Høgskulen på Vestlandet

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Jeg godkjenner avtalen om publisering av masteroppgaven min *

Ja

Er masteroppgaven skrevet som del av et større forskningsprosjekt ved HVL? *

Nei

Er masteroppgaven skrevet ved bedrift/virksomhet i næringsliv eller offentlig sektor? *

Nei

Høgskulen på Vestlandet

MASTER'S THESIS

"The learning effect of the coastal navigation course taught at HVL"

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Submission Date: 01.06.2023

I confirm that the work is self-prepared and that references/source references to all sources used in the work are provided, cf. Regulation relating to academic studies and examinations at the Western Norway University of Applied Sciences (HVL), § 12-1.

Abstract

This master's thesis aims to determine whether there is a noticeable difference in coastal navigational skills between students at HVL who have completed the coastal navigation course, and students without the coastal navigation course. The study is based on participating observation of three candidates from each category during a planning exercise, a simulator exercise, and a personal interview.

The low number of participants in each groups makes it hard to determine whether there are any noticeable differences based on the collected data, whether it is the number of participants, the measures or the exercises which renders the study inconclusive is also hard to determine, but there are some interesting hints and indications that point towards differences between the groups. There are also some indications that point towards some similarities between the groups as a whole related to their attitudes towards simulator exercises, but this angle has not been explored in this study.

Acknowledgement

To my loving wife and children – thank you for allowing me to spend countless hours in my office, in the simulator, and at sea – for all the moments missed, and all the hours apart, I can never make it up to you, but I will spend my entire life trying to.

Contents

Abbreviations

CNC – Coastal navigation course

Cadet PEC – Cadet Pilot Exemption Certificate

CPA – Closest point of approach

EBL – Electronic bearing line

PEC – Pilot Exemption Certificate

PI – Parallel index

STCW Convention – International Convention on Standards of Training, Certification and Watchkeeping for Seafarers

VRM – Variable range marker

Figures and tables

1 Introduction

1.1 Background

The Norwegian coastline measures about 24.000 kilometres along the Norwegian mainland and in- and out of the many fjords along the Norwegian coast (if we include the coastline around all the islands, we are almost at 103.000 kilometres) (Havforskningsinstituttet, 2023). In order to ensure safe navigation along the coast, the Norwegian government have through the "*Act relating to ports and navigable waters*" and the "*Regulations on compulsory pilotage and the use of pilot exemption certificates (Compulsory Pilotage Regulations)*" enabled a set of rules defining the use of pilot or pilot exemption certificates (PEC) in defined fairways.

Deck officers who have yet to fulfil the requirements to apply for a PEC may apply for a Cadet Pilot Exemption Certificate (Cadet PEC), allowing them to navigate PEC fairways in order to gain enough experience to apply for an ordinary PEC.

One of the three requirements to acquire a Cadet PEC is the completion of a coastal navigation course taught at an institution approved by the Norwegian Coastal Administration. Today there are eight institutions teaching this course to their students, and HVL is one of them. However, the model taught at HVL differs from the majority of these institutions by being a course taught in addition to the STCW requirements as an independent course with additional simulator exercises and additional lectures. The author of this thesis has been responsible for this course at HVL for the past seven years and has a background from the Norwegian Armed Forces with a bachelor's degree in nautical science from the Royal Norwegian Naval Academy from 2008, and continuous service on board Norwegian Coastguard vessels from 2008 to the present day.

Most of the institutions have had their course model approved by using their ordinary STCW lectures and simulator exercises as the basis for covering the course description from the Norwegian Coastal Administration. This approach makes the examination by a certified pilot the only necessary additional required activity in order to receive a coastal navigation course diploma. This approach raises some interesting questions regarding this course, and specifically the question; if the course is covered by the STCW demands, why do we need it?

My objective is to find out whether there is a noticeable difference in the level of coastal navigation skills between students who have attended the coastal navigation course at HVL, and students without this course, but with education in accordance with the STCW regulations. Since HVL has both categories (only 14 out of 40+ students are admitted to the coastal navigation course each year), this thesis is based on final year students from HVL and not on students from any of the other institutions.

1.2 Research Focus and Research Question

The main focus of this research is to find whether there are any aspects related to coastal navigation skills which are in need for further exploration and research. This could be related to skills and knowledge related to coastal navigation, how we teach coastal navigation, and what the student actually learns regarding coastal navigation. The basis of this thesis has been restricted to last year students at HVL for practical reasons.

The research question will therefore be: Is there a noticeable difference in coastal navigational skills between the students who have attended the coastal navigation course at HVL and the students who has not attended the course?

The research related to this question is divided into two main parts:

1. Literature review
2. Three step study
    i. Voyage planning
        a) Participating observation of students planning a coastal voyage in a paper chart.
    ii. Simulator test
        a) Participating observation of students sailing the planned voyage in the navigational simulator
    iii. Interview with the students
        a) Part one: debrief and questions related to the planning process and the voyage.
        b) Part two: theory related to coastal navigation and navigational techniques.

2 Coastal navigational skills and control methods

In order to answer the research question, it is first necessary to define the skills, and what is meant by the term skills, what is «coastal navigational skills»? There are two distinct categories that need to be defined in order to measure coastal navigational skills, the first is planning skills, and the second is executive skills. How to plan, and how to conduct a coastal voyage. One might argue that planning is also an executive skill related to that it is knowledge used in a specific task – making the plan, but to maintain a clear distinction of the two categories I will reserve the executive term for the actual sailing/voyage part of the study.

It is also necessary to make a distinction regarding the control method which is applied to the voyage. What control method is the plan based upon, and what control method is applied during the actual voyage. Se figure 2-1 for the relationship between skills and control methods.

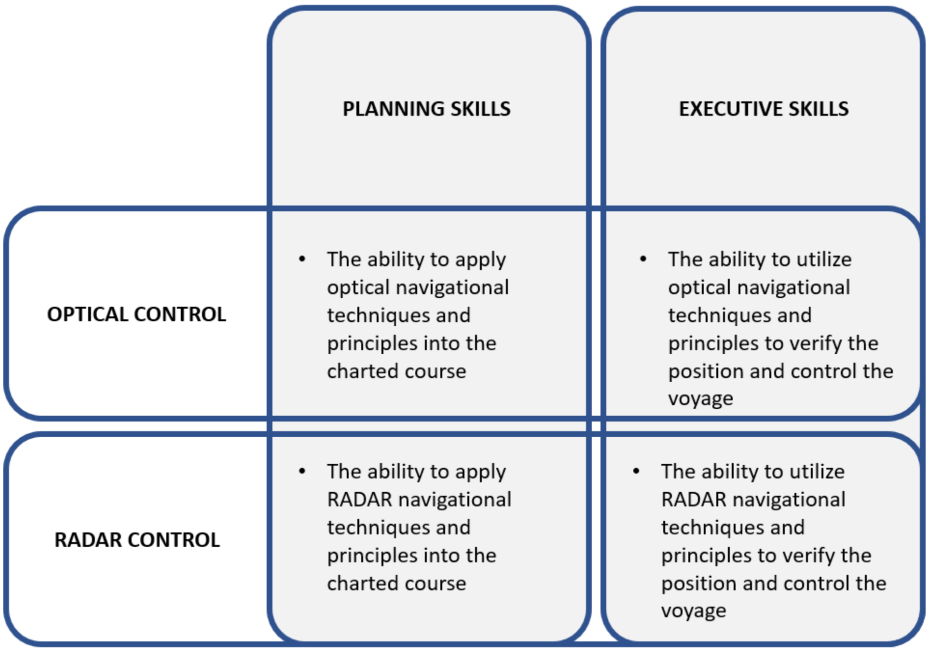

Figure 2-1 The relationship between skills and control methods

Skills are related to knowledge, both theoretical and practical, in this paper the term skill will be used as a description of how knowledge related to coastal navigation are shown/expressed through theoretical understanding of navigational theory and techniques, the ability to apply coastal navigational techniques into voyage planning, and the ability to apply and utilize coastal navigational techniques in voyage execution in the simulator. In other words, if you can name and describe a coastal navigational technique you have the theoretical foundation to utilize it as a skill in your voyage planning, if you then in addition are able to utilize it in the practical part in the simulator you have further advanced your skill related to the specific technique.

2.1 Control methods in coastal navigation

The goal for the coastal navigation course, as it is stated in the course model description from the Norwegian Coastal Administration is to (the authors translation) (Kystverket - Senter for los og VTS, 2020):

"Create a standardized framework for training students and navigators in demanding coastal voyages along the Norwegian coast".

The course description states that students and navigators shall have training in optical positioning, RADAR positioning and the use of both ECDIS and paper charts. In the course taught at the Western Norway University of Applied Sciences we operate with two distinct control methods for monitoring and controlling the voyage. These are optical control and RADAR control.

An optical controlled voyage is a voyage planned in either ECDIS or paper charts. The voyage is planned according to optical techniques in such a way that it is possible to sail the voyage at night without any other aids to navigation than optical references. When using paper charts, positioning is done with optical techniques and plotted into the paper chart to verify the position, and when using ECDIS the position shown in ECDIS are controlled with optical positioning.

A RADAR controlled voyage is a voyage planned in either ECDIS or paper charts. The voyage is planned according to optical techniques in such a way that it is possible to sail the voyage at night without any other aids to navigation than optical references, but the plan is converted to be sailed with RADAR for monitoring and positioning purposes. The reason for always planning voyages in such a manner that they can be sailed at night with nothing but optical references, is that these voyages can be applied to fit all circumstances with minor modifications. When using paper charts, positioning is done with RADAR techniques and plotted into the paper chart to verify the position, and when using ECDIS the position shown in ECDIS are controlled with RADAR positioning.

In the first half of the coastal navigation course, the two control methods are used quite rigidly to allow the students to become comfortable with one method at a time, in the second half of the course the control methods are combined into optical control with RADAR support. This method is based on optical control techniques, but with RADAR support for positioning and detecting purposes. The reason for having optical control as the main method is to train the students to look out through the windows, or in the simulator – keep the focus on their surroundings and use ECDIS and RADAR as aids to help ensure safe navigation.

2.2 Coastal navigational techniques

In order to be able to say something about the use of coastal navigational skills, it is necessary to first describe some of the techniques that exist and are available for the students to use. These techniques will be divided into their own subchapters optical and RADAR techniques.

Regardless of the choice of optical or RADAR techniques, it is necessary to have some basic understanding of the relationship between *time, speed,* and *distance* in order to understand and utilize the techniques in both categories. Especially when sailing in paper charts without the automatic countdown and timekeeping in the ECDIS system.

2.2.1 The relationship between time, speed, and distance

Many of the techniques used in coastal navigation are based upon a basic understanding of the relationship between time, speed, and distance. To be able to do these calculations during a voyage we have some basic tables and rules to help us structure and simplify these calculations. The basis for swift assessment of distances is the six-minute rule. This rule is based upon the fact that the unit knots is nautical miles per hour, and since six minutes is one tenth of an hour (sixty minutes), this gives that through dividing our current speed by ten, we will always find the distance we will sail in six minutes. If we know the distance we will sail in six minutes, it is easy to find the distance for twelve or three minutes also, and similar variations with simple addition and subtraction.

$$\text{Knots} = \frac{\text{Nautical miles}}{\text{Hour}} \quad \text{and} \quad \frac{6\ \text{minutes}}{60\ \text{minutes}} = \frac{1}{10}$$

Combined with the six-minute rule we often use a time, speed, and distance table like shown in table 2-1, giving us the number of seconds per 0,1 nautical mile at various velocities. This table could be made even larger showing the speed for distances ranging from 0,1 to 1,0 nautical miles, but this is unnecessary. As long as we have some relations between time and speed for 0,1 nautical miles, the rest can be calculated or interpolated based on the values in this table. The key point of the table is that the information should be easy to memorize, and thus be easy to use without needing to look it up.

Table 2-1 Seconds per 0,1 nm at various velocities in knots

10	12	15	18	20	24	30	36	Speed in knots
36	30	24	20	18	15	12	10	Seconds per 0,1 nm

This table forms the basis for calculating the number of seconds per 0,1 nautical miles for various velocities in knots. If you need to know how many seconds you will use to sail 0,1 nm in 40 knots all you need to do is to divide the numbers of seconds you use in 20 knots by two and you will get your answer.

2.2.2 Optical coastal navigation techniques

In this section I will give a short explanation of the various optical techniques which is evaluated in the three stages of the field study. Some of the techniques might be evaluated in all three stages, and some are just evaluated in the simulator exercise and interview.

2.2.2.1 Heading point

The use of heading point is one of the most basic optical navigational principles. Shortly explained using a heading point means heading towards an aid to navigation, thus providing the navigator with a line of position on which the vessels must be located. See figure 2-2 “Heading point” for an illustration of the principle.

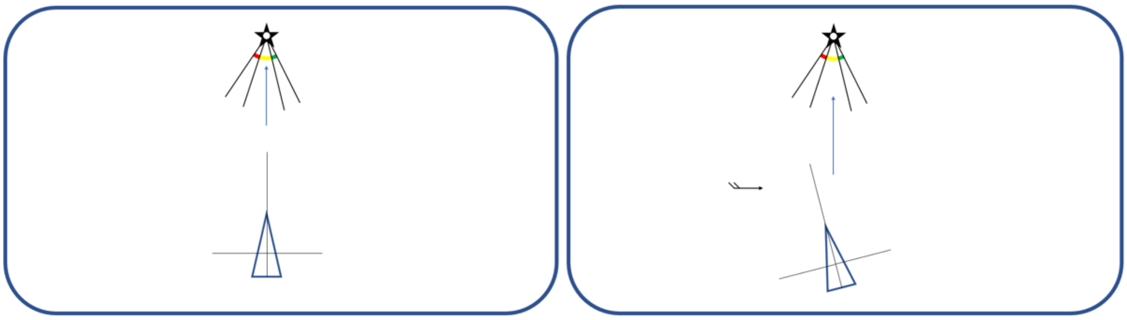

Figure 2-2 Heading point – The use of a heading point in ideal conditions, and when compensating for external forces. (Skare, 2018)

2.2.2.2 Aft heading point

The use of aft heading point is based on the same method as for heading point. The only difference is that you move away from the aid to navigation seeing the aid to navigation astern of your vessel. See figure 2-3 "Aft heading point" for an illustration of the principle.

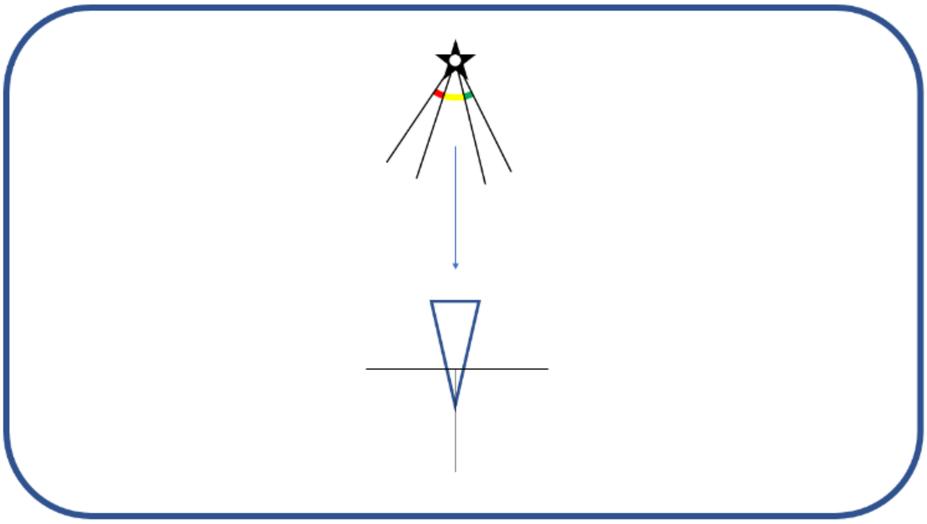

Figure 2-3 Aft heading-point - Illustration showing the use of an aft heading-point (Skare, 2018)

2.2.2.3 Cross bearing

The use of cross bearings with two or three bearings are simple optical positioning techniques which are based solely on optical bearings. A cross bearing using two bearings is a positioning method where the bearing towards two aids to navigation is found using an optical bearing device. The bearings are drawn in the chart, and where the bearings intersect each other, we have the position of the vessel. The optimum angle between the two bearings are 90 degrees. When used in combination with a heading point, the heading point provides a constant line of position while moving towards an aid to navigation, while every aid to navigation which are passed abeam of the vessel provides the second line of position in the cross bearing. Making heading point and abeam a quick and easy way of determining the vessels position during coastal navigation. See figure 2-4 "Cross bearing with heading point and abeam" for an illustration of the principle.

A cross bearing using three bearings is a positioning method typically used in more open fjords where you do not have a heading point, and you need to establish your position and you cannot find two objects with a sufficient angle between them to base your position on only two objects. The optimum angle between the three aids to navigation are 60 degrees, and the sequence in which the bearings are conducted is of importance in order to get the smallest possible error triangle in which the vessel position is determined. Due to the advance of the vessel, we always start with the aid to navigation with the smallest relative angle from the bow of the vessel, and end with the aid to navigation with the largest relative angle.

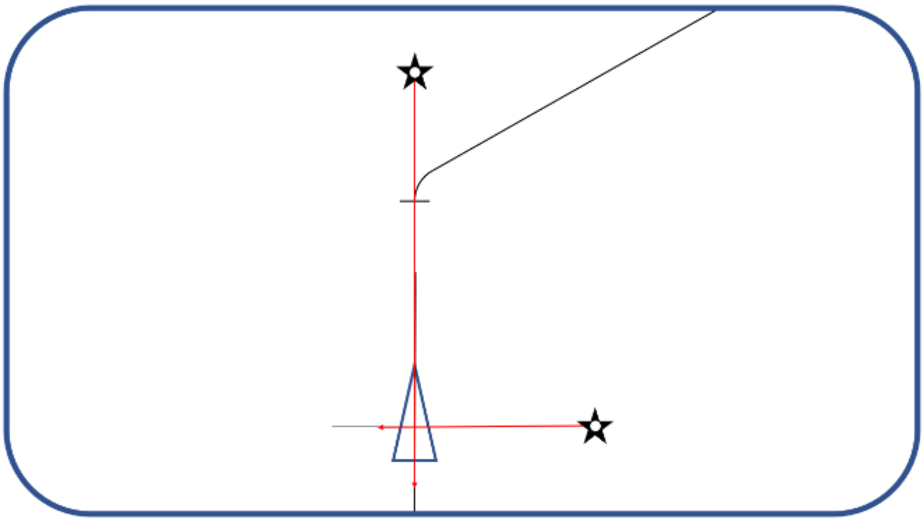

Figure 2-4 Cross bearing with heading point and abeam (Skare, 2018)

2.2.2.4 Four-point bearing

A four-point bearing is an optical positioning method based upon an optical bearing and a calculated distance to an aid to navigation. The name four-point bearing is based upon old compasses which was divided into points, and not degrees like compasses are today. In these compasses one point is the equivalent to 11,25 degrees, making four points the equivalent to 45 degrees. In trigonometry a triangle with two angles of 45 degrees and one angle with 90 degrees have two sides which are equal. This combined with the knowledge that distance = speed x time makes it possible to determine both a bearing and a distance to an aid to navigation.

