

Why not let the crews train themselves?

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ABSTRACT

Many organisations struggle to get enough measurable effects out of their training equipment in form of training hours and documented benefits. Reduced manpower at the Norwegian Navy Submarine School demanded a new approach and a new way of thinking. By creating new training manuals/scenarios and giving key crew members education in how to conduct and lead training in the simulators, the submarine service are able to show an increase in the use of the simulator and get measurable effects onboard the submarines. The Submarine School have together with the Norwegian University College developed a new e-learning course targeted towards simulator instructors, giving the crewmember a basic introduction to how to plan, conduct and evaluate a proper training session. This paper discusses the thoughts behind this approach and the results so fare.

ABOUT THE AUTHORS

Commander Geir Isaksen is the XO of the Norwegian Defence University College/ADL office. His operational background is from the Ula class submarines, where he served for 6 years as an electro engineer. Cdr Isaksen spent 2 years as the head instructor in the technical simulator at the Submarine School before he started to work at the ADL office in 2002. As an ADL (Advanced Distributed Learning) Adviser he has been responsible for the development of several e-learning courses and the Defence ADL regulations. He has bachelor in electro engineering and different courses in pedagogies, learning styles and Crew resource management. For the last 5 years he has represented NoD in the NATO Training Group (NTG), Working Group for individual training & education development (IT/ED) and he is the current chairman of the NTG/Working Group IT/ED ADL subgroup.

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BACKGROUND

The Norwegian submarine service consists of 6 German built Ula class diesel submarines delivered in early nineteen nineties. Each submarine has a total crew of 21 based on the lean manning principle¹. Of these, 20% are enlisted or Non Commissioned Officers (NCOs²) that serves onboard for a limited time. Some of the enlisted and NCO's (Non Commissioned Officer) serves as submarine pilots. The Norwegian submarine service has used different forms of simulators since the late 1960s.



Figure 1: Steering console simulator NoD Submarine Service

USE OF SIMULATORS IN THE SUBMARINE SERVICE

When the Norwegian submarine service started to use the Ula class submarine simulators² in the beginning of the nineties, all training in the simulator was led by a simulator instructor. Because the technical entry-level for the simulator were high, specific training was needed to start and stop the system. The decision was made that the simulator instructor should lead all training of the crews in addition to the running it.

Early training methodology

After a few years using the Ula simulator, it became normal procedure that simulator instructors leading training sessions often used large scenarios and applied a workload that was very difficult to manage for the crew members being trained. In addition the technology was already becoming old and almost outdated resulting in a low stability. All this reduced the students self efficacy³ and motivation to use the simulator and resulted in a reduced training effect. As a result the crews desire to utilize the simulator decreased more and more towards the end of the nineteen nineties.

The reasons for this development were many. The technology used in the simulator was something completely new back in 1990. It was very tempting for the simulator instructors to use the simulators full fidelity during training. It was more entertaining to apply difficult weather conditions, difficult system errors and several faults at the same time. The challenge became too high for the students and not tailored to their level of experience as it should be. Despite the fact that the senior crewmembers were

¹ Each crewmember has a wide competence and cover different areas and roles onboard. This principle was implemented with the 500 ton Kobben class submarine in the mid sixties.

² Simulators for the Steering console, waterman's station, electronic control console and the weapons system including the periscope.

³ The belief that one is capable of performing in a certain manner to attain certain goals, Ormrod, J. E. (2006)

instructors onboard the ship and probably knew their crewmembers training needs better, they were not involved in the planning and training.

In the mid nineties the training scenarios had the tendency to focus on faults rather on good practice. If a student was good and fast in his performance, the instructor simply added some more malfunctions, so the student would ultimately fail. The trainees never felt that they could cope with any situation and the real training needs often were forgotten. This also meant that our students did not feel that the simulator training was relevant because unrealistic scenarios were applied most of the time.

