educates officers to leadership positions at platoon- and company level in the Army. The education is three years long and leads to a Bachelor degree in military studies and leadership. After completing their three years of study, the students or cadets as they are referred to will serve with units in Norway or in Norwegian military forces in international operations. The period of study at NMA is characterised by a great variation in pedagogical working methods. These methods may vary from studies of military theory and security

policy to practical courses and field exercises. One of NMA´s main subjects is tactics and operations. To achieve the learning goals in this subject the instructors use a combination of lectures, group tasks, practical implementations conducted out in the field, and simulator training.

The tactical simulator (henceforth referred to as the simulator) is installed in a big classroom. It consists of two big computer screens on a wall (visible for all cadets) and it is controlled by the instructors. These two computer screens are used for joint walk-and talk-through sessions and to shed light upon specific elements in the "game". In the classroom there also exists 20 computers that all can be given a suitable role in relation to what one wishes to practice. The game that is simulated is what Gee refers to as "a world game", a virtual reality where the player will have to solve different tactical problem issues [2]. This reality is presented to the players in the form of a two-dimensional map seen from above. This map is identical to the maps that are used in the practice of the profession in the real world. Units, vehicles, installations and other movable objects are represented on the computer screen with standardised signs that also are identical to the signs that are used in the practice of the profession. The game is designed for professional military units, and all the data models that are embedded in the game are developed according to customers´ need. The data models are based on data from the real world. However, the simulator is not commercially available.

A typical educational situation will consist of groups of four cadets situated around three computers. In each group a cadet is the leader, and he or she is normally not situated in front of a computer. The leader´s task is to lead "the game" through the three others that are positioned in front of the computers. These three cadets move units, observe what is going on by looking at their respective screens and report this back to the leader.

IV. The Simulator as a Computer Game

One perspective on the use of a simulator as a learning resource is to consider the simulator as a computer game. To consider the simulator as an advanced toy, a computer game valued at approximately 1,4 million dollars, is normally one of the most common arguments against the use of simulators. James Paul Gee has argued that if good computer games are used correctly, there might be a potential for learning in this [1]. In this context, good computer games mean that there is a potential for learning when using the games. In this article we first want to approach computer games in a general term, and thereafter we will discuss computer games with a professional content.

V. Computer Games in General and the Semiotic Domain

Traditionally one might state that knowledge has been disseminated or communicated mainly through language and written in texts. In the post modern age the use of pictures, symbols, diagrams and artefacts has to an increasing degree taken place as a part of our communication form in addition to language and text. This is referred to as multimodal texts [3], or texts that are a combination of several forms of expressions. In order to be able to read, understand, and develop knowledge from this kind of texts, the person who is about to learn must develop a competence in the literacy of multimodal texts. The interpretation and understanding of the symbols used in the multimodal texts is tied to the social practice in the domain where the text originates from. Gee has argued that the person who is about to learn will have a potential for deeper understanding if he knows of or is a part of this social practice, but this is however not necessary. Because knowledge within a domain increasingly becomes transferred by multimodal texts, Gee postulates that we should extend the concept of literacy to include what he refers to as the semiotic domain. By semiotic domain he means all different types of expressions, such as symbols, pictures, artefacts, acts, and forms of communication or texts, that will give meaning within the frame of a domain. By domain he means the social practice within a special area. The learner is literate within a semiotic domain if he or she has the ability to recognise (read), understand and give meaning to all those forms of expressions that constitute meaning within the specific domain [1]. In the post modern age it is not enough to have a traditional and general reading ability. In order to meet this development the students or the participants of a community must develop a competence within a spectre of semiotic domains. It is this competence that Gee claims that computer games may help us to develop, namely the ability to read and to create meaning within one or more semiotic domains.

Gee has also claimed that the use of good computer games is not a waste of time when you are about to learn something new. The learner may develop competence within one or several semiotic domains, but this requires what Gee refers to as active learning and critical learning [1]. Our understanding of this is that Gee through these concepts links the computer game to experiences from the real world within the domains´ social practice.