The four-point bearing is conducted by starting a stopwatch or resetting the trip log when you have the aid to navigation at a relative 45-degree angle to the bow. When you get the aid to navigation at a relative 90-degree angle to the bow you stop the stopwatch or read the sailed distance on the trip log. The distance you have sailed between the bearings is equal to the distance you are passing the aid to navigation, giving you a bearing and a distance, and thus two lines of position to the aid to navigation. See figure 2-5 "Four-point bearing" for an illustration of the principle.

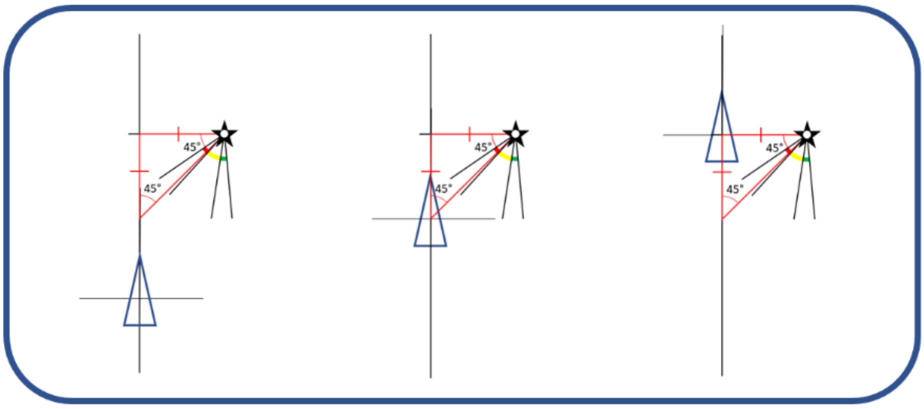

Figure 2-5 Four-point bearing - Illustration showing the different stages of a four-point bearing (Skare, 2018)

2.2.2.5 Running fix

A running fix is an optical positioning method using two optical bearings to the same aid to navigation and a sailed distance to create a sufficient intersection between the two bearings. The technique is typically used in fjords with few aids to navigation available, making cross bearings difficult. In many ways you can say that a running fix is a variation of a cross bearing since the lines of position in this technique is the two bearings to the aid to navigation. When finding the first bearing you start a stopwatch or reset the trip log. After enough time 12 – 15 minutes when you get a sufficient increase in the relative angle towards the aid to navigation you make the second bearing to the same aid to navigation. The first bearing gives you a probable position based on your dead reckoning position and the first bearing, from this position you chart a course and plots the sailed distances between the bearings on this course leg. Then you put the second bearing into the chart, and then finally you slide the first bearing to the plotted distance along the sailed course. Where the two bearings intersect you have your observed position. See figure 2-6 "Running fix" for an illustration of the principle.

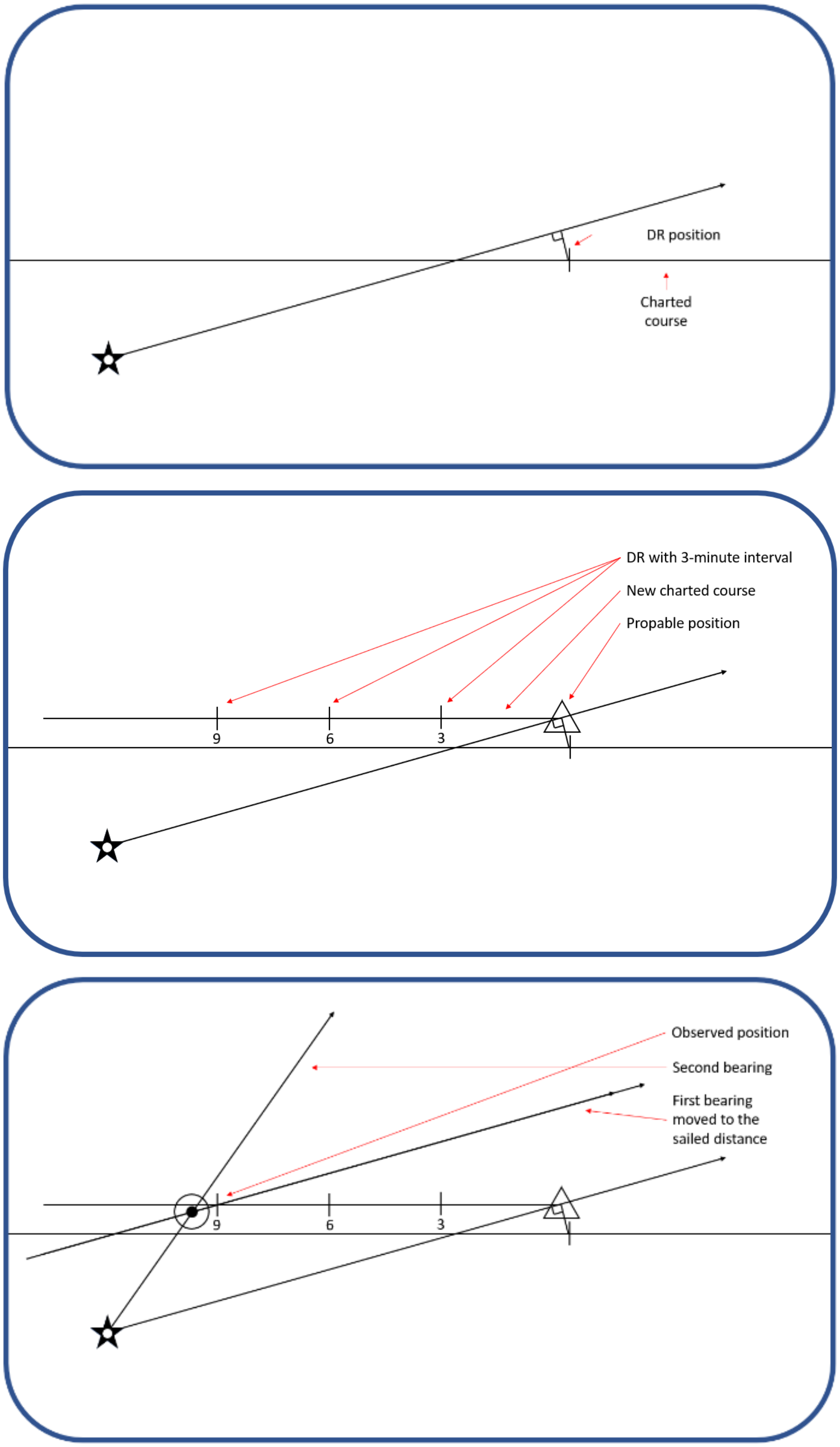

Figure 2-6 Running fix. Illustrations showing the different stages of a running fix position (Skare, 2018)

2.2.2.6 Half-a-point bearing/technique

Half-a-point bearing/technique is a very versatile technique which can be applied and utilized in many different situations. As the name indicates, this technique also has its name from when the compass was divided into points. Half-a-point is about 6 degrees (5,625°) and we may use this technique based on trigonometry using tangent or sine approximations, since tan (6°) = 0,1051 and sine (6°) = 0,1045. We may also use the technique with other angles but sticking to 6 degrees until you get comfortable with the technique is advisable. The key point is that both tan (6°) and sine (6°) ≈ 1/10.

Table 2-2 Tangent and sine value variations used in half-a-point bearing/technique

Tangent (°)	Tangent	Sine (°)	Sine	Approximately
3°	0,0524	3°	0,0523	0,05
6°	0,1051	6°	0,1045	0,1
9°	0,1583	9°	0,1564	0,15
12°	0,2125	12°	0,2079	0,2
15°	0,2629	15°	0,2588	0,25
24°	0,4452	24°	0,4067	0,4

As is shown in table 2-2 above, the accuracy decreases as the angle increases, and from 12 degrees and above sine considerations are more accurate than tangent considerations.

The most basic use of the technique is in combination with a heading point and then changing the course with six degrees to achieve the desired closest point of approach (CPA) to the same object. If you are heading towards an aid to navigation and change your course with six degrees two nautical miles from the aid to navigation, you will get a CPA of 0,2 nm. See figure 2-7 "Half-a-point technique" for an illustration of the principle.

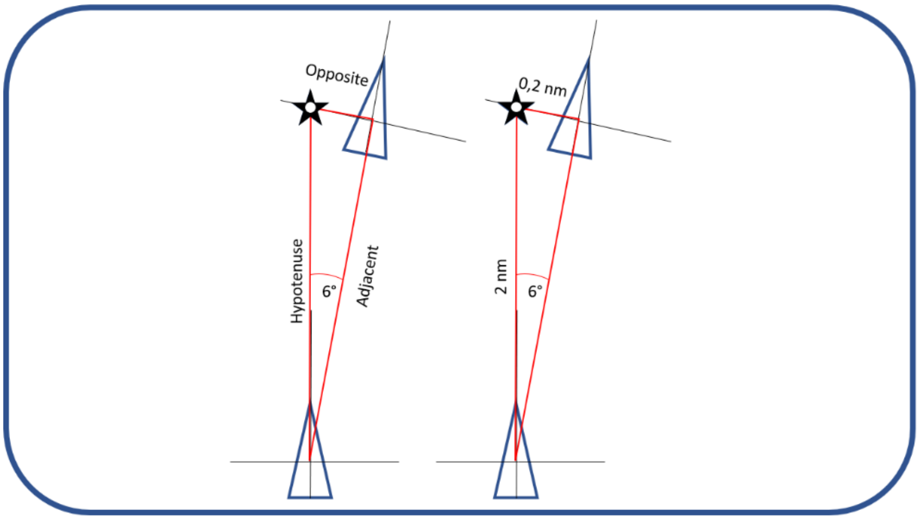

Figure 2-7 Half-a-point technique - Illustration showing the basic use of half-a-point technique in combination with a heading point (Skare, 2018)

If you use the technique without a heading point, you can chart a course with a passing distance (CPA) of 0,2 nm from an aid to navigation. In this case you should be able to have a relative bearing from the bow at six degrees two nautical miles from the aid to navigation, and at twelve degrees one nautical mile from the aid to navigation. This is an optical technique which helps you to estimate whether you will pass the aid to navigation with the desired distance or not. Should the relative bearing be higher or lower than the desired angle, all you ned to do is to change the course to get the desired relative bearing to achieve the desired passing distance. See figure 2-8 “Half-a-point technique” for an illustration of the principle.

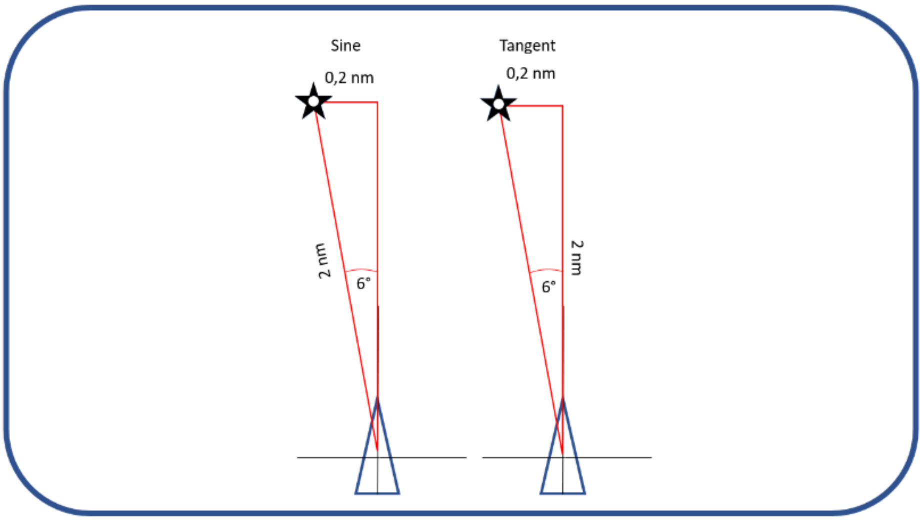

Figure 2-8 Half-a-point technique - Illustration showing the use of half-a-point technique without a heading point and with the purpose of obtaining the desired passing distance to the aid to navigation (Skare, 2018)

The technique can also be used to control deviation from the planned course. If you deviate by six degrees from your planned course, you are able to control the sideways movement based on the fact that the movement sideways is $1/10^{th}$ of the advance.

It is also possible to estimate your cross-track error based on a bearing to an aid to navigation which you planned to use as a heading point, and the estimated distance towards the aid to navigation, by using this formula:

$$\frac{\text{deviation in bearing} \cdot \text{distance to object}}{6} = \text{cross track error in } 1/10^{th} \text{ of nautical mile}$$

2.2.3 RADAR coastal navigation techniques

During coastal navigation with RADAR there are a variety of possibilities in how to combine the use of electronic bearing lines (EBL), variable range markers (VRM) and parallel indexes (PI). Since the simulation exercise is done in darkness with good visibility the focus on RADAR techniques have been downscaled in the interview phase compared with optical techniques.

2.2.3.1 Electronic bearing line (EBL)

In coastal navigation EBL on the RADAR is typically used for visualizing the next course leg in the RADAR before turning into the next course, determining whether targets are “steady” and thus pose a collision danger and finding the heading point if you are on an intersecting course to return to your planned course.

2.2.3.2 Variable range marker (VRM)

In coastal navigation VRM on the RADAR is typically used for turning based on a distance ahead or astern of the vessel, or as a substitute for a PI in narrow sounds and passings. It is also used as a fixed distance around the vessel in combination with relative vectors to determine the tracking and CPA of targets.

2.2.3.3 Parallel index (PI)

In coastal navigation PI on the RADAR is typically used for controlling whether you are in following the charted course. It may also be used as a turn index for the next course leg, or as a safety index showing you the maximum distance you can deviate from your planned course.

3 Literature review

No published research on the precise topic has been found, but there is a lot of research available for the effects of simulator training, and research regarding how we learn and obtain knowledge. The Cadet PEC arrangement is a Norwegian arrangement based on a course description from the Norwegian Coastal Administration, but at the core it is based on the requirements laid out in the STCW code. Since the research is based on a comparison between a group who have training and education based on the STCW code, and a group who have training and education based on the STCW code and the course description from the Norwegian Coastal Administration the first subchapter will be used to look into the STCW code and the course model description.

The second subchapter will focus on learning and knowledge obtained through simulator exercises and training.

3.1 Rules and regulations

This subchapter will take a look at the STCW Code and the Cadet PEC course description and describe the skills and knowledge required to fulfil these regulations.

3.1.1 STCW Convention and coastal navigation

The International Convention on Standards of training, Certification and Watchkeeping for Seafarers (STCW) describes the basic requirements on training, certification and watchkeeping for seafarers on an international level. The convention was first adopted in 1978 and was revised in 1995 and 2010. The convention describes the minimum requirements for various aspects for seafarers and is divided into chapters and the STCW Code. The code is then divided into part A, which is mandatory, and part B which contains recommendations and guidance (IMO, 2023)

The navigational education at HVL is in accordance with the STCW Code Table A-II/1 "Specifications of Minimum Standard of Competence for Officers in Charge of a Navigational Watch on Ships of 500 Gross Tonnage or More" and Table A-II/2 "Specification of Minimum Standard of Competence for Masters and Chief Mates on Ships of 500 Gross Tonnage or More" (Western Norway University of Applied Sciences, 2023).

The code is presented in a four-column format. The first column “Competence” describes what the navigational officer as a minimum should be able to do. The second column “Knowledge, understanding and proficiency” describes the minimum requirements which is needed to be able to do the tasks from column one. The third column “Methods for demonstrating competence” describes how the competence from column one, and the knowledge understanding and proficiency from column two should be demonstrated. The fourth column “Criteria for evaluating competence” describes how the demonstrated competence should be evaluated. In short, the two first columns describe what a candidate should know and be able to do, and the third and fourth column describes how the content from the two first columns should be demonstrated and evaluated.

Listed below is an extract of the parts in column two from the STCW Code which is deemed most relevant for assessing the performance of the participants in this project. This extract is examples which every participant in the study should be able to master as a minimum based on their education. The extracts are edited to keep them as to the point as possible. The entire Table A-II/1, A-II/2 and B-II/1 is available in the Appendix section for further reading.

TABLE A-II/1 – Plan and conduct a passage and determine position

- Knowledge understanding and proficiency
    - Ability to determine the ships’ position by use of:
        - landmarks
        - aids to navigation, including lighthouses and buoys
        - dead reckoning, taking into account winds, tides, currents and estimated speed
    - Ability to determine the ships’ position by use of electronic navigational aids.
    - Ability to determine errors of the gyrocompass, using terrestrial means, and to allow for such errors
    - Steering: Change-over from manual to automatic and vice versa

TABLE A-II/2 – Plan a voyage and conduct navigation

- Voyage planning and navigation for all conditions by acceptable methods of plotting ocean tracks, taking into account e.g.:
    - restricted waters
- Routing in accordance with the General Provisions on Ships' Routeing

TABLE A-II/2 – Determine position and the accuracy of resultant position fix by any means

- Position determination in all conditions
    - By terrestrial observations, including the ability to use appropriate charts, notices to mariners and other publications to assess the accuracy of the resulting position fix
    - Using modern electronic navigational aids, with specific knowledge of their operating principles, limitations, sources of error, detection of misrepresentation of information and methods of correcting to obtain accurate position fixing

TABLE A-II/2 – Determine and allow for compass errors

- Ability to determine and allow for errors of the gyrocompass

TABLE A-II/1 – Maintain a safe navigational watch

- The use of information from navigational equipment for maintaining a safe navigational watch

TABLE A-II/1 – Use of RADAR and ARPA to maintain safety of navigation

- Use, including:
    - range and bearing; course and speed of other ships; time and distance of closest approach of crossing, meeting overtaking ships
    - plotting techniques and relative- and true- motion concepts

    - parallel indexing

TABLE A-II/2 – Maintain safe navigation through the use of information from navigation equipment and systems to assist command decision making

- Evaluation of navigational information derived from all sources
- The interrelationship and optimum use of all navigational data available for conducting navigation

TABLE A-II/1 – Use of ECDIS to maintain the safety of navigation

- Navigation using ECDIS
    - Familiarity with the functions of ECDIS
    - Safe monitoring and adjustment of information, including own position

TABLE A-II/1 – Manoeuvre the ship

- Knowledge of the effects of wind and current on ship handling

TABLE A-II/2 – Manoeuvre and handle a ship in all conditions

- Handling ship in restricted waters, having regard to the effects of current, wind and restricted water on helm response

The above mentioned should be the minimum performance one should expect from the participants in the study, since all participants at the time of the study had completed their nautical subjects at HVL.