There were numerous reasons why the training methodology took a wrong turn. Simulator instructors were recruited from the submarine crews but were not given any education in how to be one. The submarine service also overlooked the facts that they were training adults up to the age of 45 and that student involvement in the planning and execution of the training is a critical factor. In many cases the students were just thrown in the training situation without any knowledge about the learning goals or context.

The simulator instructors at the NoD submarine school are recruited from the submarine crews. Being a small service limits the population from which the simulator instructors are recruited. The only demand towards a new simulator instructor in the late nineties was a minimum of one year onboard, and certified as a submariner (Golden dolphin)⁴. The only instructor training they had been given was during Junior Officer School, where all students get a basic introduction to the role as an instructor as a part of the basic leadership training. This training focuses mostly on traditional classroom lectures. All Officers serving onboard Norwegian Navy vessels have this basic instructor training as a minimum.

In the late nineteen nineties it became clear that the crews only used the simulator a few weeks of mandatory training every year, minimizing the training- and cost effectiveness of the simulators. The training itself was not motivating and as effective as it should be.

⁴ The dolphin is a well known symbol for all submarine services around the world that you are a qualified submariner. To get the dolphin you have to demonstrate both theoretical and practical skills in your area of expertise.

Challenges

The main challenges using simulators for the submarine service going into the millennia were that⁵:

- The crews didn't want to train in the simulator
- The crews were not involved in the planning and execution of the training
- There were no simulator instructor course available for the instructors
- The simulator instructors lacked proper knowledge of how to plan, lead and evaluate training
- The qualifying period for new pilots, especially enlisted personnel were much too long, reducing the cost benefits of having enlisted onboard.

PILOT TRAINING

This paper takes a look on how the submarine service trained their pilots early on and how it have changed due to a new way of thinking and more crew involvement in the planning and execution of training

Pilot training concepts up until 2000

Based on the lean manning principle (in recent years know as the hybrid sailor) enlisted, NCOs' and officers from the technical branch of the crew acts like helmsmen or pilots in Ula class submarine. Engineers and electricians are manning the steering consol at sea in addition to their other primary tasks and responsibilities. Before year 2000, new helmsmen got a theoretical introduction as a part of the 10 week basic submarine course (6 weeks basic safety course plus 4 weeks technical course). Through a few hours of theoretical training the new pilots were introduced to the role as a helmsman. After passing the basic submarine course, the helmsman training continued onboard the sub. At sea new pilots had to demonstrate their capability to operate the steering consol and to execute normal and emergency procedures before they were certified as helmsmen. Depending on how often the submarine was at sea it could take several months at best, before new helmsmen were certified (fig 2). The chief engineer leading the technical branch is responsible for the training and certification of the new pilots.

⁵ Norwegian Submarine Service Training report 1998, classified

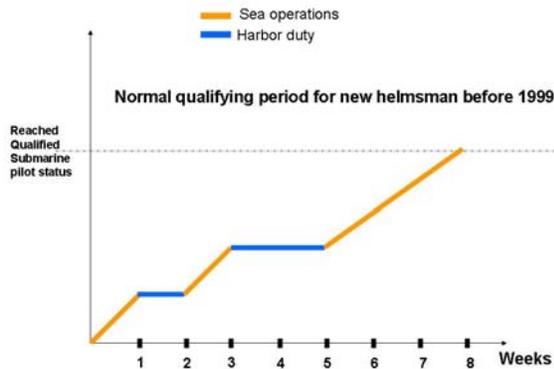


Figure 2 Qualifying period for a helmsman prior to 1999

Time until a new pilot is certified is a critical factor for the submarine service. Particularly for enlisted personal that only serve for a 12 month period. Therefore it's important to qualify them as soon as possible to maximize the cost effectiveness of having them on board.

The identified challenges (Norwegian Submarine Service Training report 1998, classified) led to a whole new training philosophy and resulted in a different approach to how to train instructors, use the simulators, and train new helmsmen and how to involve the experienced crew members in the training.

The new pilot training course

After the shift in the training paradigm a new helmsman course were developed in 2000. Instead of just including it in the basic course a 2 weeks helmsman course was established. The new so called S5 course gave the new pilots more practical training focused on the specific tasks they would meet as helmsmen. The new course focused on the tasks they had to manage to be a qualified helmsman.