Active learning involves three aspects. The first aspect is that the student learns to understand a phenomena in the world in new ways. The second aspect is that the student establishes a connection with the people that constitute the domains´ social practice. The second aspect is that through the experiences and patterns the student learns in the game, he or she establishes new learning strategies or problem solving methods that can be used in future situations, perceivably within adjacent domains. The active component in learning is, as we understand it, that the student shall not remain in the game world. Instead the student will use the knowledge he or she accumulates in the game world to understand and further develop this knowledge in the real world, within the domain where the student has acquired competence.

Our understanding of Gee´s concept of critical learning is that the student does not only develop understanding and adds

meaning within the semiotic domain, but that he or she also constructs understanding on a meta level. In this way the student will be able to look upon the domain from a superior perspective. In other words, the student understands the relation between the different phenomena in the complex pattern that constitutes the domain. The student must also be able to be innovative within the domain. He or she must deal with the construction of new patterns or acts that are recognisable for the participants in the social practice, even though they may be new.

With reference to the problem to be addressed in this article, we have now discussed the first method of using a simulator as a resource for learning. Using a computer game as a resource for learning will in this way contribute to develop the NMA cadet's ability to read and to create meaning within one or more semiotic domains. This is a general competence that not only the cadets at NMA will benefit from. Competence is useful for anyone that is engaged in acquiring information either for learning, for decision making, or to create an overall impression within a domain.

VI. The Problem of Content

A common critique against computer games is that one does not learn anything professionally– i.e. they are without any substantial content. In his book Gee meets this critique by emphasising that the benefits from learning primarily does not deal with professional content, but instead deals with the development of meta competence. Meta competence can be described as special ways of thinking or problem solving methods that are superior to professional substance [1]. Now we wish to look closer upon the problem to be addressed in this article in relation to the professional content. This is because the tactical simulator at NMA is designed specifically to have a professional content – this content is placed in a military context. We propose that one can view a computer game with professional content as a resource for learning from two different approaches. The first approach is to help to develop a deeper understanding of the theoretical knowledge, the second approach is tied to the semiotic domain and modern leadership systems.

VII. The Understanding of Theoretical Knowledge

Before the cadets start to train in the simulator, they have been subjected to several theoretical lectures. They have received lectures on principles, definitions, and models. Most of the lectures have been mainly abstract in nature. The exception are some specific examples that are being used to describe the principles, but where the lecturer has no guarantee that the cadets have any experiences from practice that will make them understand the given example the way the lecturer is trying to get it through [4]. The result may be that the cadets will not necessarily acquire a greater specific understanding of the abstract knowledge that he or she receives during a lecture. At this point the development of knowledge for a cadet has consisted of reading and interpreting multimodal texts. However, we cannot be sure that the texts that have been read by the cadets have succeeded in mediating the collective military knowledge from the educational books and transferred this to the individual [5]. The cadet's ability to read, understand and later deal with a critical view of the text based knowledge is dependent upon the practice of interpretation that the student is a part of. This practice of interpretation is developed at the same time as the theoretical knowledge is developed. This may pose to be a challenge, because the quality of one of these developments will be a prerequisite for the development of the other.

In this way, the cadets´ professional knowledge (before the simulator training starts) is based upon their understanding of the text without them having a thorough knowledge of the social practice the knowledge is used in [1], [6].

Because the simulator simulates situations and events that are taken from the profession´s practice field, the cadets will be able to use the professional knowledge they have acquired in simulated situations. This may lead to that they develop a greater understanding of the professional content. So it is not for instance only general problem solving methods that a cadet learns in the computer game, he or she also learns problem solving methods in a context taken from the domain´s social practice. The cadets´ refinement of meaning will in this way both be situated and domain specific [1]. To give a specific example from the simulator; the cadets learn about the use of artillery where facts about range, types of ammunition, observation and planning are important. The relation between these theoretical concepts will not be revealed to them until they "practice" this in the simulator and understand how these concepts are influenced by each other. In addition they will see how this affects others factors that do not have to do with artillery, for instance securing the lines of supply. The result of this is that the cadets develop an understanding for the relations between domains that will not be apparent by reading the educational books.