3.1.2 Cadet PEC course description from the Norwegian Coastal Administration

Since the Cadet PEC arrangement is a Norwegian solution, and the course is only available in Norway, the course description is only available in Norwegian. Descriptions and tables from the model description in this paper is therefore the authors own translation. The course description is available in Norwegian in the Appendix section.

In the course description, the background for establishing the course and the purpose of the course is stated as follows:

Background

"From both the maritime teaching institutions and the maritime businesses it is desirable to raise the quality of the education given regarding the subject demanding coastal navigation. At the same time there is a desire from the Norwegian Coastal Administration to have a more efficient and quality-based regime related to Pilot Exemption Certificates. The development of better simulation technology and better graphical databases have now made it possible to create better and more relevant simulator exercises within coastal navigation along the Norwegian coast".

The purpose of the course

"The purpose of the course is to have a standardized framework for training of students and navigators in demanding coastal navigation along the Norwegian coast".

The course consists of a total of 58 hours (á 45 minutes), where it is recommended that at least 40 of these are in the simulator. From the curriculum in the course description, we can make the following extraction which is relevant for this study:

Optical positioning / terrestrial positioning

- Repetition of different forms of optical positioning techniques and errors related to them
- Planning safe voyages in coastal waters
- Using dead reckoning based on optical positioning in paper charts and ECDIS
- Simulator exercises day- and night-time

Electronic navigation

- Repetition of limitations related to the use of RADAR in coastal waters and with difficult environmental conditions
- Repetition of the use of parallel indexing, VRM and EBL techniques used in coastal waters
- Planning course alterations in narrow waters
- Repetition of the performance of navigational systems, including gyros and GNSS systems, with emphasis on integrity and accuracy on these systems
- Limitations and possibilities when using ECDIS/ECS
- ECDIS in DR mode (dead reckoning)
- The use of autopilot and manual steering
- Simulator exercises in all visibilities

Basically, the course model description is based on the minimum requirements from the STCW Code and builds on these requirements providing further training requirements to meet the challenges navigating inshore along the Norwegian coast. For the examination exercise, a certified pilot needs to be the examiner.

3.2 Existing literature / literature review

In section 2 “Coastal navigation skill and control methods” the usage of the term “skill” in this thesis was explained. However, this usage is based on a practical approach clarifying the distinctions which are sought discovered in the research, rather than an academic definition of the term “skills”.

The research is aimed at discovering whether there are any noticeable differences between a group with further education and repetition within an overall subject – coastal navigation – than another group, the literature review will therefore be aimed at perspectives related to learning and repeated learning. Especially the effects of repetition should be explored to better understand the field studies conducted in the research.

If we start by exploring some perspectives about learning and what this is, we will find that there are different directions within this field as well, and if we reflect on our own learning experiences and our perception of the learning experience of the people we have interacted with during our lifetime it is reasonable to assume that we all know someone who seem to learn everything just by listening to something once, while others need hours of work and processing to learn something. These basic observations from our everyday life indicate that learning is a complex process, and not a uniform process which is similar and fits all of us.

In the Ecological Theory Model Urie Bronfenbrenner argues that learning is a complex process which does not only happen at the cognitive level, but it is also influenced by psychosocial and cultural influence. The surrounding environment provides conditions for development and learning, and thus needs to be seen in relation to one and other. His five systems model (expanded from the original four systems to five) argues that the environment you grow up in and are a part of influence how you act, think, and feel. In short the systems can be described as; the Microsystem which is made up of the groups you have direct contact with, the Mesosystem which is relations between groups in the microsystem, the Exosystem which is factors that affect a person's life without having a direct relationship with the person, the Macrosystem which is the cultural elements affecting the person and those around the person, and the Chronosystem which is the stage of life a person is in related to the situation which is experienced (Bronfenbrenner, 1979). Since the subjects in this study is only classified in two groups, and other parameters as age, gender, and previous experience is disregarded, it is hard to apply these factors to findings and observations in the study. It is possible that some of the findings could be explained through the use of this model, but the categorizing of the participants does not allow this type of analysis.

According to Illeris, learning is a widely used term which can contain several meanings depending on the dimension and perspective one has towards learning and the learning process. This is shown through these four definitions of learning (Buli-Holmberg, Guldahl, & Jensen, 2007; Illeris, 1999) (own translation):

1. *Learning can reflect the learning process, where learning is a description of what has been learned and is characterized as a lasting change in behaviour as a result of experience and practise.*
2. *Learning can reflect psychological processes, where learning describes something which is happening individually but with the same result as in the previous point.*
3. *Learning can reflect the interaction between the individual and its surroundings, where psychological processes is involved in a various degree.*

4. *Learning can, in some contents, be a synonym of what is being taught, basing it on the assumption that the student will learn that which is taught.*

Since learning may be a widely used term, with varying definitions depending on one's perspective upon learning and the learning process, it might prove useful to try to describe the result of learning and the learning process, in other words, a classification of the learning outcome. In the book "Taxonomy of Educational Objectives: The Classification of Educational Goals" Benjamin Bloom introduces a six-level classification of the learning outcome ranging from knowledge to evaluation (Bloom, 1956).

The first level, knowledge, is the lowest level of learning outcome. At this level the learning outcome may be described as a reproduction and repetition of facts. The second level, comprehension, means that one is able to describe the material in another form or format, in other words the material can be explained through other means than mere repetition of facts. The third level, application, means being able to use (apply) the material in new settings for problem solving purposes. The fourth level, analysis, means that one is able to decompose material and analyse the components. The fifth level, synthesis, means the ability to apply knowledge and skills in new and creative ways, and the sixth level, evaluation, means being able to evaluate material based on personal opinions and definite criteria's (Buli-Holmberg, Guldahl, & Jensen, 2007; Bloom, 1956). These six levels of learning outcome are built upon each other, gradually increasing the cognitive and behavioural learning outcome as one advances from one level to the next, and thus this approach could be helpful trying to classify the results from the field study later on. Especially when evaluating the half-a-point technique such a classification system could prove useful because of the great variety of application the technique has, and the creativity in which types of situations it might be used.

In this study we have two groups which are compared against each other with regards to coastal navigational skills, and therefore it would be prudent to make some assumptions regarding what to expect based on the academic difference between the two groups. All the participants in the study have completed and passed the courses navigation I, II, and III, but one of the groups have in addition completed and passed the course coastal navigation. If we consider all the information we have received through our lifetime, it is fair to assume that none of us are able to recollect and repeat all of this at any given time, we all forget things as time moves along, and therefore we need to consider how much we forget and how we remember. In 1885 Herman Ebbinghaus identified the “spacing effect” and described how repetition, or rather spaced repetition, allowed us to utilize our long-term memory rather than our short-term memory for information storage. According to the forgetting curve we forget almost 50% of new information within the next day, and therefore to preserve knowledge we need to repeat it in order to allow it to be stored in our long-term memory. The spacing effect is thus the effect of spaced repetitions, where the effect of short repetitions has proved more sustainable over time than a massive one-time study session to pass e.g., an exam (Ebbinghaus, 1885 / 1964). If we consider this effect, the group that has completed the coastal navigation course should presumably have had more repetitions spaced over time than the group without. However, since background information and experience among the participants is not used as categories to nuance the individuals, it is not possible to say with certainty that this is so. The participants could have taken part in the voluntary evening simulator training at HVL, and thus have had a spaced repetition in this way, or they could have previous experience from the maritime domain which has been repeated at HVL. It is however an interesting effect to keep in mind when analysing the results of the field studies.

4 Research method

In the literature review the thesis points out a direction towards learning and how we learn. This combined with the initial statement that the thesis is a preliminary study to see if there is anything worth further studies, have led to the conclusion that a form of participating observation would be the best approach to find answers to the research question for this thesis.

"Is there a noticeable difference in coastal navigational skills between the students who have attended the coastal navigation course at HVL and the students who has not attended the course?"

In short, the research is based on two practical tasks and a supporting interview discussing the two practical assignments. In the field of coastal navigation, it is possible to look at specific elements within this type of navigation, but since the question is based on identifying differences, the research method needs to allow natural behaviour among the participants. What is interesting is how they behave, and what they do on a ships bridge (simulator) when given the freedom to execute their own knowledge in their own natural way. However, it is also necessary to be able to participate in the planning process and on the bridge in order to observe and clarify the why and how sometimes during the process.

The usage of the phrase *noticeable* indicates that differences should be of a clear or apparent nature which makes them easily seen or noticed. The reason for looking for noticeable differences rather than just differences is to ensure that any findings related to differences most likely would be done by another observer, and to reduce the risk of bias from the researcher in situations where it is unclear whether there is a difference or not.

4.1 Participant observation as a research method

Participant observation is a qualitative research method which allows the researcher to be a part of the environment which is being observed. This allows the researcher to connect to the subjects in the study, and to get to know them in such a way that nuances and other "hidden" hints and data might be discovered. Being a participating observer does not mean that you participate in the task performed by the research subject, but rather that you have a social interaction with the research subject (Fangen, 2010).

According to Fangen, the purpose of participant observation is to be able to describe what people say and do in a context which has not been manipulated by the researcher. The key aspect is to study the activities and doings initiated by the research subject on its own accord (Fangen, 2010). The research method is also often combined with other data collections methods, like in this study where it is combined with an interview.

The term participant observation is usually divided into five different levels of participating, ranging from nonparticipating to complete participation. Within this range the involvement of the researcher ranges from no involvement to high involvement. According to Spradley the different levels of participation can be described as; nonparticipation, the researcher does not interact with the subject in any way, and the presence is restricted to observing. Passive participation, the researcher is present in the environment, but with a spectator role with minimum interaction with the subject. Moderate participation, the researcher alters between being a spectator and a participant in the environment. Active participation, the researcher takes an active part in the environment and participates in what is being done. Complete participation, the researcher is fully involved in the doings in the studied environment and is involved in the same way as the subject (Spradley, 1980). In the fieldwork connected to this study the researcher has been swapping between passive and moderate participation during the planning and simulator part of the study.

4.1.1 The validity of participant observation as a research method

According to Fangen, qualitative researchers have for a long time claimed that qualitative research cannot be assessed based on the same criteria as quantitative research, and that using the same criteria makes qualitative research seem inferior to quantitative research since it cannot be mathematically quantified and described (Fangen, 2010). Instead of seeing qualitative and quantitative research as two different research methods, Kalleberg argues that it should be seen as two different ways of interpreting data, saying that data may be transformed into numbers or into text, and that qualitative data have a logical advantage because social experiences needs to be put into words before they can be made into numbers, and thus stating that the two methods are equal and that the research question must decide the choice of method (Fangen, 2010; Kalleberg, 1996). The research question for this thesis does not indicate that what is being studied is something that is possible to quantify, it is rather aimed at describing and noticing differences without knowing what these differences might be, and thus a qualitative approach seems as the most reasonable choice.

According to Svartdal, participating observation is a method which ensures a high degree of validity with regard to whether the research measures what it is intended to measure (Fangen, 2010; Svartdal, 1998). In this statement there is a presumption that the method participating observation is applied in a way which allows the researcher to interact with the participants in a way that results in good and valid data collection. In this thesis what is measured is *noticeable differences* between subjects which are divided into two categories. Since every subject is unique and thus have their own differences related to each other, the task will be to see if there are any differences which can be defined as *noticeable* between the two groups. When being a participating observer the researcher has the advantage of being able to assess the validity of the statements made by the subject, the validity of the observations made in the context in which they are observed, and the validity of the interpretations made in the same context (Fangen, 2010; Svartdal, 1998). Being a part of the planning process and being present on the bridge during the simulation makes it possible to further the understanding of the choices and activities made during these processes.

4.1.2 The reliability of participant observation as research method

In quantitative research reliability could be described based on the accuracy of the measuring instrument or how easy it is to reproduce the data in the same conditions. In qualitative research on the other hand the expression needs further refinement before we put it to use. According to Fangen, reliability in qualitative research could ideally be described through the question; *would another independent observer have noticed the same events and interpreted them in the same way us you did?* This is an ideal, but not possible (Fangen, 2010), because we are all different as humans, and thus stating that we notice and interpret something in the exact same way seems unlikely.

According to Treharne and Riggs, the most highly cited system of quality criteria for qualitative research is the five key concepts described by Guba, Lincoln and their colleagues (Treharne & Riggs, 2014; Lincoln & Guba, 1985; Lincoln, Lynham, & Guba, 2011). These five key concepts may be summarized in the following way:

- *Credibility* – does the participant in the study feel that the findings represent their experience?
- *Transferability* – are the findings applicable in other contexts? If the findings are in harmony with the experience of the individual evaluating the research, it is transferable in the eyes of the reader.
- *Dependability* – Would similar findings be produced if someone else also undertook the research?
- *Confirmability* – Are the findings a product of participants' responses and not the researcher's biases, motivation, interests, or perspectives?
- *Authenticity* – Does the research represent a fair range of differing viewpoints on the topic?

(Treharne & Riggs, 2014; Lincoln & Guba, 1985; Lincoln, Lynham, & Guba, 2011)

Regarding *credibility* the thesis and findings will not be presented to the participants before it is submitted, so it will be hard to determine whether the participants agree with the findings. However, the first part of the interview is dedicated to the participants impression of the planning task and the simulation. The notes and sound recordings from the interview sessions thus help to improve the credibility of the findings.

Regarding *transferability,* this is a known weakness of qualitative studies. The data and findings in this study alone is not enough to generalize towards other domains, but perhaps some of the data could support other research aimed at repeated learning. In order to make this research more transferable there are two possibilities; multiple similar questions could be researched to increase the transferability, or a supporting quantitative study based on concrete findings could also increase the transferability.

Regarding *dependability* it is hard to be certain if someone else would have similar findings, but most likely this would be the case. The research is preliminary research trying to determine if there is something worth looking into further on, and since it is at this preliminary level, it is reasonable to assume that similar, if not the same, findings would be made by other researchers.

Regarding *confirmability* and the bias of the researcher there is a significant possibility that a bias could be present. The researcher is the lead lecturer in coastal navigation at HVL, and thus might have a personal interest related to advocating for results forwarding the coastal navigation course. The personal interest in coastal navigation, being taught and trained in coastal navigation at the Royal Norwegian Naval Academy, and still serving in the Norwegian Coastguard might also pose a possibility for bias regarding the researchers' perspectives. This has all along been one of the concerns regarding this thesis, is the subject to close at hart for the researcher, and is it possible to keep an objective distance? This realization in advance hopefully enhances the possibility for avoiding bias from the researcher.

Regarding *authenticity* the research might not be representing enough differing viewpoint to be able to claim a high degree of authenticity. The key question is to see if there are any *noticeable differences* between the two groups being researched, in order to see if any further studies are warranted. There is off course some discussion regarding these differences, and in some cases arguments for further steps, but as stated regarding credibility, the findings will not be presented to the participants before the thesis is submitted, and thus the interview (and the first part in particular) will be the best source to determine authenticity as well.

4.1.3 Research ethics

In this study data has been collected through participating observation, video recordings, audio recordings and interviews. The participants have all given their written consent to the participation in the study and the recording of data. The research method and data collection have also been assessed by Sikt prior to the study and deemed lawful. Sikt reference number for the research is 184112.

According to the project notification form, all collected data will be deleted no later than 15.08.2023.

4.2 Field study and data collection

As mentioned earlier the data collection is based on three separate sources. Voyage planning, a simulator voyage, and an interview. In this section the three different phases will be described in the order the participants were a part of the field study. In total six persons participated in the study, three from each group. Factors such as gender, age, previous experience, etc. are not considered when analysing the data, the groups are only separated by the criteria coastal navigation course. The participants were invited to join the study through several announcements on the student platform CANVAS. As a part of these announcements a participant information and consent form were enclosed as an attachment to the announcements. This form is available in APPENDIX F.

Initially the field study was planned with twelve participants, with six from each group, but only six candidates volunteered for the study. The low number of participants could pose a risk that other criteria which are not used for classifying the groups might affect the data more than if the study was conducted with the planned twelve participants. The low number of participants might also make it challenging to determine if there are any distinct differences in patterns or behaviour between the two groups.

The participants took part in the study one at a time, and started with a planning session before they moved on to the simulator where they used their own plan throughout the simulation. Immediately after the simulation there was a two-phased interview, where the first part was aimed as a dialogue talking about the planning process and the voyage, and the second part was a more direct interview aimed at describing coastal navigational techniques and theory. Before starting the planning session each participant was given a short conversation with the researcher where the aims of the research were discussed, and that the purpose of the research method was that the participant should act in accordance with their natural choices in each situation, and that there are no right or wrong way to do things during the exercises.

The intention of the planning task and the simulator voyage was to see what the natural choice of plan and execution by the participants is. When designing the research there where two possible approaches that needed to be considered. Complete freedom for the participant in both the planning task and the simulator exercise, or complete freedom in the planning task, and a fixed route to be sailed by all participants. The second approach was discarded since the purpose of the research is to see if there are any *noticeable differences*. A fixed route would make it easier to compare how the participants sailed that exact route, but it would not show the natural choices and behaviour of the participants, but rather the behaviour that they would adapt to sail the researchers planned voyage. Allowing the participants to have full freedom in their planning task, and then sail their own plan thus seemed like the appropriate choice in order to get the best possible data from these two tasks.

4.2.1 Field study – voyage planning

In this part of the research, the participants were given a task to plan a voyage from just south of Leroeyosen, through Vatlestraumen and to Bergen, see figure 4-1 for an overview of the area. There was not given an exact starting point, just an area, making the choice from where to start completely up to the participant. The reason for not choosing an exact start position was to avoid influencing the first course leg of the participants. The information given to the participants at the start of the planning task was the starting area, the end position, the vessel used in the simulation, and that they could expect a southbound tidal current of 1 – 1,5 knots in Vatlestraumen.