Into 2000 – 2001, economical cutbacks and the challenge of recruiting enough new submariners, forced the submarine school personnel to fill up vacancies onboard from time to time. This limited the use of the simulators, because the instructors were at sea.

NEW TRAINING PHILOSOPHY

At the end of the nineties the submarine service started to take a look outside the Armed Forces. By cooperating and seeking out lessons learned from other organizations using simulators, like the nuclear power

industry, oil and gas industry and the airline industry new knowledge found its way to the submarine service. Learning from others that succeeded in their simulator training made the submarine community realize that they were doing things the wrong way. They realized that a new approach on how to plan, execute and evaluate training were imminent.

A new philosophy on how to use the simulator as a learning tool and how to conduct simulator training started to take its form going into the new millennia. One of the first results was that all simulator training at the submarine school should consist of three phases:

- Planning and Brief
- Execution of training
- Evaluation (Debrief)

This approach was later confirmed by Torgersen, Bergh (2006) in “The Basic Pedagogical view of the Norwegian Defence”⁶ as the three important didactical phases. This meant that when planning a training session it is important to take into consideration all factors influencing the training.

In a brief it's important to communicate the training goals. The execution of the training session should be based on realistic scenarios relevant to the tasks onboard and linked to the learning objectives. It is important to make sure that it is possible to collect relevant data from the training. The student should be aware how and why data measurements are taking place. The students will be aware of that they are measured during the training at it could influence the students performance (the Hawthorne effect⁷). It's important to just measure what is relevant and to use the results in a positive way to increase learning outcome and student motivation.

Simulator Instructor & crew competence

An important recognition was made in the fact that if done wrong a simulator training session could actually give a negative learning outcome instead of just no learning outcome, like from a poorly executed classroom session. So bad simulator training could result in students obtaining dangerous routines or lower the crew self's efficacy towards the job performance to a critical low level.

⁶ Torgersen, Bergh (2006) The Basic Pedagogical view of the Norwegian Defense, page 12, 15

⁷ Hawthorne effect: When people know there are being measured, they modify their behavior. Rick Brenner (2002), www.chacocanion.com

As a part of the new philosophy the submarine service looked at how we trained simulator instructors and senior crewmembers acting as instructors onboard and what kind of competence they needed. All the officers within the Armed Forces have, as a minimum, basic knowledge of pedagogy and instructor training from the Junior Officers School. Their instructor experience is limited to practical instructions for a small group of sailors. Because the simulator itself is an advanced learning tool, a different approach on how to plan, execute and evaluate simulator training is needed.

This all led to the establishment of a new in-house simulator instructor course in 2001. The course was based on the new philosophy, and covering areas like pedagogy, training adults, Training Needs Analysis (TNA), building realistic scenarios, didactics, how to measure and evaluate. The course was aimed at both new simulator instructors and senior crewmembers.

Simulator Instructor education in the submarine service

The new simulator instructor course was divided in two parts:

- The first part had focus on pedagogy and human factors.
- The second had focus on how to technically operate the simulator. This part covered how to start, restart, shut down and retract relevant data from the simulator.

Other main areas were basic operations, scenario settings and how to measure performance. Although the new approach were well received, the school realized after some years that it had too little in-house competence especially in areas like simulator pedagogy to really give the new simulator instructors a factual background.

At the same time (2003) the Norwegian Defence University first published the "The Basic Pedagogical view of the Norwegian Defence",⁸ for the entire defense. This was a great help for the Submarine service, in order to further develop our instructor course. When the instructors started to apply these ideas in the training, the submarine service had some positive experiences based on student feedback, instructor's course reports and feedback from the submarine crews. Examples of such:

- Students coping with a certain task are likely to have an increased motivation and self efficacy.
- A proper brief that clarifies the training goals of the training session makes the student focus on his objectives.
- A good debrief with focus on performance, is vital for the motivation and self-realization of what really happened for the trainees.
- To build the students self efficacy it's important to starts with basic tasks.
- If the student sees the relevance in the training, towards his/hers job onboard, the motivation increase.