With regard to the problem to be addressed in this article this is the second perspective of how we perceive that the simulator can be used as a resource for learning. Using the simulator and considering it as a computer game with a professional content will probably create learning situations that will give the cadets possibilities to "practice" their theoretical knowledge in situations that are taken from the practice of the profession. This will probably facilitate a deeper understanding of the theory.

VIII. The Semiotic Domain Revisited

Before we proceed, it will be useful to bring into consideration additional facts about the education that NMA conduct and to see this in relation to Gee´s theoretical reflections on the semiotic domain. The modern military profession´s field of practice consists to an increasing degree of the use of symbols. The reason for this is primarily the technological development within leadership systems, where large amounts of data are supposed to be visualised on

computer screens in order to create a basis for decision for the military leader. At this point we will not go into detail on this. We will however establish that the development of the cadet's literacy and skill within several semiotic domains (for instance information- and leadership systems) that are related to the profession´s field of practice are of great value to the cadet's later exertion of their profession.

In the simulator maps, symbols and the presentations are taken from the field of practice, and the user interface in the simulator clearly has many similarities in common with the systems that are being used in the field of practice. By learning in the simulator the students will not only deepen their professional understanding as we have discussed before, but also receive practice in using systems similar to those that are being used in the real world. The same meta competence, ways of thinking, and problem solving models we discussed earlier in general terms will be situated in a context taken from the profession´s field of practice. It is therefore possible to say that the development of the cadets literacy within this special semiotic domain also will be situated in the professions field of practice as it has a professional content.

Referring to the problem to be addressed in this article, this is the third perspective of how we see that simulators can be used as a resource for learning. The development of the general meta competence Gee is arguing for is situated in that the reality and the user interface that the simulator simulates are so close to existing systems that there exists a transferring value here.

IX. A Critique of the Simulator as a Computer Game

In the introduction part of this article, we mentioned that there exist several pedagogical problems to be addressed that are related to the use of simulators. Gee has as a premise that when using a computer game the learning must be active and critical [1]. When using a simulator it is so easy to be caught up in trying to "beat the game" that one tends to forget this learning dimension. To be conscious of the transferring value of the knowledge that has been acquired through the computer game, and to be able to bring this into situations within the relevant domain in the real world is difficult. This remains a task for at least two actors. The first and most important is the teaching supervisors. They have to focus on guiding or instructing in accordance with the theoretical knowledge and other factors that support the cadets´ understanding of knowledge and not their skill in "playing the computer game". The other actor in this is the educational institution. If the faculty staff looks upon the simulator as an ordinary computer game, this is how the simulator will be used and the framework factors to treat the transferring value seriously will not be reached. If however, the faculty staff looks upon the simulator as a resource for learning that can facilitate good learning situations, the simulator may become just this in the eyes of both the cadets and the instructors.

A second justified critique is that simulators are based upon data models, and that these data models will never be able to exactly represent the reality. According to this view knowledge or lines of action acquired in a simulator will therefore not work in real life, in worst case they will be dangerous to reproduce in real life. This is a factor that must be sorted out during the use of a simulator. If this view is taken to the extreme, it will lead to that simulators in the education of a profession is unsuitable. The only way to educate students would then be to do it in the field of practice by "on-the-job-training" or by something similar to this. On the other hand, sometimes there are conditions that render this impossible. This may be caused by practical, security, economic or ethical reasons [7]. It is in these situations that one will find the simulators useful.