The reason for choosing this area is that all participants have sailed this at some point during their education at HVL, it is also one of the paper charts the students at HVL need to buy for themselves during their education.

The voyage planning was done in a paper chart, the reason for planning the voyage in the paper chart, is that this is a better medium for analysing and discussing the route later on. It also shows planning techniques in a better way than if the route had been planned directly in the ECDIS. The planning session was filmed and observed by the researcher. In addition to a paper chart and tools for planning in the paper chart a notebook was made available for the participants for making notes about their plan.

When the plan was finished there was a quick dialog where the participants described their plan and their priorities for the various course legs.

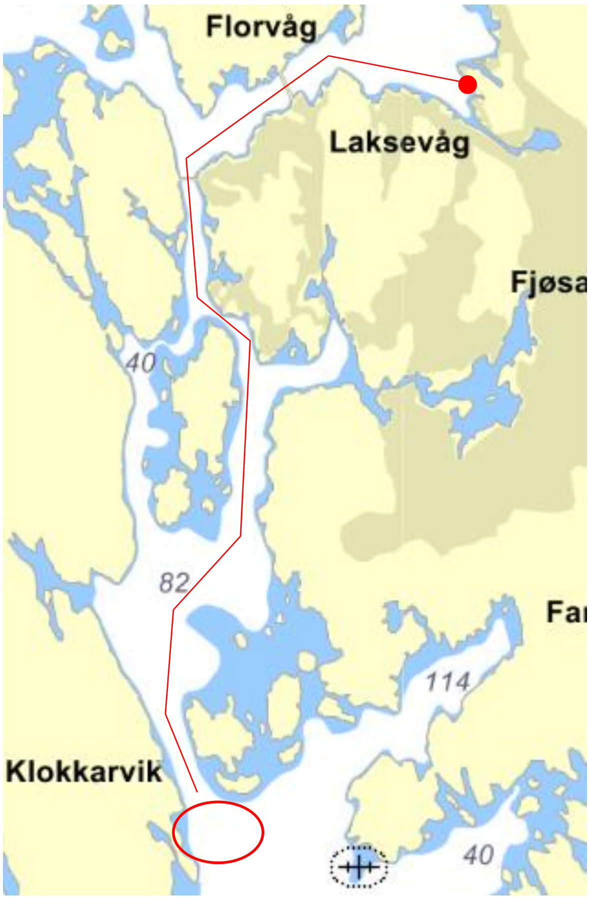

Figure 4-1 Area for route planning and simulator exercise – Chart screenshot from gulesider.no/kart

4.2.2 Field study – simulator exercise

After completing the planning session, the participants were allowed into the bridge. In the simulator exercise the participants were given the choice to sail there plan directly from the paper chart, or to transfer their plan into the ECDIS, all the participants chose to transfer their plan into the ECDIS. Since the focus was towards coastal navigational skills, there was no other traffic present in the simulation. The participants were not informed of this choice from the researcher in advance.

During the simulator exercise the researcher was present on the bridge observing the participant, and the session was videorecorded, and recordings from the simulator, including ECDIS and RADAR were also recorded.

For the simulation the conditions and vessel model stated in table 4-1 "simulator settings" and table 4-2 "Ship particulars" was used:

Table 4-1 Simulator settings

SIMULATOR EXERCISE PARTICULARS			
Simulator type:	Kongsberg K-SIM		
Simulator owner/location:	HVL / SIMSEA Haugesund		
EXERCISE AREA			
Database:	NO24_Bergen-Selbjornsfd		
EXERCISE – ENVIRONMENT AIR			
Lights		**Air**	
Sun illumination:	5%	Wind – direction from:	335°
Threshold navigation lights:	50%	Wind – speed (knots):	16
Threshold cultural lights:	50%		
Clouds			
Type:	Nimbostratus		
Density:	66%		
EXERCISE – ENVIRONMENT SEA			
Wind generated waves		**Local weather polygon**	
Age	9%	Area	Vatlestraumen
Height	0.89	Local current min	0.5
Direction	335	Local current max	1.5
Period	3	Local current direction	Southbound
Length	13.24		
EXERCISE - FAILURES			
Gyro error	-2°		

Table 4-2 Ship particulars

VESSEL PARTICULARS			
Model name: PRODC 04		Vessel name:	M/T Maria Theresa
Gross tonnage	2659 tonnes	Deadweight	3900 tonnes
Max displacement	6897 tonnes	Block coefficient	0,88
Draught forward loaded	4,91 m	Draught forward ballasted	1,36 m
Draught aft loaded	7,37 m	Draught aft ballasted	5,25 m
Condition during simulator exercise:		LOADED	
STEERING PARTICULARS			
Type of rudder	Schilling	Time hard-over to hard-over	
Maximum rudder angle	70°	- with one power unit	52,2 s
		- with two power units	26,1 s

PROPULSION PARTICULARS					
Engine order		**RPM**	**Pitch**	**Speed (knots)**	
				Loaded	**Ballasted**
Full sea speed	1	180	100%	11.44	11.95
Full ahead	0.8	180	77%	9.28	10.95
Half ahead	0.5	180	46%	6.14	7.23
Slow ahead	0.25	180	27%	4.08	4.75
Dead slow ahead	0.125	180	14%	2.56	2.91
Stop	0	180	0%	0.00	0.00
Dead slow astern	-0.125	180	-13%		
Slow astern	-0.25	180	-34%		
Half astern	-0.5	180	-64%		
Full astern	-1.0	172	-100%		

4.2.3 Interview part one

After completing the simulator session, the participants were interviewed by the researcher. The first part of the interview was a dialog between the researcher and the participant, where the participants were allowed to express their own thoughts and reflections regarding the planning session and the simulator exercise, and whether they thought the plan had been good, or if there was anything they would have changed in their plan if they were to do the same simulator exercise once more. Based on the field notes made for each participant, the researcher used this part of the interview to verify and clarify observations and impressions from the two tasks. The interviews were recorded (audio only).

4.2.4 Interview part two

After completing the first part of the interviews, the second part started directly afterwards. In this part a set of questions related to coastal navigational techniques was presented to the participants. The reason for including these theoretical questions was to be able to see if the participant had any knowledge of techniques that they did not use during their planning and simulator exercises. To get an overall idea of the theoretical level all participants were asked the same questions regardless of whether they had applied the techniques in their planning exercise or in the simulator exercise. The purpose of these questions was to verify whether the observations and impressions done by the researcher related to coastal navigational techniques were correct or not.

The following questions was asked to the participants:

- Q1: Please describe what using heading point means and the advantages and disadvantages of this technique.
- Q2: Please describe what using cross bearings means and the advantages and disadvantages of this technique.
- Q3: Please describe what using a four-point bearing means and the advantages and disadvantages of this technique.
- Q4: Please describe what a running fix bearing means and the advantages and disadvantages of this technique.
- Q5: Please describe what using half-a-point bearing/technique means and the advantages and disadvantages of this technique.
- Q6: Please describe the six-minute rule.
- Q7: Please describe how you would use a radar distance as a turn indicator in coastal navigation.

4.3 Assessment of coastal navigation techniques

4.3.1 Heading point

In the planning process this principle is visible through planning charted courses which aim/head directly towards aids to navigation.

In the simulator exercise this principle is visible through sailing towards aids to navigations. Compensating for external forces and prioritizing a course over ground towards the aids to navigation shows a further understanding of the principle beyond merely heading towards the aid to navigation.

In the interview the ability to describe the principle as a line of position, and describing the compensation against external forces while maintaining a course over ground which corresponds with the charted course is seen as a perfect answer.

4.3.2 Aft heading point

In the planning process this principle is visible through planning charted courses which move away from an aid to navigation along a line extending from the aid to navigation.

In the simulator exercise this principle is visible through sailing away from aids to navigations on a line extending from the aid to navigation, keeping the aid to navigation visible astern of the vessel. Compensating for external forces and prioritizing a course over ground away from the aid to navigation shows a further understanding of the principle beyond steering the charted course.

In the interview the ability to describe the principle as a line of position, and describing the compensation against external forces while maintaining a course over ground which corresponds with the charted course is seen as a perfect answer.

4.3.3 Cross bearing

In the planning process cross bearings are not visible, though planning charted courses using heading points facilitates cross bearings using two bearings.

In the simulator exercise this principle is visible mainly through the use of heading points and abeam. The area for the exercise does not indicate the need for cross bearings using three bearings. Frequent position updates based on heading points and abeam shows a good understanding and good practical use of the principle.

In the interview the ability to describe the principle with both two and three bearings, and describing the optimum angles between the bearings shows a theoretical understanding of the principle. Describing the use of heading point and abeam, and the sequence and the reason for the sequence using three bearings shows a theoretical understanding of the practical use of the principle in coastal navigation.

4.3.4 Four-point bearing

In the planning process four-point bearings are not visible, though planning with easily calculated distances to aids to navigation facilitates four-point bearings using measured time between bearings to calculate distance.

In the simulator exercise this principle is visible mainly through the use of optical bearings in combination with a stopwatch or the trip log when passing aids to navigation.

In the interview the ability to describe the principle shows a theoretical understanding of the principle. Describing the use of the principle and the maximum range of 0,5 nm miles shows a further understanding of the accumulated errors in the time and/or log measurements and the effect of inaccurate bearings over larger distances.

4.3.5 Running fix

In the planning process a running fix is not visible.

In the simulator exercise a running fix would be an unnecessary choice of positioning method in the exercise area.

In the interview the ability to describe the principle shows a theoretical understanding of the principle. Describing the use of the principle and in addition describing that every line of position in the ECDIS uses a variant of this principle shows a further understanding of the principle.

4.3.6 Half-a-point bearing/technique

In the planning process half-a-point bearing/technique are not visible, though planning with easily calculated passing distances or heading points with course changes of six degrees at easily calculated distances from the aid to navigation facilitates half-a-point bearings.

In the simulator exercise this principle is visible mainly through the use of optical bearings in combination with a stopwatch or the trip log to determine the distance from objects.

In the interview the ability to describe the principle shows a theoretical understanding of the principle. Describing the use of the principle and the variety in which it may be used shows a further understanding of the principle.

5 Findings

In this chapter the findings from each task will be presented in its own subchapter. A summary of the findings will be presented in a separate subchapter at the end.

Regarding the findings in the planning exercise and the simulator exercise, it is necessary to establish a baseline regarding what might be considered to be the best plan for navigating the exercise area. As the author of this paper, I do have my preferred route in this area, but using this as the baseline would be the wrong approach, especially since I also have taught the coastal navigation course at HVL. The baseline, or reference route will be the route available from the Norwegian Coastal Administration webservice "Kystinfo" (Kystverket, 2022). "Kystinfo" (coastal information (translation)), is a web service with charts, rules and regulations, recommended routes, etc. along the Norwegian coast. The routes have been developed and approved by a group of pilots who frequently navigates the specific areas, and thus must be assumed to be valid as a reference route for this study.

When describing and comparing charted and sailed courses the following four section indexing will be used to describe the placement in the fairway:

- Starboard 1: area from the centre of the fairway and towards starboard 2.
- Starboard 2: area from starboard 1 and towards the starboard side limitation of the fairway.
- Port 1: area from the centre of the fairway and towards port 1.
- Port 2: area from port 1 and towards the port side limitation of the fairway.
- See figure 5-1 "Example of fairway indexing" for an illustration of the principle.

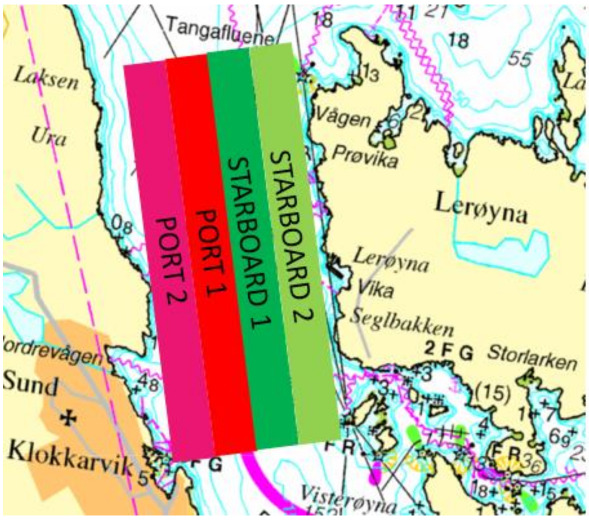

Figure 5-1 Example of fairway indexing - chart extract from Norwegian maritime chart number 21

5.1 Findings from the planning exercises

In order to compare the results from the planning exercise with the reference route and between the two groups, the findings and differences will first be presented in their own subchapters with relation to a defined geographical area, and then a generalization/summary of the findings will be presented in a subchapter at the end.

5.1.1 Leroeyosen – From Boernestangen Oc 6s to Tangaflu Iso G 6s

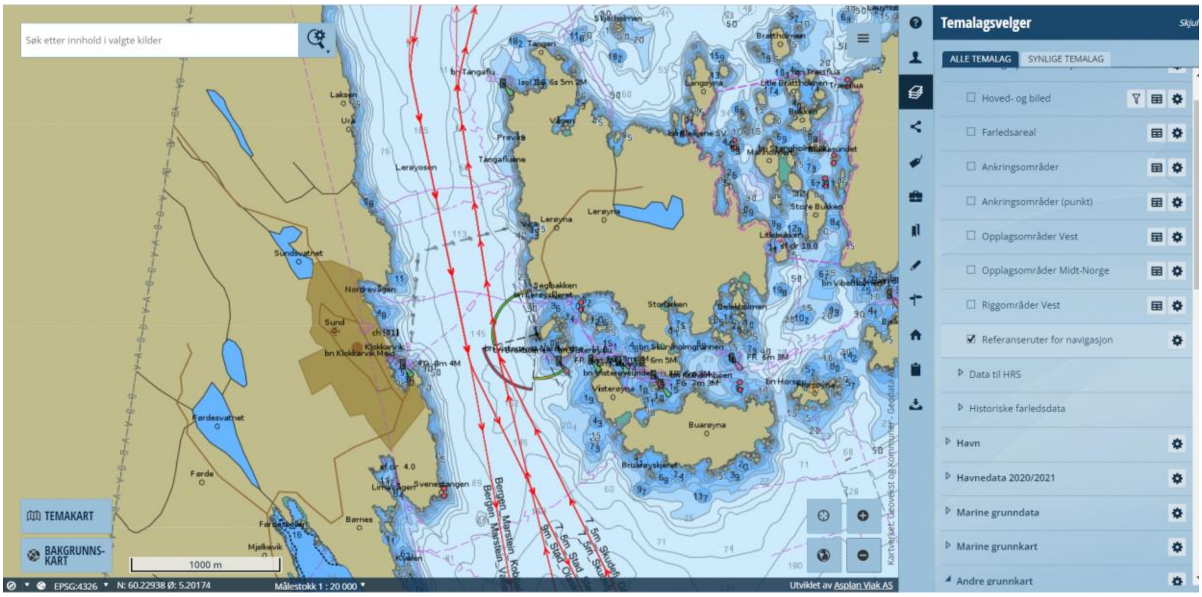

Figure 5-2 Screenshot of Leroeyosen with reference routes from the online database "Kystinfo" provided by the Norwegian Coastal Administration

Depending on the approach to Leroeyosen (the area shown in figure 5-2) there are two reference routes entering Leroeyosen from the south. Since the participants does not know the exact starting position, the best part for comparison will be from Leroey Oc (2) 8s to Tangaflu Iso G 6s. If we use the indexing method stated in the previous section, we can see that the reference route in this area is parallel with land on the starboard side, and it is placed on the border between starboard 1 and starboard 2. Both northbound reference routes in the area have a change in heading at Leroey Oc (2) 8s and Tangaflu Iso G 6s.

The findings from this area are presented in table 5-1 “Findings in Leroeyosen”.

Table 5-1 Findings in Leroeyosen

LEROEYOSEN – From Leroey Oc (2) 8s to Tangaflu Iso G 6s		
	Group 1 – with CNC	**Group 2 – without CNC**
Placement	Starboard 1: 2 Starboard 2: 1	Starboard 1: 2 Starboard 1 to port 1: 1
Parallel to land	Yes: 3 No: 0	Yes: 2 No: 1
PI noted in the chart	Yes: 3 No: 0	Yes: 2 No: 1
Course change abeam Tangaflu Iso G 6s	Yes: 3 No: 0	Yes: 1 No: 2
General remarks and observations • As is visible in the screenshot showing the reference route, the area invites vessels to have a parallel course to land northbound along Leroey. This makes it easy to utilize both RADAR and optical control in this area. RADAR control by using a PI along land on the starboard side, and optical control by using half-a-point technique in relation with Tangaflu Iso G 6s. • From Tangaflu Iso G 6s it is possible to turn into two possible reference routes, one through Kobbeleia, and the other towards Vatlestraumen. Both reference routes have a turn abeam Tangaflu Iso G 6s.		

5.1.2 Raunefjorden south – From Tangaflu Iso G 6s to Rauneskjerane Oc 6s

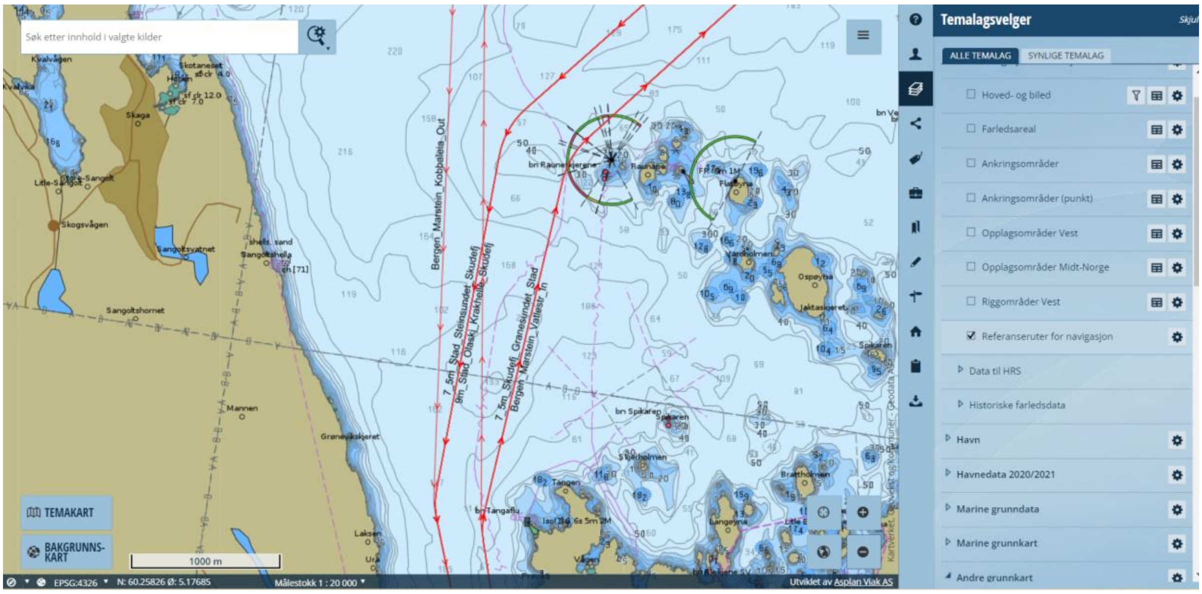

Figure 5-3 Screenshot of Raunefjorden south with reference routes from the online database "Kystinfo" provided by the Norwegian Coastal Administration

In this area, as shown in figure 5-3, there are two possible routes northbound to Bergen. In our exercise we will use the route closest to Rauneskjerane Oc 6s. If we use the same indexing as before the reference route is to the left in starboard 2, and the southbound route is in the centre of port 1.