These experiences correlated with the important factors highlighted in the "The Basic Pedagogical view of the Norwegian Defense" and later in "Motivation and Online learning, Isaksen, Ramberg (2005).

Even though positive experiences were made, the general overview in "The Basic Pedagogical view of the Norwegian Defense" did not cover all aspects of simulator pedagogy and training. The submarine school realized that there was a need for more education within this field. When they in 2003 searched around for existing courses, they realized that there was practical none existing education for simulator instructors.

DEFENCE SIMULATOR INSTRUCTOR EDUCATION

Status prior to 2003

As one of the first units within the Norwegian Armed forces the Submarine service pointed out the fact that there was no existing education for simulator instructors. Since the nineteen sixties, the NoD has spent several hundred million dollars on simulators without investing in instructor's competence. The indication that simulators were little used compared to its potential and in many cases used wrong, lead to the recognition that something had to be done to the simulator instructor training in the Armed Forces.

On the initiative of the submarine service, a TNA (Training Need Analysis) was conducted by the Norwegian Navy in 2003 led by LtCdr Vedvik. The TNA showed that although the typical simulator instructor was an expert of their subject matter, they often lacked knowledge of how to plan, lead and evaluate simulator training (Vedvik 2003). Almost all the instructors at the time pointed out the fact that they

⁸ Torgersen & Bergh, NoD University College (2006)

had no specific training, preparing them for the role as an instructor in a simulator.

The main competence gap was found in areas like⁹:

- Training methodology
- Evaluation tools
- Evaluation of adults
- Crew Resource Management, Group processes
- Pedagogies

The Navy realized that a simulator instructor course of education was over due and in late 2005 a project was established together with the NoD University College and the other services to develop a simulator instructor course. This led to the development of the first educational concept aimed at the simulator instructor role. As a first step an e-learning course was created in 2008, covering the basic knowledge needed to become a good simulator instructor.

Basic instructor e-learning course

The pedagogical principles used in simulator training are basically no different from other types of training. The main difference is the learning method (tool) itself. Isaksen, Ramberg, (2005) identified the MACCI learning principles as the key factor in online training. These principles also apply to simulator training.

- Motivation
- Activation
- Concretization
- *C for cooperation*
- Individualization

These factors in addition to the didactical phases described by Torgersen & Bergh, NoD (2006) were the foundation of the new training philosophy displayed in e-learning course.

Through a project funded by Norwegian MoD, a vendor was chosen to produce the new course. The course was developed by involving Subject Matter Experts (SME) from the Norwegian Armed Forces in the process. Mintra AS facilitated the development thru workshops and meetings.

The e-learning course is sequenced in the following modules:

1. Introduction
2. Planning
3. Conducting the training
4. Evaluation
5. Course exam

Bjorndal & Lieberg (Nordskog & Popperud, 2000) presents a model for relevant factors that one has to take account of in order to succeed with knowledge dissemination. The model is called the didactical relation model¹⁰ and is implemented in the course (figure 3). It ensures that all relevant factors are taken into consideration when planning training. When you plan a training activity you should take into consideration factors like:

- Your learning goals for the course or activity
- The plan to access or evaluate the outcome
- The specific training method
- What are you training on (content)
- The student experience
- The training culture
- Simulators availability, status (framework)
- Instructors competence



Figure 3. The didactical relation model

The course also covers topics like brief, debrief, student motivation, instructors role, training methods assessment and much more. The 90 minutes course is now mandatory for all submarine personal responsible for simulator training (both simulator instructors and senior crew members leading training) and made available for reuse in an English version sponsored by the Norwegian Defence University College.

⁹ Vedvik ,2003

¹⁰ “The basic pedagogical views of the Norwegian Defense” page 13



Figure 4: Screenshot from the basic simulator instructor course

CREW MEMBERS AS INSTRUCTORS

A technical upgrade to ensure operational stability and to improve the user interface in the simulators started in 2002. After the upgrade, the reduced technical complexity made it easier to operate the simulator.