In the last part of the article we will no longer consider the simulator as a computer game. The goal then becomes to investigate other interesting sides of this learning resource.

X. The Simulator as a Mediator of Social Practice

As mentioned in the introduction part of this article the cadets often work in groups, and there are ongoing processes within the groups. The cadets observe the game, they communicate both verbally and in writing to the leader and amongst themselves, decisions are made, and orders are given. Skills within all these processes are an important part of the competence that a practitioner of a profession is expected to have. These learning situations are created by the situations that came into being in the simulator, but the process of learning only has an indirect connection with the simulator – it takes place just as much during the interaction between the people in the classroom. In this part of the article we want to take a closer look at this learning situation. We will start by describing shortly how the simulator can be viewed as an artefact and how this mediates a context that is supposed to be as similar to the practice of the profession as possible.

XI. The Simulator as a Mediating Artifact

An artefact is a human made material object that mediates a meaning, an idea or a conception [5]. Artefacts will be observed and will create an intended reaction in the viewer. To understand the correct meaning of the artefact the viewer must know about the practice of interpretation that gives meaning to the artefact. The meaning is not explicitly written down on or in the artefact. The user must himself have an idea about what the artefact can be used for. This idea has its origin in that the user is a part of an interpretative community and that he or she is familiar with its practice of interpretation.

An artefact thus has no own characteristic value, it is dependent upon that the user understands how to use it as a result of the practice that the user is a part of. In this way we could say that artefacts in a socio-cultural perspective are carriers of the culture they are created in. It was Vygotsky back in 1978 that first came up with the idea of mediation. Mediation means that humans interact with external tools when they act in and register the external world [5]. The mediating tools can be physical or intellectual tools, and it is

the physical tools we refer to as artefacts. An artefact can be said to mediate the message between a subject and an object, given that the subject is familiar with the used practice of interpretation in relation to the object. If we want to put the simulator into this picture, we could say that the simulator is an artefact that mediates a context tied to a specific social context. It is this context that creates the learning situations we wish to take a closer look at.

At this point we can clearly state that the simulator can be considered as an artefact that mediates a context, and that it is in this context that situations for learning are created. From this it follows that the use of simulators in the education of a profession assumes that the student has a certain degree of knowledge about the profession that he or she is being educated upon.

This knowledge constitutes the student´s practice of interpretation, and it is this that makes the student able to understand the context that the simulator mediates. If the student has little or no knowledge of the profession, he will have a lesser utility of the simulator because he does not understand the context being mediated. The intended learning situation will not be present. Gradually as the student learns, he will have a clearer understanding of the context being mediated by the simulator. As this understanding continues to increase, he will also apprehend several variables or conditions that affect the actions he performs in the interaction with the simulator.

In the following part of the article the discussion will focus upon the skills that educational books to a lesser degree can teach a student: cooperation, the ability to make decisions, observational skills and communication. We claim that the simulator is able to mediate a context where these skills can be practiced in a way that is both situated and domain specific.

XII. The Simulator as a Resource for Learning in order to Train Specific Professional Skills

Lave and Wengers theory about situated learning has as its starting point learning outside the classroom and studies of apprenticeship with an employer [6]. It is according to this theory not a prerequisite for learning that one has received any education beforehand. Learning is created by the interaction between individuals in a practice community and individual learning comes from participation in activities in the practice. Lave and Wenger refer to this process as legitimate peripheral participation. The focus is not on knowledge or skills that an individual has, but more on the development of understanding and the degree of involvement the individual reveals in the situations where he interacts with others. In the simulator classroom a practice community is created between the cadets and the instructor. In this relation the simulator mediates the context that the learning takes place in. The learning takes place in the interaction between the cadets, the instructor and the context. As the group of cadets gradually understand more and more of the situation that takes place in the simulator, they will tend to get more involved, and be more and more ”acting” in the situations. The understanding of the practice increases, and the cadets will then be able to use their knowledge in new ways if this leads to better results. The instructor acts as a master. He gives advice, guides, fills in knowledge or gives hints on how to communicate during the ongoing process. The simulator can give guidance in the form of replaying situations or statistical data on how one has carried out one´s actions. It is in this interaction between the cadets that they are given the opportunity to practice communication, the ability to make decisions, cooperation and other skills that are central to the practice of the profession. Without a context to practice this in, it would have been difficult to make this learning as close to the profession´s practice as possible. Here the simulator plays a central role.