The findings from this area are presented in table 5-2 "Findings from Raunefjorden south".

Table 5-2 Findings from Raunefjorden south

RAUNEFJORDEN SOUTH – From Tangaflu Iso G 6s to Rauneskjerane Oc 6s		
	Group 1 – with CNC	**Group 2 – without CNC**
Placement	Port 1: 2 Port 2: 1	Port 1: 0 Port 2: 3
Similar solution as reference route	Yes: 3 No: 0	Yes: 2 No: 1
PI noted in the chart	Yes: 2 No: 1	Yes: 1 No: 2
Heading-point to Fleslandsskjeret Oc (3) 10s	Yes: 3 No: 0	Yes: 3 No: 0
Course change abeam Rauneskjerane Oc 6s	Yes: 3 No: 0	Yes: 1 No: 2
General remarks and observations • As is visible in the screenshot showing the reference route, the north- and southbound reference route allows for a good flow of traffic in the area.		

- It is easy to utilize both RADAR and optical control in the area with PI or half-a-point technique used in relation to Rauneskjerane Oc 6s

5.1.3 Raunefjorden north – From Rauneskjerane Oc 6s to Fleslandsskjeret Oc (3) 10s

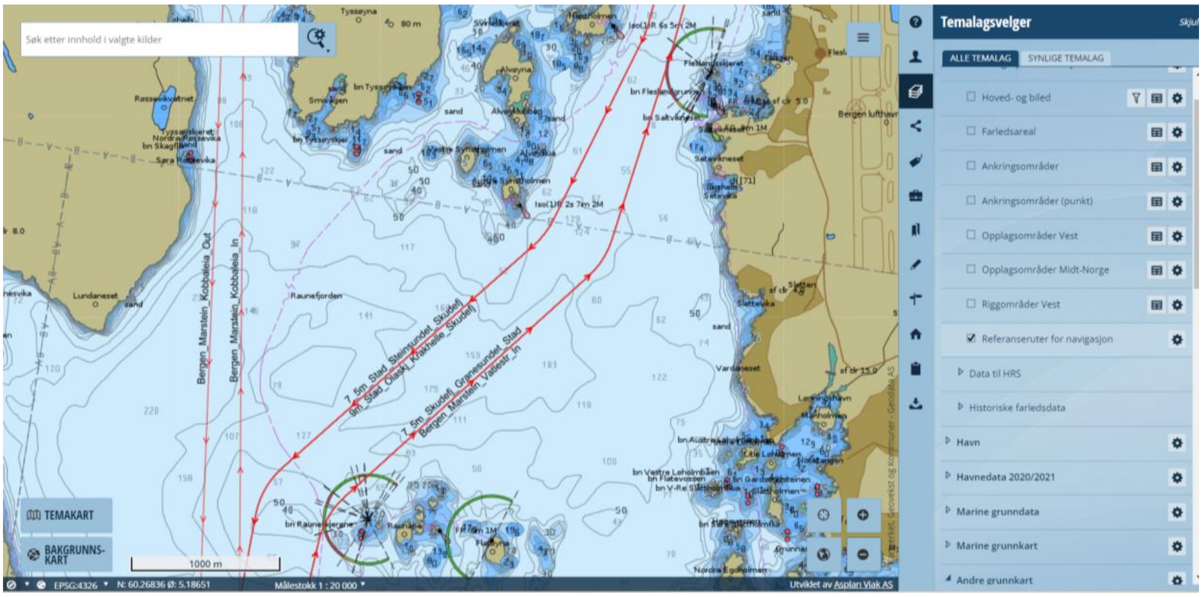

Figure 5-4 Screenshot of Raunefjorden north with reference routes from the online database "Kystinfo" provided by the Norwegian Coastal Administration

In this area, as shown in figure 5-4, the reference route is charted with consideration to the traffic situation in the area. The route opens up the fairway from Fleslandsskjeret and northbound, favouring a conflict free traffic situation between south- and northbound traffic in the area. The FG south of Fleslandsskjeret could have been used as a heading-point for optical reference, but instead it seems as Seteviksneset south of the FG is used as a heading-point on RADAR. If we define the northbound route to be in starboard 1, and the southbound route to be in port 2, the boarder between starboard 1 and port 1 is at 1/3 of the distance between the two reference routes.

The findings from this area are presented in table 5-3 “Findings from Raunefjorden north”.

Table 5-3 Findings from Raunefjorden north

RAUNEFJORDEN NORTH – From Rauneskjerane Oc 6s to Fleslandsskjeret Oc (3) 10s		
	Group 1 – with CNC	**Group 2 – without CNC**
Placement	Starboard 1: 2 Starboard 2: 1	Starboard 1: 2 Port 1 to port 2: 1
Similar solution as reference route	Yes: 0 No: 3	Yes: 0 No: 3
PI noted in the chart	Yes: 0 No: 3	Yes: 0 No: 3

<table>
<tr><td>Heading-point to Fleslandsskjeret Oc (3) 10s</td><td>Yes: 3
No: 0</td><td>Yes: 3
No: 0</td></tr>
<tr><td>Course change abeam Iso R 2s</td><td>Yes: 0
No: 3</td><td>Yes: 0
No: 3</td></tr>
<tr><td colspan="3">General remarks and observations
• In this area all participants chose to use a heading-point towards Fleslandsskjeret Oc (3) 10s. Thus, every participant places their vessel to the port side in the fairway.</td></tr>
</table>

5.1.4 Flesland - Hilleren – From Fleslandsskjeret Oc (3) 10s to Hilleren Oc (2) 8s

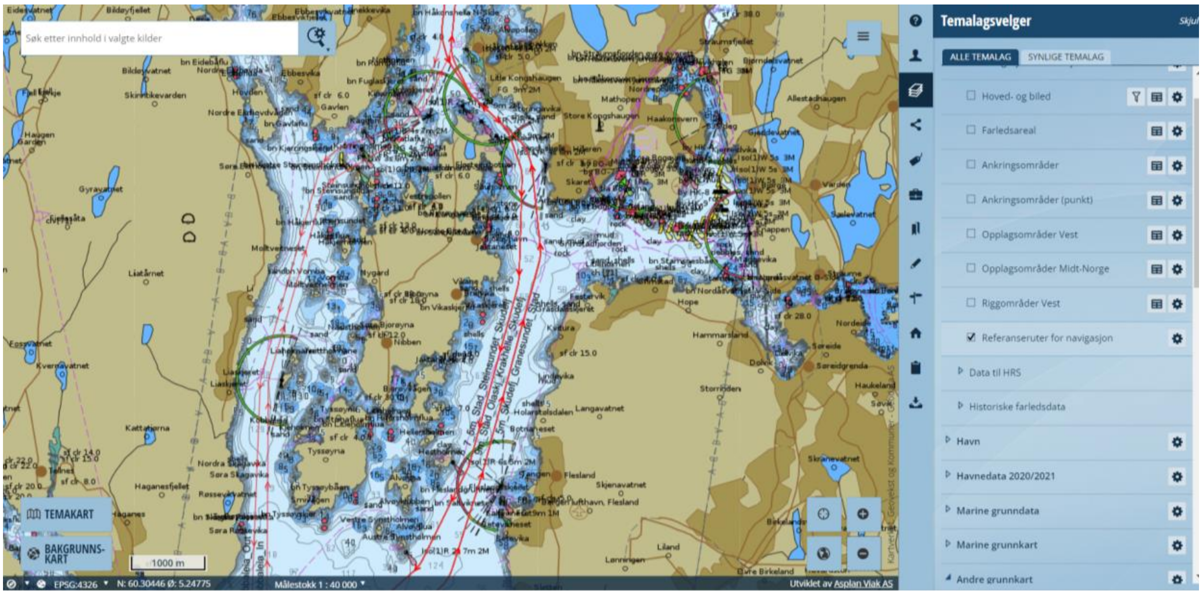

Figure 5-5 Screenshot of Flesland to Hilleren with reference routes from the online database "Kystinfo" provided by the Norwegian Coastal Administration

In this area, as shown in figure 5-5, the reference route is charted with two course legs. If we define the northbound route to be in starboard 1/border between starboard 1 and port 1, and the southbound route to be in port 2 for comparison.

The findings from this area are presented in table 5-4 "Findings from Flesland to Hilleren".

Table 5-4 Findings from Flesland to Hilleren

FLESLAND - HILLEREN – From Fleslandsskjeret Oc (3) 10s to Hilleren Oc (2) 8s		
	Group 1 – with CNC	**Group 2 – without CNC**
Placement	Starboard 1: 3 Starboard 2: 0	Starboard 1: 1 Port 1: 1 Port 2 to port 1: 1
Similar solution as reference route	Yes: 3 No: 0	Yes: 1 No: 2
PI noted in the chart	Yes: 0 No: 3	Yes: 0 No: 3
Heading-point on course leg one	Yes: 3 No: 0	Yes: 1 No: 2
Heading-point on course leg two	Yes: 3 No: 0	Yes: 1 No: 2
General remarks and observations • In this area there is a clear distinction regarding the placement in the fairway.		

5.1.5 Vatlestraumen – From Hilleren Oc (2) 8s to Haakonshella Iso G 4s

Figure 5-6 Screenshot of Vatlestraumen with reference routes from the online database "Kystinfo" provided by the Norwegian Coastal Administration

In this area, as shown in figure 5-6, both the south- and northbound reference route utilizes the small white sector in Hilleren Oc (2) 8s. If we call this the centre line, and the starboard area for starboard 1 and 2, and the port area for port 1 and 2.

The findings from this area are presented in table 5-5 "Findings from Vatlestraumen".

Table 5-5 Findings from Vatlestraumen

VATLESTRAUMEN – From Hilleren Oc (2) 8s to Haakonshella Iso G 4s		
	Group 1 – with CNC	**Group 2 – without CNC**
Placement	Port 1 to starboard 1: 1 Centre: 2	Port 1: 1 Centre: 1 Starboard 1 to port 1: 1
Similar solution as reference route	Yes: 3 No: 0	Yes: 1 No: 2
PI noted in the chart	Yes: 0 No: 3	Yes: 0 No: 3
Aft heading-point to Hilleren Oc (2) 8s	Yes: 3 No: 0	Yes: 1 No: 2
Course change abeam FG	Yes: 1 No: 2	Yes: 0 No: 3
General remarks and observations • The white sector from Hilleren sector light is the obvious choice on both north- and southbound routes through Vatlestraumen. This choice puts you in the centre of the fairway and allows for good optical control in an area with severe tidal currents.		

5.1.6 Brattholmen – From Haakonshella Iso G 4s to Stongi Oc 6s

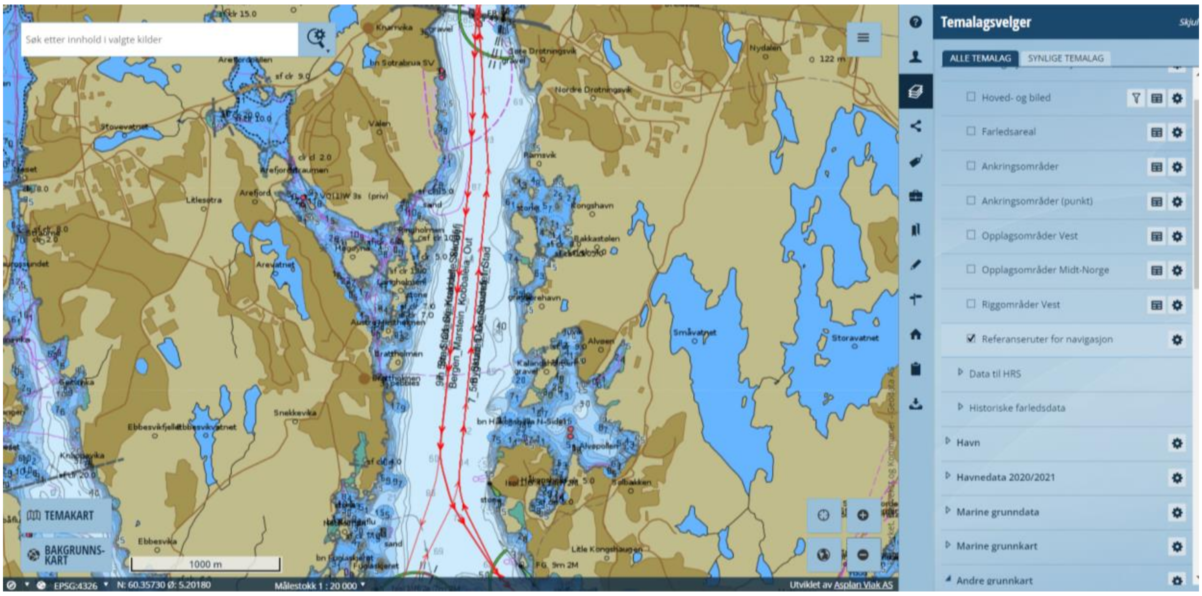

Figure 5-7 Screenshot of Brattholmen with reference routes from the online database "Kystinfo" provided by the Norwegian Coastal Administration

In this area, as shown in figure 5-7, the traffic is separated by Stongi Oc 6s leading northbound traffic towards Byfjorden, and Vonflua Oc 6s leading southbound traffic towards Kobbeleia and Vatlestraumen. If we define the reference routes to be at right side of starboard 1 and at the left side of port 1. The centre line between starboard and port are in the middle between the reference routes.

The findings from this area are presented in table 5-6 "Findings from Brattholmen".

Table 5-6 Findings from Brattholmen

BRATTHOLMEN – From Haakonshella Iso G 4s to Stongi Oc 6s		
	Group 1 – with CNC	**Group 2 – without CNC**
Placement	Starboard 1: 3	Port 1: 1 Starboard 1: 2
Similar solution as reference route	Yes: 2 No: 1	Yes: 1 No: 2
PI noted in the chart	Yes: 0 No: 3	Yes: 0 No: 3
Heading-point to Stongi Oc 6s	Yes: 2 No: 1	Yes: 1 No: 2
Course change abeam FG	Yes: 2 No: 1	Yes: 1 No: 2
General remarks and observations • When leaving Vatlestraumen it is normal to make a course change at the FG opening up for traffic. The next course change is made at Haakonshella Iso G 4, where it is normal to turn to a heading-point course towards Stongi Oc 6s. Just south		

of Ramsvik it is normal to change course towards the centre of the bridge. The participants have made some other choices in this area, in general those who does not have similar routes as the reference routes have continued on the same course as they left Vatlestraumen with, and thus not opened up the waters for southbound traffic.

5.1.7 General observations and remarks

In the previous sections the planned voyage has been broken up into smaller defined geographical parts. The reason for doing this is to be able to compare the reference route and the participants routes step-by-step through the planned voyage. It is also easier to make some short factual notes about each part, which then can be used when summarizing impressions and findings.

Based on the research question, the purpose of this study is to see if there are any noticeable differences in coastal navigational skills between students with the coastal navigational course, and students without the coastal navigational course. Even though the focus is differences, there are also some similarities which must be presented as findings and brought into the discussion part of the thesis. Especially the sloppy work done in the paper chart must be mentioned. This is a finding which is repeated among all the participants, some are sloppier than others, but the same inconsistencies and faults repeat themselves among all the participants. Typical examples are:

- Course changes without considering the advance of the vessel.
- Heading-points, and aft-heading-points which are off target.
- Course lines extended beyond the waypoint.
- Missing parallel index information for course legs where PI are a part of the voyage plan.
- Missing distance information for the course leg.