Experienced personnel onboard navy ships have through history always had the role of an instructor for new crew members. Informal learning is an important learning method in all military forces in the world. These acknowledgments lead to the idea of letting the experienced crew members plan, lead and evaluate the training of their own crew even in the simulator.

After the technical upgrade, crew members¹¹ could for first time operate the simulator and led training without having a simulator instructor present at all times. To let crewmembers lead training demanded that they were given a minimum of simulator instructor competence without having to spend a lot of time in the classroom. This was made possible by the new e-learning course they could access thru the NoD Learning Portal. At the same time the Simulator Instructors needed to learn more about the facilitator role.

So by giving crewmembers training in how to operate the simulator and a minimum of instructor competence, the idea was that training of the crew would be more flexible, tailored to the individual needs and contribute to a more cost effective use of the simulators.

¹¹ With the rank of Second lieutenant and above, that are an experienced pilot and have a basic knowledge of pedagogies and some experiences in instructing others from the Junior Officers School (NoD Junior Officers Curriculum, 20XX)

Hopefully it would also reduce the time needed to qualify new submarine pilots because they could conduct pilot train during harbour duty as well.

RESULTS AND FINDINGS

From 1990 to 2005 the submarine service made a lot of significant changes to how they used the simulator as a learning tool. Evaluation showed that by changing the training philosophy, make the simulator more stable technically, establishing a specific pilot course and by giving crew members instructor competence, certification time for new pilots could decrease as much 40%¹² (as shown in figure 5) and the use of the simulator have increased with almost 40%¹³ (figure 6).



Figure 5 Difference in certification time with and without crew lead training

Saved time is different for each student depending on his/hers individual performance. Crew led training has made it easier to tailor the training to each individual. This meant that those crew members that were serving onboard for a limited time became more cost-effective while onboard.

Time to certification no longer only depended on how many weeks at sea you had, but the combination of the new pilot course (S5), training at sea and simulator training led by senior officers of the crew.

¹² Norwegian Submarine Service S5 course evaluation report, (2009)

¹³ NoD Submarine Service Technical Operation Report, 2009

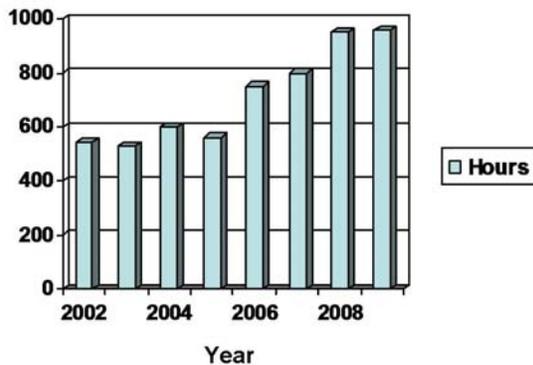


Figure 6: Use of NoD Submarine simulators by year

WAY AHEAD

In the coming years there will be a need for a facilitator course aimed at the simulator instructors. The Submarine service plans to make the e-learning course mandatory for all crewmembers at a certain level, so that they are prepared to lead simulator training. It has been a success to give crew members a basic knowledge and understanding on how to be a good simulator instructor.

The submarine service will also measure the effects of the higher competence of the experienced crewmembers to see if it has an impact in higher motivation to use the simulator. We will also move away from the system of constantly controlling each individual. This is done because the Submarine service wants to use the simulators as a positive tool for learning more than a tool for controlling the competence. The goal is to find ways of measuring the effect of training in other ways than to measure exactly each crewmembers performance in the simulator. The idea is that this will increase motivation to use the simulators in a positive way.

The positive experience made of the pilot training will be transferred into other similar areas onboard (sonar operator, engineering control console operator etc)

Challenges

The Ula class submarines will go thru an extensive technical upgrade during the next 5 years. It will be a challenge to keep the simulator operational in the whole lifecycle.

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