Previously we mentioned that a simulator will not be able to create a virtual reality that is the same as the reality where the profession is practised. If we on the other hand look at the interaction that takes place between the cadets in a group when using the simulator, this situation will be more realistic (with reservations for factors such as stress or risk). And because the learning situation is embedded in the interaction between the cadets and not in the interaction with the simulator, this learning situation will appear more realistic than compared to if one looks upon the simulator as a computer game.

A difference between simulator training and the theory of situated learning is the degree of education received before one uses the simulator. Lave and Wenger base their theory on the fact that one does not necessarily have to be given any education before one starts [6]. In this case the degree of the master’s involvement will be high in the beginning. Same will be true for the simulator. If the cadets do not have knowledge of the practice of interpretation that is a prerequisite in order to understand the context, the output will be less, and they will demand help from fellow cadets or teaching supervisors. We therefore think it is purposeful to have a theoretical foundation before one starts training with the simulator.

Again, referring to the problem to be addressed in this article, this is the fourth perspective of how we see that simulators can be used as a resource for learning. The learning takes place in a social process in the practice community. The practice of interpreting and theoretical understanding is developed through the interaction of the group, and through this each individuals understanding of the practice community within the profession will be developed. The theoretical knowledge is put into a cultural frame that is defined by the profession´s knowledge, norms and rules, and the proficiencies of the profession is practiced in a context that is realistic in relation to the practice of the profession. As far as we can assess, we consider this an important learning perspective when using simulators, but also the most difficult to facilitate. The learning situations that arise are often difficult to predict. The teaching supervisor, who has the greatest amount of competence within the profession, has a big responsibility to make visible the learning situations so that these situations may lead to good learning experiences for the students. It is also difficult to describe what constitutes

good behavior or correct actions in the different situations. The learning situations are found in the interaction between the participants in the practice, and in the argumentative dialogue they have between themselves after the simulations are conducted [8].

XIII. Conclusion

In this article we have discussed four different ways of looking upon the simulator as a resource for learning in an education of a profession. The first way considers the simulator as a simple computer game where professional substance is not essential, and the goals of learning are related to the development of meta competence and literacy within the relevant semiotic domain. The second and the third perspective consider the simulator as a computer game with a relevant professional content. The goals of learning are related to achieving a deeper understanding of how the theoretical concepts functions in specific situations taken from the profession´s field of practice, and to make the meta competence domain specific. The fourth perspective considers the simulator as an artifact that mediates a context from the profession´s field of practice, and the goals of learning are related to the skills that are being developed in the practice community between the students. The development of skills like the ability to communicate or to make a decision and to cooperate are central goals of learning.

The perspectives upon how to view the simulator are different, as they focus on various pedagogical goals. At the same time they have many similar features. They are related in the way that they all focus upon developing central aspects of the field of knowledge of the profession. They facilitate to acquire knowledge and skills where traditional education may not always appear practical or appropriate. Learning the ability to make a decision or ways of communication in a credible manner in a classroom often poses many pedagogical challenges. The best alternative to practice these skills are found in the practice of the profession– in the exercise of the profession. In the case of the officer, it will be neither practically, morally or ethically defendable to send cadets to real and dangerous conflict areas to learn, and normal field exercises with military units is a question of resources that are available. This is when the simulator will be useful as a good resource for learning if it is being used in a correct way, and if the pedagogical goals are in harmony with how the simulator is being used.

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