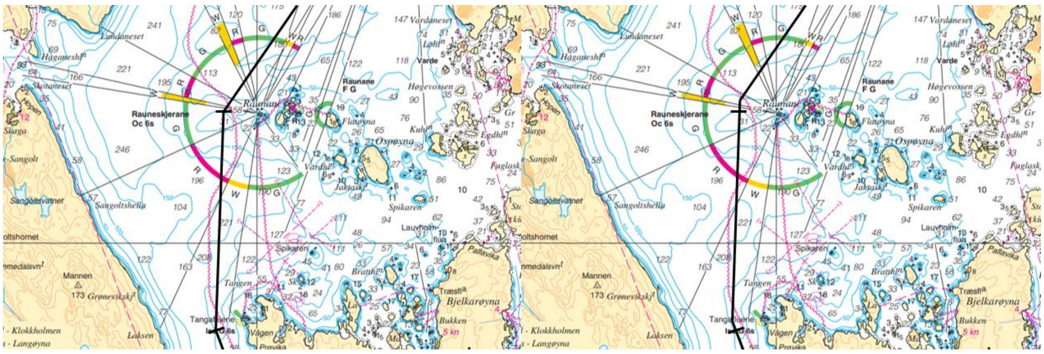

Figure 5-8 Charted course with and without advance - chart extract from Norwegian maritime chart number 21

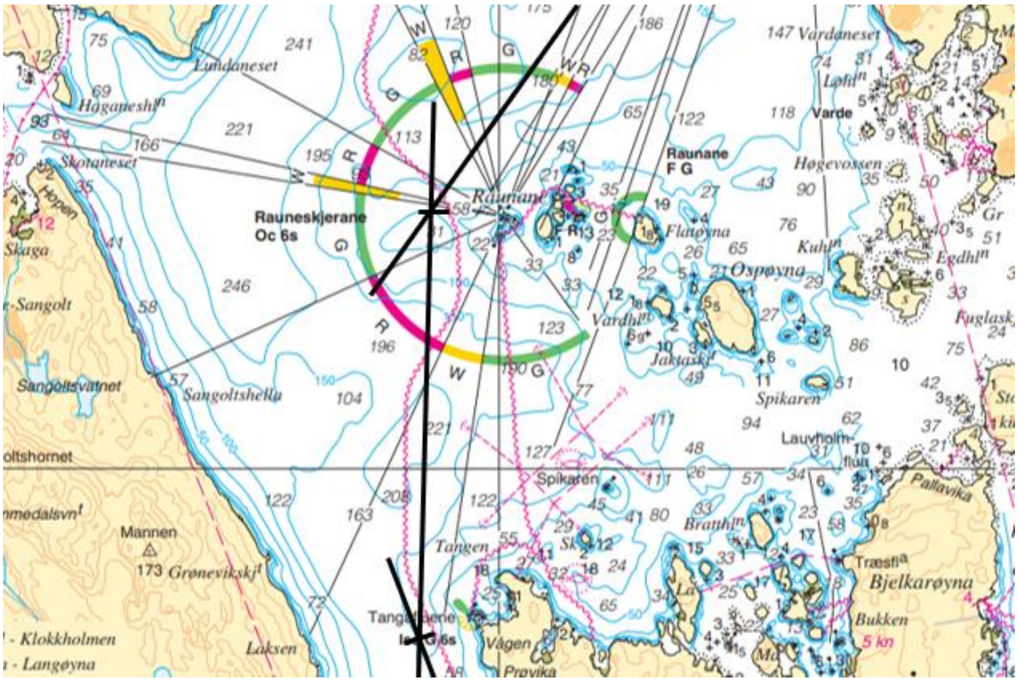

Figure 5-9 Example of sloppy chartwork - chart extract from Norwegian maritime chart number 21

Finding that the work done in the paper chart appears to be sloppy by all the participants was not anticipated. All the participants are third year students, and the participants with the coastal navigation course have been tested in planning a voyage in a paper chart as a part of their course examination. The reason for using the word sloppy to describe the work in the paper chart is because it could easily have been done better. Take planning course changes without considering the advance as an example. The courses charted in the paper chart are correct, but turning from one course to the next like it is presented in the chart is impossible. Every vessel has some advance from the wheel-over point and until the vessel is stable on the new course, not taking this into account when planning the voyage results in the vessel not being on the planned course after every course change. This is easily mended and taken into account, but it makes the work appear sloppy.

Every participant made a passage plan with information regarding each course leg. Participants with the coastal navigational course chose the setup used in the course, while the participants without the coastal navigational course had a more loose and diverse form in their passage plans. Based on these plans and the dialog during the planning session it appears that the key method of controlling whether the vessel is in the plan or not is a combination of heading-points and parallel indexes. When asked if a course was somewhat port in the fairway, the normal response was that this was not a problem, because all you needed to do was to deviate from your plan, on the other hand if the plan had been to starboard in the fairway, a deviation would perhaps not have been necessary.

In sum it appears that the group with the coastal navigation course have a tendency to place the charted course better in the fairway with consideration to meeting traffic, but the main impression is that none of the groups were considering traffic during their planning session. This is seen very clearly in their solution in Raunefjorden North. All the participants were focused on having a heading-point towards Fleslandsskjeret Oc(3) 10s, and at the same time closing the fairway for southbound traffic.

5.1.8 Summary of findings from the planning exercise

Based on the previous sections the following findings was discovered during the planning exercise:

Similarities among both groups

- The work done in the paper chart appears sloppy for both groups.
- Both groups used a passage plan with information about the voyage and the planned course legs.
- When asked about the placement of the charted course in the fairway, participants from both groups stated that it did not matter because all you needed to do was to deviate from the plan.
- None of the groups seems to focus on conflicting traffic in their planning, it appears that the considerations made in the planning process are based solely on navigation, and not a combination of navigation and traffic avoidance. There are several examples where the plans for both groups place the vessel in positions and areas which must be assumed is more naturally used by southbound vessels.

Possible differences between the groups

- It appears that the group with the coastal navigation course have a tendency to place their plan somewhat more to starboard in the fairway than the group without the coastal navigational course.
- It appears that the group with the coastal navigation course have a tendency to apply more heading-points and aft-heading-points into their plan than the group without the coastal navigation course.

5.2 Findings from the simulator exercises

Regarding the findings from the simulator exercise it could be possible to break this down to areas in the same way as is done with the planning exercise, but since there are not any other traffic in the simulator exercise, the voyages have mainly been according to the planned voyage. Therefore, it is deemed more useful to give some considerations based on the voyage as a whole, using the field notes and the recordings from the simulator exercises to summarize this impression.

In the simulation there was a gyro error of - 2°. This was introduced in order to see if any of the participants noticed this error. There were also placed two stopwatches on the chart table prior to the exercise, this was to see if any of the participants naturally chose to have an extra control on the time spent on each course leg.

Similarities among both groups

- Both groups use parallel indexes to control their voyage, but it seems like the group with the coastal navigational course is somewhat quicker in adding and removing the parallel indexes on the RADAR.
- None of the participants noticed the gyro error, which is a bit disturbing since all the participants at some point used a heading-point and simultaneously stated that they were moving along according to their plan.
- None of the participants used the available stopwatches as a mean of extra time control.
- It appears that participants from both of the groups often accepts being off from their charted course, either by accepting that the parallel index is at the wrong place, or by accepting that the heading-point is not at the correct bearing.
- It appears that participants from both groups often bases their decisions on the general impression given by the situation presented on the ECDIS and the RADAR screen, rather than an accurate measurement and control.
- None of the participants made an active effort positioning the vessel during the voyage, no bearings or distances were plotted into the ECDIS or into the paper chart to verify the vessels position in relation to the charted course.

Possible differences between the groups

- All of the participants in the group without the coastal navigational course used autopilot through Vatlestraumen, while the participants with the coastal navigation course chose to use manual steering through Vatlestraumen.
- It appears that the group with the coastal navigation course in sum is better placed in the fairway, keeping more to starboard.
- The participants with the coastal navigation course appear to make their turns at the right time and place their vessels better in the narrow fairway at Vatlestraumen.

5.3 Findings from the interview session

In this part findings from the interview session will be presented. As mentioned earlier, the first part of the interview is a debrief of the voyage and planning session. This means that depending on the participants experiences and reflections from the previous two parts, the interview can move in various directions.

The second part of the interview session is a pre-planned set of questions related to coastal navigational techniques. In order to grade the replies to these questions the following scale is used:

- Good and correct description
  - The question is answered in a good and correct way. The answer includes the use of the principle/technique in a practical way, it includes the strength and weaknesses of the principle/technique and the theory behind the principle/technique is described in a correct and understandable way.

- Adequate and almost correct description
  - The question is almost answered correctly. The answer includes the basic ideas of the principle/technique, but the strengths and weaknesses are not described sufficiently or the theory behind the principle/technique is not described correctly.

- Have heard of the principle but cannot describe it.
  - The participants have heard the name of the principle, and might have a vague idea of its use, but are not able to describe it or the theory behind it.

- Have never heard of the principle.
  - The participant has never heard of the principle/technique.

5.3.1 Debrief of the planning session and simulator exercise

In this part all of the participants express that they were content with their plans, they felt that the plans worked, and that the plan and the voyage was coherent. There are some suggestions about changing one or two waypoints in some of the plans, but other than that the participants would use the same plan if they were to do the simulator exercise once more.

There are no clear and noticeable differences between the two groups regarding their answers in the first part of the interview session. However, there is a notion that perhaps the participants with the coastal navigational course have a better vocabulary when describing their planning process and simulator exercise. This is not a definitive finding, but rather a notion or impression one is left with after listening to the interviews a couple of times.

5.3.2 Heading point

When describing heading point five out of six participants have a similar and good description. The sixth participant is not able to describe the technique, but since the other five have good and similar descriptions it is impossible to say whether there is a noticeable difference between the two groups.

The findings related to heading point are shown in table 5-7 “Heading point”.

Table 5-7 Heading point

HEADING-POINT		
	Group 1 – with CNC	**Group 2 – without CNC**
Good and correct description	3	2
Adequate and almost correct description		
Have heard of the principle but cannot describe it		1
Have never heard of the principle		

5.3.3 Cross bearings

When describing cross bearings those who achieve the top score often only mentions cross bearings with two bearings. When asked about three bearings they are able to explain this also, but the impression is that two bearings is their natural choice. When further asked about the optimal order for conducting bearings to three objects none of the participants are able to answer correctly, but this is a bit further than what the question initially indicates.

The findings related to cross bearings are shown in table 5-8 “Cross bearings”.

Table 5-8 Cross bearings

CROSS BEARINGS		
	Group 1 – with CNC	**Group 2 – without CNC**
Good and correct description	3	1
Adequate and almost correct description		1
Have heard of the principle but cannot describe it		1
Have never heard of the principle		

5.3.4 Four-point bearing

When describing four-point bearings many of the participants are unable to give a good explanation to what this is. Four-point bearing is not a commonly used technique, but it is taught at the first day of the coastal navigation course, and for the rest of the students it is taught/mentioned during their first year at HVL.

The findings related to four-point bearings are shown in table 5-9 "Four-point bearing"

Table 5-9 Four-point bearing

FOUR-POINT BEARING		
	Group 1 – with CNC	**Group 2 – without CNC**
Good and correct description	1	
Adequate and almost correct description		
Have heard of the principle but cannot describe it	2	
Have never heard of the principle		3

5.3.5 Running fix

When describing running fix there is a variation among the participants regarding their understanding of this method. Compared to four-point bearings a running fix is a more commonly used technique, in fact every line of position which is defined in a ECDIS system today could be the basis of a running fix since these lines of position moves based on course and speed as time passes.

The findings related to running fix are shown in table 5-10 “Running fix”.

Table 5-10 Running fix

RUNNING FIX		
	Group 1 – with CNC	**Group 2 – without CNC**
Good and correct description		
Adequate and almost correct description	1	
Have heard of the principle but cannot describe it	1	2
Have never heard of the principle	1	1

5.3.6 Half-a-point bearing

When describing half-a-point bearings there is a variation among the groups and within one group. This technique can be applied to various situations during coastal navigation, but as far as the researcher knows it is only taught at the coastal navigation course at HVL.

The findings from half-a-point bearings are shown in table 5-11 “Half-a-point bearing”.

Table 5-11 Half-a-point bearing

HALF-A-POINT BEARING		
	Group 1 – with CNC	**Group 2 – without CNC**
Good and correct description	1	
Adequate and almost correct description	1	
Have heard of the principle but cannot describe it	1	
Have never heard of the principle		3

5.3.7 The six-minute rule

When describing half-a-point bearings there is a variation among the groups regarding their knowledge of this rule. This rule is a simple way of making estimates regarding distances, and thus helping the navigator to plan ahead during the voyage.

The findings related to the six-minute rule are shown in table 5-12 “Six-minute rule”.

Table 5-12 Six-minute rule

SIX-MINUTE RULE		
	Group 1 – with CNC	**Group 2 – without CNC**
Good and correct description	1	
Adequate and almost correct description	1	
Have heard of the principle but cannot describe it	1	1
Have never heard of the principle		2

5.3.8 Using the RADAR to determine when to change course

When describing the use of RADAR as a turn indicator the main bulk of the participants do so in a very good way. It appears that there are no noticeable differences between the correct explanations from either group.

The findings related to the use of RADAR as a turn indicator are shown in table 5-13 "RADAR as a turn indicator".

Table 5-13 RADAR as a turn indicator

RADAR AS A TURN INDICATOR		
	Group 1 – with CNC	**Group 2 – without CNC**
Good and correct description	3	2
Adequate and almost correct description		
Have heard of the principle but cannot describe it		1
Have never heard of the principle		

5.3.9 Summary of findings from the interview

Based on the previous sections the following findings was discovered during the interview sessions:

Similarities among both groups

- Both groups seem content with their plan and performance in the simulator. Some minor alterations are mentioned, but in sum the participants from both groups would reuse the plan if they were to do the simulator exercise one more time.

Possible differences between the groups

- It appears that the group with the coastal navigation course have a wider knowledge about coastal navigational techniques than the group without the coastal navigation course.
- It appears that the variation in knowledge regarding coastal navigational techniques is larger in the group without the coastal navigation course.

5.4 Summary of findings

Based on the planning session, the simulator exercise and the interviews it seems as though there are more similarities than noticeable differences between the two groups. If we summarise the findings from each session, we get the following result:

Similarities among both groups

- The work done in the paper chart appears sloppy for both groups.
- Both groups used a passage plan with information about the voyage and the planned course legs.
- When asked about the placement of the charted course in the fairway, participants from both groups stated that it did not matter because all you needed to do was to deviate from the plan.
- None of the groups seems to focus on conflicting traffic in their planning, it appears that the considerations made in the planning process are based solely on navigation, and not a combination of navigation and traffic avoidance. There are several examples were the plans for both groups place the vessel in positions and areas which must be assumed is more naturally used by southbound vessels.
- Both groups use parallel indexes to control their voyage, but it seems like the group with the coastal navigational course is somewhat quicker in adding and removing the parallel indexes on the RADAR.
- None of the participants noticed the gyro error, which is a bit disturbing since all the participants at some point used a heading-point and simultaneously stated that they were moving along according to their plan.
- None of the participants used the available stopwatches as a means of extra time control.
- It appears that participants from both of the groups often accept being off their charted course, either by accepting that the parallel index is at the wrong place, or by accepting that the heading-point is not at the correct bearing.
- It appears that participants from both groups often bases their decisions on the general impression given by the situation presented on the ECDIS and the RADAR screen, rather than an accurate measurement and control.

- None of the participants made an active effort positioning the vessel during the voyage, no bearings or distances were plotted into the ECDIS or into the paper chart to verify the vessels position in relation to the charted course.
- Both groups seem content with their plan and performance in the simulator. Some minor alterations are mentioned, but in sum; participants from both groups would reuse the plan if they were to do the simulator exercise one more time.

Possible differences between the groups

- It appears that the group with the coastal navigation course have a tendency to place their plan somewhat more to starboard in the fairway than the group without the coastal navigational course.
- It appears that the group with the coastal navigation course have a tendency to apply more heading-points and aft-heading-points into their plan than the group without the coastal navigation course.
- All of the participants in the group without the coastal navigational course used autopilot through Vatlestraumen, while the participants with the coastal navigation course chose to use manual steering through Vatlestraumen.
- It appears that the group with the coastal navigation course in sum is better placed in the fairway, keeping more to starboard.
- The participants with the coastal navigation course appear to make their turns at the right time and place their vessels better in the narrow fairway at Vatlestraumen.
- It appears that the group with the coastal navigation course have a better knowledge about coastal navigational techniques than the group without the coastal navigation course.
- It appears that the variation in knowledge regarding coastal navigational techniques is larger in the group without the coastal navigation course.

6 Conclusion

If we return to the very beginning of this study and have a look at the research focus and research question presented in chapter 1.2, we find that:

The main focus of this research is to find whether there are any aspects related to coastal navigation skills which are in need for further exploration and research. This could be related to skills and knowledge related to coastal navigation, how we teach coastal navigation, and what the student actually learns regarding coastal navigation.

The research question will therefore be: Is there a noticeable difference in coastal navigational skills between the students who have attended the coastal navigation course at HVL and the students who has not attended the course?

The conclusion part of this thesis will be divided into sub-chapters. In the first chapter conclusions related to the research question will be presented, and in the second chapter observations and conclusions not directly related to the research question will be presented, in the third and last sub-chapter recommended future work will be presented.

6.1 Conclusions related to the research question

The key element in the research question is to determine whether there are any *noticeable differences* between the two groups which have participated in the research. The simple answer to this question is no, there is no such differences, or at least not any differences which could be described as so clear or apparent that they could be described as noticeable. There is off course the clear difference with the use of manual rudder or autopilot in Vatlestraumen, but to define this alone as a *noticeable difference* in coastal navigation skill would be to look for clear differences which are not there. That being said, there are differences between the two groups, but they are vaguer, like tendencies and hints of something rather than a clear and definable difference.

The small number of participants makes it harder to determine whether a difference is noticeable or vague. Perhaps a larger number of participants would help to clarify this image, but with small groups, and a variation in skills inside the groups as well, it is hard to say if a difference is representative for the entire group or not. The impression is that the group with the coastal navigation course is more equally matched compared to the group without the coastal navigation course, it is also an impression that the group with the coastal navigation course in sum appears to have a higher coastal navigation skill level, but it is impossible to conclude based on the number of participants and data collected in this study. This tendency could easily be a result of the spaced repetition effect, since the group with the coastal navigation course have had a more resent repetition of coastal navigation compared to the other group.

So, to answer the research question, the answer is no there is no noticeable difference in coastal navigational skills between the two groups which have participated in this study, but there is a hint or resemblance of a difference, but it is inconclusive.

6.2 Conclusions and observations not directly related to the research question

When allowing people to unfold themselves and solve a nautical task in whatever way they prefer, observations and findings which you never expected might appear. Even though it was impossible to conclude whether there are any noticeable differences or not, it is possible to identify some similarities which should be mentioned in this part of the thesis. The most identifiable, and perhaps surprising, similarity was the sloppy work done in the paper charts. This combined with the general impression that the participants where content with their performance, the lack of positioning of the vessels, accepting being off course, and that they often seemed to be making decisions based on the visual impression presented by the ECDIS and the RADAR might indicate that the participants does not consider the consequences of a collision during simulator training as “serious” enough to perform at their best. To maximize the effect of simulations it is important that the participants are able to participate fully and realistically in the exercise.

6.3 Recommendations for further studies

Regarding the subject coastal navigation, the following recommendations for further studies could be useful:

- A study directed at determining the level of optical coastal navigational skills among nautical students. Focusing on terrestrial navigation without ECDIS and RADAR support to identify the level of coastal navigational skill.
- A study directed at the effect of spaced repetitions in nautical education – does the current curriculum allows for spaced repetition of basic skills.

- The future OOW – a skilled navigator or a skilled systems operator – what do we want?

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8 Appendices

8.1 Appendix A - STCW Code Table A-II/1

STCW Code Table A-II/1

Specification of minimum standard of competence for officers in charge of a navigational watch on ships of 500 gross tonnage or more

Ref: https://www.edumaritime.net/stcw-code

Source: http://www.imo.org

Function: Navigation at the operational level

Column 1	Column 2	Column 3	Column 4
Competence	**Knowledge, understanding and proficiency**	**Methods for demonstrating competence**	**Criteria for evaluating competence**
Plan and conduct a passage and determine position	*Celestial navigation* Ability to use celestial bodies to determine the ship's position *Terrestrial and coastal navigation* Ability to determine the ship's position by use of: .1 landmarks .2 aids to navigation, including lighthouses, beacons and buoys .3 dead reckoning, taking into account winds, tides, currents and estimated speed	Examination and assessment of evidence obtained from one or more of the following: .1 approved in-service experience .2 approved training ship experience .3 approved simulator training, where appropriate .4 approved laboratory equipment training using chart catalogues, charts, nautical publications, radio navigational warnings, sextant, azimuth mirror, electronic navigation equipment, echo-sounding equipment, compass	The information obtained from nautical charts and publications is relevant, interpreted correctly and properly applied. All potential navigational hazards are accurately identified The primary method of fixing the ship's position is the most appropriate to the prevailing circumstances and conditions The position is determined within the limits of acceptable instrument/system errors The reliability of the information obtained from the primary method of position fixing is checked at appropriate intervals Calculations and measurements of navigational information are accurate
	Thorough knowledge of and ability to use nautical charts, and publications, such as sailing directions, tide tables, notices to mariners, radio navigational warnings and ships' routeing information *Electronic systems of position fixing and navigation*		The charts selected are the largest scale suitable for the area of navigation and charts and publications are corrected in accordance with the latest information available

Column 1	Column 2	Column 3	Column 4
Competence	**Knowledge, understanding and proficiency**	**Methods for demonstrating competence**	**Criteria for evaluating competence**
	Ability to determine the ship's position by use of electronic navigational aids		Performance checks and tests to navigation systems comply with manufacturer's recommendations and good navigational practice
Plan and conduct a passage and determine position (*continued*)	*Echo-sounders* Ability to operate the equipment and apply the information correctly *Compass – magnetic and gyro* Knowledge of the principles of magnetic and gyro-compasses		
	Ability to determine errors of the magnetic and gyro-compasses, using celestial and terrestrial means, and to allow for such errors		Errors in magnetic and gyro-compasses are determined and correctly applied to courses and bearings
	Steering control system Knowledge of steering control systems, operational procedures and change-over from manual to automatic control and vice versa. Adjustment of controls for optimum performance		The selection of the mode of steering is the most suitable for the prevailing weather, sea and traffic conditions and intended manoeuvres
	Meteorology Ability to use and interpret information obtained from shipborne meteorological instruments		Measurements and observations of weather conditions are accurate and appropriate to the passage
	Knowledge of the characteristics of the various weather systems, reporting procedures and recording systems		
	Ability to apply the meteorological information available		Meteorological information is correctly interpreted and applied

Column 1	Column 2	Column 3	Column 4
Competence	**Knowledge, understanding and proficiency**	**Methods for demonstrating competence**	**Criteria for evaluating competence**
Maintain a safe navigational watch	*Watchkeeping* Thorough knowledge of the content, application and intent of the International Regulations for Preventing Collisions at Sea, 1972, as amended Thorough knowledge of the Principles to be observed in keeping a navigational watch The use of routeing in accordance with the General Provisions on Ships' Routeing The use of information from navigational equipment for maintaining a safe navigational watch Knowledge of blind pilotage techniques The use of reporting in accordance with the General Principles for Ship Reporting Systems and with VTS procedures	Examination and assessment of evidence obtained from one or more of the following: .1 approved in-service experience; .2 approved training ship experience .3 approved simulator training, where appropriate .4 approved laboratory equipment training	The conduct, handover and relief of the watch conforms with accepted principles and procedures A proper look-out is maintained at all times and in such a way as to conform to accepted principles and procedures Lights, shapes and sound signals conform with the requirements contained in the International Regulations for Preventing Collisions at Sea, 1972, as amended, and are correctly recognized The frequency and extent of monitoring of traffic, the ship and the environment conform with accepted principles and procedures A proper record is maintained of the movements and activities relating to the navigation of the ship Responsibility for the safety of navigation is clearly defined at all times, including periods when the master is on the bridge and while under pilotage

Column 1	Column 2	Column 3	Column 4
Competence	**Knowledge, understanding and proficiency**	**Methods for demonstrating competence**	**Criteria for evaluating competence**
Maintain a safe navigational watch *(continued)*	*Bridge resource management* Knowledge of bridge resource management principles, including: .1 allocation, assignment, and prioritization of resources .2 effective communication .3 assertiveness and leadership .4 obtaining and maintaining situational awareness .5 consideration of team experience	Assessment of evidence obtained from one or more of the following: .1 approved training .2 approved in-service experience .3 approved simulator training	Resources are allocated and assigned as needed in correct priority to perform necessary tasks Communication is clearly and unambiguously given and received Questionable decisions and/or actions result in appropriate challenge and response Effective leadership behaviours are identified Team member(s) share accurate understanding of current and predicted vessel state, navigation path, and external environment
Use of radar and ARPA to maintain safety of navigation *Note*: Training and assessment in the use of ARPA is not required for those who serve exclusively on ships not fitted with ARPA. This limitation shall be reflected in the endorsement issued to the seafarer concerned	*Radar navigation* Knowledge of the fundamentals of radar and automatic radar plotting aids (ARPA) Ability to operate and to interpret and analyse information obtained from radar, including the following: Performance, including: .1 factors affecting performance and accuracy .2 setting up and maintaining displays .3 detection of misrepresentation of information, false echoes, sea return, etc., racons and SARTs	Assessment of evidence obtained from approved radar simulator and ARPA simulator plus in-service experience	Information obtained from radar and ARPA is correctly interpreted and analysed, taking into account the limitations of the equipment and prevailing circumstances and conditions

Column 1	Column 2	Column 3	Column 4
Competence	**Knowledge, understanding and proficiency**	**Methods for demonstrating competence**	**Criteria for evaluating competence**
Use of radar and ARPA to maintain safety of navigation *(continued)* *Note*: Training and assessment in the use of ARPA is not required for those who serve exclusively on ships not fitted with ARPA. This limitation shall be reflected in the endorsement issued to the seafarer concerned	Use, including: .1 range and bearing; course and speed of other ships; time and distance of closest approach of crossing, meeting overtaking ships .2 identification of critical echoes; detecting course and speed changes of other ships; effect of changes in own ship's course or speed or both .3 application of the International Regulations for Preventing Collisions at Sea, 1972, as amended .4 plotting techniques and relative- and true-motion concepts .5 parallel indexing		Action taken to avoid a close encounter or collision with other vessels is in accordance with the International Regulations for Preventing Collisions at Sea, 1972, as amended Decisions to amend course and/or speed are both timely and in accordance with accepted navigation practice Adjustments made to the ship's course and speed maintain safety of navigation Communication is clear, concise and acknowledged at all times in a seamanlike manner Manoeuvring signals are made at the appropriate time and are in accordance with the International Regulations for Preventing Collisions at Sea, 1972, as amended

Column 1	Column 2	Column 3	Column 4
Competence	**Knowledge, understanding and proficiency**	**Methods for demonstrating competence**	**Criteria for evaluating competence**
Use of radar and ARPA to maintain safety of navigation (*continued*) *Note*: Training and assessment in the use of ARPA is not required for those who serve exclusively on ships not fitted with ARPA. This limitation shall be reflected in the endorsement issued to the seafarer concerned	Principal types of ARPA, their display characteristics, performance standards and the dangers of over-reliance on ARPA Ability to operate and to interpret and analyse information obtained from ARPA, including: .1 system performance and accuracy, tracking capabilities and limitations, and processing delays .2 use of operational warnings and system tests .3 methods of target acquisition and their limitations .4 true and relative vectors, graphic representation of target information and danger areas .5 deriving and analysing information, critical echoes, exclusion areas and trial manoeuvres		
Use of ECDIS to maintain the safety of navigation Note: Training and assessment in the use of ECDIS is not required for those who serve exclusively on ships not fitted with ECDIS These limitations shall be reflected in the endorsements issued to the seafarer concerned	*Navigation using ECDIS* Knowledge of the capability and limitations of ECDIS operations, including: .1 a thorough understanding of Electronic Navigational Chart (ENC) data, data accuracy, presentation rules, display options and other chart data formats .2 the dangers of over-reliance .3 familiarity with the functions of ECDIS	Examination and assessment of evidence obtained from one or more of the following: .1 approved training ship experience .2 approved ECDIS simulator training	Monitors information on ECDIS in a manner that contributes to safe navigation Information obtained from ECDIS (including radar overlay and/or radar tracking functions, when fitted) is correctly interpreted and analysed, taking into account the limitations of the equipment, all connected sensors (including radar and AIS where interfaced), and prevailing circumstances and conditions

Column 1	Column 2	Column 3	Column 4
Competence	**Knowledge, understanding and proficiency**	**Methods for demonstrating competence**	**Criteria for evaluating competence**
	required by performance standards in force Proficiency in operation, interpretation, and analysis of information obtained from ECDIS, including: .1 use of functions that are integrated with other navigation systems in various installations, including proper functioning and adjustment to desired settings .2 safe monitoring and adjustment of information, including own position, sea area display, mode and orientation, chart data displayed, route monitoring, user-created information layers, contacts (when interfaced with AIS and/or radar tracking) and radar overlay functions (when interfaced) .3 confirmation of vessel position by alternative means .4 efficient use of settings to ensure conformance to operational procedures, including alarm parameters for anti-grounding, proximity to contacts and special areas, completeness of chart data and chart update status, and backup arrangements .5 adjustment of settings and values to suit the present conditions		Safety of navigation is maintained through adjustments made to the ship's course and speed through ECDIS-controlled track-keeping functions (when fitted) Communication is clear, concise and acknowledged at all times in a seamanlike manner

Column 1	Column 2	Column 3	Column 4
Competence	**Knowledge, understanding and proficiency**	**Methods for demonstrating competence**	**Criteria for evaluating competence**
Use of ECDIS to maintain the safety of navigation *(continued)*	.6 situational awareness while using ECDIS including safe water and proximity of hazards, set and drift, chart data and scale selection, suitability of route, contact detection and management, and integrity of sensors		
Respond to emergencies	*Emergency procedures* Precautions for the protection and safety of passengers in emergency situations Initial action to be taken following a collision or a grounding; initial damage assessment and control Appreciation of the procedures to be followed for rescuing persons from the sea, assisting a ship in distress, responding to emergencies which arise in port	Examination and assessment of evidence obtained from one or more of the following: .1 approved in-service experience .2 approved training ship experience .3 approved simulator training, where appropriate .4 practical training	The type and scale of the emergency is promptly identified Initial actions and, if appropriate, manoeuvring of the ship are in accordance with contingency plans and are appropriate to the urgency of the situation and nature of the emergency
Respond to a distress signal at sea	*Search and rescue* Knowledge of the contents of the International Aeronautical and Maritime Search and Rescue (IAMSAR) Manual	Examination and assessment of evidence obtained from practical instruction or approved simulator training, where appropriate	The distress or emergency signal is immediately recognized Contingency plans and instructions in standing orders are implemented and complied with

Column 1	Column 2	Column 3	Column 4
Competence	**Knowledge, understanding and proficiency**	**Methods for demonstrating competence**	**Criteria for evaluating competence**
Use the IMO Standard Marine Communication Phrases and use English in written and oral form	*English language* Adequate knowledge of the English language to enable the officer to use charts and other nautical publications, to understand meteorological information and messages concerning ship's safety and operation, to communicate with other ships, coast stations and VTS centres and to perform the officer's duties also with a multilingual crew, including the ability to use and understand the IMO Standard Marine Communication Phrases (IMO SMCP)	Examination and assessment of evidence obtained from practical instruction	English language nautical publications and messages relevant to the safety of the ship are correctly interpreted or drafted Communications are clear and understood
Transmit and receive information by visual signalling	*Visual signalling* Ability to use the International Code of Signals Ability to transmit and receive, by Morse light, distress signal SOS as specified in Annex IV of the International Regulations for Preventing Collisions at Sea, 1972, as amended, and appendix 1 of the International Code of Signals, and visual signalling of single-letter signals as also specified in the International Code of Signals	Assessment of evidence obtained from practical instruction and/or simulation	Communications within the operator's area of responsibility are consistently successful

Column 1	Column 2	Column 3	Column 4
Competence	**Knowledge, understanding and proficiency**	**Methods for demonstrating competence**	**Criteria for evaluating competence**
Manoeuvre the ship	*Ship manoeuvring and handling* Knowledge of: .1 the effects of deadweight, draught, trim, speed and under-keel clearance on turning circles and stopping distances .2 the effects of wind and current on ship handling .3 manoeuvres and procedures for the rescue of person overboard .4 squat, shallow-water and similar effects .5 proper procedures for anchoring and mooring	Examination and assessment of evidence obtained from one or more of the following: .1 approved in-service experience .2 approved training ship experience .3 approved simulator training, where appropriate .4 approved training on a manned scale ship model, where appropriate	Safe operating limits of ship propulsion, steering and power systems are not exceeded in normal manoeuvres Adjustments made to the ship's course and speed to maintain safety of navigation

8.2 Appendix B - STCW Code Table A-II/2

STCW Code Table A-II/2

Specification of Minimum Standard of Competence for Masters and Chief Mates on Ships of 500 Gross Tonnage or More

Ref: https://www.edumaritime.net/stcw-code

Source: http://www.imo.org

Function: Navigation at the management level

Column 1	Column 2	Column 3	Column 4
Competence	**Knowledge, understanding and proficiency**	**Methods for demonstrating competence**	**Criteria for evaluating competence**
Plan a voyage and conduct navigation	Voyage planning and navigation for all conditions by acceptable methods of plotting ocean tracks, taking into account, e.g.: .1 restricted waters .2 meteorological conditions .3 ice .4 restricted visibility .5 traffic separation schemes .6 vessel traffic service (VTS) areas .7 areas of extensive tidal effects Routeing in accordance with the General Provisions on Ships' Routeing Reporting in accordance with the General principles for Ship Reporting Systems and with VTS procedures	Examination and assessment of evidence obtained from one or more of the following: .1 approved in-service experience .2 approved simulator training, where appropriate .3 approved laboratory equipment training using: chart catalogues, charts, nautical publications and ship particulars	The equipment, charts and nautical publications required for the voyage are enumerated and appropriate to the safe conduct of the voyage The reasons for the planned route are supported by facts and statistical data obtained from relevant sources and publications Positions, courses, distances and time calculations are correct within accepted accuracy standards for navigational equipment All potential navigational hazards are accurately identified
Determine position and the accuracy of resultant position fix by any means	Position determination in all conditions: .1 by celestial observations .2 by terrestrial observations, including the ability to use appropriate charts, notices to mariners and other publications to assess the accuracy of the resulting position fix .3 using modern electronic	Examination and assessment of evidence obtained from one or more of the following: .1 approved in-service experience .2 approved simulator training, where appropriate .3 approved laboratory equipment training	The primary method chosen for fixing the ship's position is the most appropriate to the prevailing circumstances and conditions The fix obtained by celestial observations is within accepted accuracy levels The fix obtained by terrestrial observations is

Column 1 Competence	Column 2 Knowledge, understanding and proficiency	Column 3 Methods for demonstrating competence	Column 4 Criteria for evaluating competence
	navigational aids, with specific knowledge of their operating principles, limitations, sources of error, detection of misrepresentation of information and methods of correction to obtain accurate position fixing	using: .1 charts, nautical almanac, plotting sheets, chronometer, sextant and a calculator .2 charts, nautical publications and navigational instruments (azimuth mirror, sextant, log, sounding equipment, compass) and manufacturers' manuals .3 radar, terrestrial electronic position-fixing systems, satellite navigation systems and appropriate nautical charts and publications	within accepted accuracy levels The accuracy of the resulting fix is properly assessed The fix obtained by the use of electronic navigational aids is within the accuracy standards of the systems in use. The possible errors affecting the accuracy of the resulting position are stated and methods of minimizing the effects of system errors on the resulting position are properly applied
Determine and allow for compass errors	Ability to determine and allow for errors of the magnetic and gyro-compasses Knowledge of the principles of magnetic and gyro-compasses An understanding of systems under the control of the master gyro and a knowledge of the operation and care of the main types of gyro-compass	Examination and assessment of evidence obtained from one or more of the following: .1 approved in-service experience .2 approved simulator training, where appropriate .3 approved laboratory equipment training using: celestial observations, terrestrial bearings and comparison between magnetic and gyro-compasses	The method and frequency of checks for errors of magnetic and gyro-compasses ensures accuracy of information

Column 1 **Competence**	Column 2 **Knowledge, understanding and proficiency**	Column 3 **Methods for demonstrating competence**	Column 4 **Criteria for evaluating competence**
Coordinate search and rescue operations	A thorough knowledge of and ability to apply the procedures contained in the International Aeronautical and Maritime Search and Rescue (IAMSAR) Manual	Examination and assessment of evidence obtained from one or more of the following: .1 approved in-service experience .2 approved simulator training, where appropriate .3 approved laboratory equipment training using: relevant publications, charts, meteorological data, particulars of ships involved, radiocommunication equipment and other available facilities and one or more of the following: .1 approved SAR training course .2 approved simulator training, where appropriate .3 approved laboratory equipment training	The plan for coordinating search and rescue operations is in accordance with international guidelines and standards Radiocommunications are established and correct communication procedures are followed at all stages of the search and rescue operations
Establish watchkeeping arrangements and procedures	Thorough knowledge of content, application and intent of the International Regulations for Preventing Collisions at Sea, 1972, as amended Thorough knowledge of the content, application and intent of the Principles to be observed in keeping a navigational watch	Examination and assessment of evidence obtained from one or more of the following: .1 approved in-service experience .2 approved simulator training, where appropriate	Watchkeeping arrangements and procedures are established and maintained in compliance with international regulations and guidelines so as to ensure the safety of navigation, protection of the marine environment and safety of the ship and persons on board

Column 1	Column 2	Column 3	Column 4
Competence	**Knowledge, understanding and proficiency**	**Methods for demonstrating competence**	**Criteria for evaluating competence**
Maintain safe navigation through the use of information from navigation equipment and systems to assist command decision making *Note*: Training and assessment in the use of ARPA is not required for those who serve exclusively on ships not fitted with ARPA. This limitation shall be reflected in the endorsement issued to the seafarer concerned	An appreciation of system errors and thorough understanding of the operational aspects of navigational systems Blind pilotage planning Evaluation of navigational information derived from all sources, including radar and ARPA, in order to make and implement command decisions for collision avoidance and for directing the safe navigation of the ship The interrelationship and optimum use of all navigational data available for conducting navigation	Examination and assessment of evidence obtained from approved ARPA simulator and one or more of the following: .1 approved in-service experience .2 approved simulator training, where appropriate .3 approved laboratory equipment training	Information obtained from navigation equipment and systems is correctly interpreted and analysed, taking into account the limitations of the equipment and prevailing circumstances and conditions Action taken to avoid a close encounter or collision with another vessel is in accordance with the International Regulations for Preventing Collisions at Sea, 1972, as amended
Maintain the safety of navigation through the use of ECDIS and associated navigation systems to assist command decision making Note: Training and assessment in the use of ECDIS is not required for those who serve exclusively on ships not fitted with ECDIS. This limitation shall be reflected in the endorsement issued to the seafarer concerned	Management of operational procedures, system files and data, including: .1 manage procurement, licensing and updating of chart data and system software to conform to established procedures .2 system and information updating, including the ability to update ECDIS system version in accordance with vendor's product development .3 create and maintain system configuration and backup files .4 create and maintain log files in accordance with established procedures .5 create and maintain route plan files in accordance with established procedures	Assessment of evidence obtained from one of the following: .1 approved in-service experience .2 approved training ship experience .3 approved ECDIS simulator training	Operational procedures for using ECDIS are established, applied, and monitored Actions taken to minimize risk to safety of navigation

Column 1	Column 2	Column 3	Column 4
Competence	**Knowledge, understanding and proficiency**	**Methods for demonstrating competence**	**Criteria for evaluating competence**
	.6 use ECDIS log-book and track history functions for inspection of system functions, alarm settings and user responses Use ECDIS playback functionality for passage review, route planning and review of system functions		
Forecast weather and oceanographic conditions	Ability to understand and interpret a synoptic chart and to forecast area weather, taking into account local weather conditions and information received by weather fax Knowledge of the characteristics of various weather systems, including tropical revolving storms and avoidance of storm centres and the dangerous quadrants Knowledge of ocean current systems Ability to calculate tidal conditions Use all appropriate nautical publications on tides and currents	Examination and assessment of evidence obtained from one or more of the following: .1 approved in-service experience .2 approved laboratory equipment training	The likely weather conditions predicted for a determined period are based on all available information Actions taken to maintain safety of navigation minimize any risk to safety of the ship Reasons for intended action are backed by statistical data and observations of the actual weather conditions
Respond to navigational emergencies	Precautions when beaching a ship Action to be taken if grounding is imminent, and after grounding Refloating a grounded ship with and without assistance Action to be taken if collision is imminent and following a collision or impairment of the watertight integrity of the hull by any cause	Examination and assessment of evidence obtained from practical instruction, in-service experience and practical drills in emergency procedures	The type and scale of any problem is promptly identified and decisions and actions minimize the effects of any malfunction of the ship's systems Communications are effective and comply with established procedures Decisions and actions maximize safety of persons on board

Column 1	Column 2	Column 3	Column 4
Competence	**Knowledge, understanding and proficiency**	**Methods for demonstrating competence**	**Criteria for evaluating competence**
	Assessment of damage control Emergency steering Emergency towing arrangements and towing procedure		
Manoeuvre and handle a ship in all conditions	Manoeuvring and handling a ship in all conditions, including: .1 manoeuvres when approaching pilot stations and embarking or disembarking pilots, with due regard to weather, tide, headreach and stopping distances .2 handling ship in rivers, estuaries and restricted waters, having regard to the effects of current, wind and restricted water on helm response .3 application of constant-rate-of-turn techniques .4 manoeuvring in shallow water, including the reduction in under-keel clearance caused by squat, rolling and pitching .5 interaction between passing ships and between own ship and nearby banks (canal effect) .6 berthing and unberthing under various conditions of wind, tide and current with and without tugs .7 ship and tug interaction .8 use of propulsion and manoeuvring systems	Examination and assessment of evidence obtained from one or more of the following: .1 approved in-service experience .2 approved simulator training, where appropriate .3 approved manned scale ship model, where appropriate	All decisions concerning berthing and anchoring are based on a proper assessment of the ship's manoeuvring and engine characteristics and the forces to be expected while berthed alongside or lying at anchor While under way, a full assessment is made of possible effects of shallow and restricted waters, ice, banks, tidal conditions, passing ships and own ship's bow and stern wave so that the ship can be safely manoeuvred under various conditions of loading and weather

Column 1	Column 2	Column 3	Column 4
Competence	**Knowledge, understanding and proficiency**	**Methods for demonstrating competence**	**Criteria for evaluating competence**
Manoeuvre and handle a ship in all conditions *(continued)*	.9 choice of anchorage; anchoring with one or two anchors in limited anchorages and factors involved in determining the length of anchor cable to be used .10 dragging anchor; clearing fouled anchors .11 dry-docking, both with and without damage .12 management and handling of ships in heavy weather, including assisting a ship or aircraft in distress; towing operations; means of keeping an unmanageable ship out of trough of the sea, lessening drift and use of oil .13 precautions in manoeuvring to launch rescue boats or survival craft in bad weather .14 methods of taking on board survivors from rescue boats and survival craft .15 ability to determine the manoeuvring and propulsion characteristics of common types of ships, with special reference to stopping distances and turning circles at various draughts and speeds .16 importance of navigating at reduced speed to avoid damage caused by own ship's bow wave and stern wave		

Column 1	Column 2	Column 3	Column 4
Competence	**Knowledge, understanding and proficiency**	**Methods for demonstrating competence**	**Criteria for evaluating competence**
Manoeuvre and handle a ship in all conditions (*continued*)	.17 practical measures to be taken when navigating in or near ice or in conditions of ice accumulation on board .18 use of, and manoeuvring in and near, traffic separation schemes and in vessel traffic service (VTS) areas		
Operate remote controls of propulsion plant and engineering systems and services	Operating principles of marine power plants Ships' auxiliary machinery General knowledge of marine engineering terms	Examination and assessment of evidence obtained from one or more of the following: .1 approved in-service experience .2 approved simulator training, where appropriate	Plant, auxiliary machinery and equipment is operated in accordance with technical specifications and within safe operating limits at all times

8.3 Appendix C - STCW Code Table B-II/1

STCW Code Section B-II/1

Ref: https://www.edumaritime.net/stcw-code
Source: IMO

Guidance regarding the certification of officers in charge of a navigational watch on ships of 500 gross tonnage or more

Training

1. Every candidate for certification as officer in charge of a navigational watch should have completed a planned and structured programme of training designed to assist a prospective officer to achieve the standard of competence in accordance with table A-II/1.
2. The structure of the programme of training should be set out in a training plan which clearly expresses, for all parties involved, the objectives of each stage of training on board and ashore. It is important that the prospective officer, tutors, ships' staff and company personnel are clear about the competences which are to be achieved at the end of the programme and how they are to be achieved through a combination of education, training and practical experience on board and ashore.
3. The mandatory periods of seagoing service are of prime importance in learning the job of being a ship's officer and in achieving the overall standard of competence required. Properly planned and structured, the periods of seagoing service will enable prospective officers to acquire and practice skills and will offer opportunities for competences achieved to be demonstrated and assessed.
4. Where the seagoing service forms part of an approved training programme, the following principles should be observed:
    1. The programme of onboard training should be an integral part of the overall training plan.
    2. The programme of onboard training should be managed and coordinated by the company which manages the ship on which the seagoing service is to be performed.
    3. The prospective officer should be provided with a training record book* to enable a comprehensive record of practical training and experience at sea to be maintained. The training record book should be laid out in such a way that it can provide detailed information about the tasks and duties which should be undertaken and the progress towards their completion. Duly completed, the record book will provide unique evidence that a structured programme of onboard training has been completed which can be taken into account in the process of evaluating competence for the issue of a certificate.
    4. At all times, the prospective officer should be aware of two identifiable individuals who are immediately responsible for the management of the programme of onboard training. The first of these is a qualified seagoing officer, referred to as the "shipboard training officer", who, under the authority of the master, should organize and supervise the programme of training for the duration of each voyage. The second should be a person nominated by the company, referred to as the "company training officer", who

should have an overall responsibility for the training programme and for coordination with colleges and training institutions.

5. The company should ensure that appropriate periods are set aside for completion of the programme of onboard training within the normal operational requirements of the ship.

***** *The relevant IMO Model Course(s) and a similar document produced by the International Shipping Federation may be of assistance in the preparation of training record books.*

Roles and responsibilities

5. The following section summarizes the roles and responsibilities of those individuals involved in organizing and conducting onboard training:
   1. The company training officer should be responsible for:
      1. overall administration of the programme of training;
      2. monitoring the progress of the prospective officer throughout; and
      3. issuing guidance as required and ensuring that all concerned with the training programme play their parts.
   2. The shipboard training officer should be responsible for:
      1. organizing the programme of practical training at sea;
      2. ensuring, in a supervisory capacity, that the training record book is properly maintained and that all other requirements are fulfilled; and
      3. making sure, so far as is practicable, that the time the prospective officer spends on board is as useful as possible in terms of training and experience, and is consistent with the objectives of the training programme, the progress of training and the operational constraints of the ship.
   3. The master's responsibilities should be to:
      1. provide the link between the shipboard training officer and the company training officer ashore;
      2. fulfil the role of continuity if the shipboard training officer is relieved during the voyage; and
      3. ensure that all concerned are effectively carrying out the onboard training programme.
   4. The prospective officer's responsibilities should be to:
      - follow diligently the programme of training as laid down;
      - make the most of the opportunities presented, be they in or outside working hours; and
      - keep the training record book up to date and ensure that it is available at all times for scrutiny.

Induction

6. At the beginning of the programme and at the start of each voyage on a different ship, prospective officers should be given full information and guidance as to what is expected of them and how the training programme is to be organized. Induction presents the opportunity to

brief prospective officers about important aspects of the tasks they will be undertaking, with particular regard to safe working practices and protection of the marine environment.

Shipboard programme of training

7. The training record book should contain, amongst other things, a number of training tasks or duties which should be undertaken as part of the approved programme of onboard training. Such tasks and duties should relate to at least the following areas:
    1. steering systems;
    2. general seamanship;
    3. mooring, anchoring and port operations;
    4. life-saving and fire-fighting appliances;
    5. systems and equipment;
    6. cargo work;
    7. bridge work and watchkeeping; and
    8. engine-room familiarization.
8. It is extremely important that the prospective officer is given adequate opportunity for supervised bridge watchkeeping experience, particularly in the later stages of the onboard training programme.
9. The performance of the prospective officers in each of the tasks and duties itemized in the training record book should be initialled by a qualified officer when, in the opinion of the officer concerned, a prospective officer has achieved a satisfactory standard of proficiency. It is important to appreciate that a prospective officer may need to demonstrate ability on several occasions before a qualified officer is confident that a satisfactory standard has been achieved.

Monitoring and reviewing

10. Guidance and reviewing are essential to ensure that prospective officers are fully aware of the progress they are making and to enable them to join in decisions about their future programme. To be effective, reviews should be linked to information gained through the training record book and other sources as appropriate. The training record book should be scrutinized and endorsed formally by the master and the shipboard training officer at the beginning, during and at the end of each voyage. The training record book should also be examined and endorsed by the company training officer between voyages.

Assessment of abilities and skills in navigational watchkeeping

11. A candidate for certification who is required to have received special training and assessment of abilities and skills in navigational watchkeeping duties should be required to provide evidence, through demonstration either on a simulator or on board ship as part of an approved programme of shipboard training, that the skills and ability to perform as officer in charge of a navigational watch in at least the following areas have been acquired, namely to:
    1. prepare for and conduct a passage, including:
        1. interpreting and applying information obtained from charts;
        2. fixing position in coastal waters;

3. applying basic information obtained from tide tables and other nautical publications;
4. checking and operating bridge equipment;
5. checking magnetic and gyro-compasses;
6. assessing available meteorological information;
7. using celestial bodies to fix position;
8. determining the compass error by celestial and terrestrial means; and
9. performing calculations for sailings of up to 24 hours;

2. operate and apply information obtained from electronic navigation systems;
3. operate radar, ARPA and ECDIS and apply radar information for navigation and collision avoidance;
4. operate propulsion and steering systems to control heading and speed;
5. implement navigational watch routines and procedures;
6. implement the manoeuvres required for rescue of persons overboard;
7. initiate action to be taken in the event of an imminent emergency situation (e.g., fire, collision, stranding) and action in the immediate aftermath of an emergency;
8. initiate action to be taken in event of malfunction or failure of major items of equipment or plant (e.g., steering gear, power, navigation systems);
9. conduct radiocommunications and visual and sound signalling in normal and emergency situations; and
10. monitor and operate safety and alarm systems, including internal communications.

12. Assessment of abilities and skills in navigational watchkeeping should:
    1. be made against the criteria for evaluating competence for the function of navigation set out in table A-II/1;
    2. ensure that the candidate performs navigational watchkeeping duties in accordance with the Principles to be observed in keeping a safe navigational watch (section A-VIII/2, part 4-1) and the Guidance on keeping a navigational watch (section B-VIII/2, part 4-1).

Evaluation of competence

13. The standard of competence to be achieved for certification as officer in charge of a navigational watch is set out in table A-II/1. The standard specifies the knowledge and skill required and the application of that knowledge and skill to the standard of performance required on board ship.
14. Scope of knowledge is implicit in the concept of competence. Assessment of competence should, therefore, encompass more than the immediate technical requirements of the job, the skills and tasks to be performed, and should reflect the broader aspects needed to meet the full expectations of competent performance as a ship's officer. This includes relevant knowledge, theory, principles and cognitive skills which, to varying degrees, underpin all levels of competence. It also encompasses proficiency in what to do, how and when to do it, and why it should be done. Properly applied, this will help to ensure that a candidate can:
    1. work competently in different ships and across a range of circumstances;
    2. anticipate, prepare for and deal with contingencies; and
    3. adapt to new and changing requirements.

15. The criteria for evaluating competence (column 4 of table A-II/1) identify, primarily in outcome terms, the essential aspects of competent performance. They are expressed so that assessment of a candidate's performance can be made against them and should be adequately documented in the training record book.
16. Evaluation of competence is the process of:
    1. collecting sufficient valid and reliable evidence about the candidate's knowledge, understanding and proficiency to accomplish the tasks, duties and responsibilities listed in column 1 of table A-II/1; and
    2. judging that evidence against the criteria specified in the standard.
17. The arrangements for evaluating competence should be designed to take account of different methods of assessment which can provide different types of evidence about candidates' competence, e.g.:
    1. direct observation of work activities (including seagoing service);
    2. skills/proficiency/competency tests;
    3. projects and assignments;
    4. evidence from previous experience; and
    5. written, oral and computer-based questioning techniques*.
18. One or more of the first four methods listed should almost invariably be used to provide evidence of ability, in addition to appropriate questioning techniques to provide evidence of supporting knowledge and understanding.

The relevant IMO Model Course(s) may be of assistance in the preparation of courses.

8.4 Appendix D - Corse model description for the Cadet PEC course from the Norwegian Coastal Administration (in Norwegian)

Modellkurs
Kystnavigasjon for Kadettfarledsbevis

01.10.2020

Kystverket
Senter for los og VTS,
Haugesund

Innhold

Introduksjon

Ordningen med kadettfarledsbevis er regulert gjennom Lov om havner og farvann (LOV-2019-06-21-70), Forskrift om losplikt og bruk av farledsbevis (FOR-2014-12-1808).

2. Kadettfarledsbevis.

Kadettfarledsbevis ble innført på bakgrunn av dialog med skipsnæringen om behovet for å kunne gi navigatører med begrenset erfaring fra norskekysten en gradvis opplæring, ved å la styrmenn basert på skipsførerens tillit, seile selvstendige vakter under oppfølging. Intensjonen med dette er å gi en bedre mulighet til gradvis å bygge opp erfaring, enn gjennom det generelle farledsbevis systemet, ved at navigatørene kan benytte lengre tid før en søknad om ordinært farledsbevis leveres. Dette vil være gunstig for bemanningen om bord da en styrmann med kadettfarledsbevis også kan inngå i det vaktsystemet i lospliktig område.

Ordningen med kadettfarledsbevis er hjemlet i Forskrift om farledsbevis § 20. Kadettfarledsbevis, §21. Seilas med kadettfarledsbevis og §22. Kadettfarledsbevisets gyldighetstid

For kadettfarledsbevis gjelder Forskrift om farledsbevis. I tillegg setter Kystverket følgende begrensninger og vilkår:

• Modellkurs for kadettfarledsbevis skal være gjennomført og bestått samt gyldig sertifikat for dekksoffiser i henhold til STCW-95 kreves for å søke kadettfarledsbevis.

• Det skal fremlegges en skriftlig avtale mellom rederi, skipsfører og navigatøren som søker kadettfarledsbevis. Avtalen skal omfatte og forplikte partene til opplæring i kystnavigasjon, med hensikt for søkeren å omsette kadettfarledsbeviset til et ordinært farledsbevis, når kvalifikasjonene for dette er oppnådd. Rederiet skal også beskrive egen praksis og intensjon med bruk av navigatører med kadettfarledsbevis.

• Kadettfarledsbeviset er kun gyldig sammen med skipsføreren(e) som har signert avtale om opplæring med kadetten. Skipsføreren står ansvarlig for kadettens handlinger. Dette medfører at navigatøren ikke kan benytte kadettfarledsbeviset med mindre den eller de skipsførerne som har signert avtalen er om bord.

• Kadettfarledsbeviset er gyldig i 36 måneder etter utstedelsesdato og kan ikke fornyes..

• Ved fullført opplæring om bord i gitte farleder kan det søkes ordinært farledsbevis.

• Kadettfarledsbeviset kan kombineres med et ordinært farledsbevis. Dette innebærer at navigatøren kan ha ordinært farledsbevis for deler av kysten, og kadettfarledsbevis for andre områder.

3. Målsetting

Målet med kurset er å lage et standardisert rammeverk for opplæring av studenter og navigatører i krevende kystseilas på Norskekysten. Basert på bestått eksamen og obligatorisk fremmøte skal en kunne få utstedt et Kadettfarledsbevis av Kystverket.

4. Bakgrunn

Det er ønskelig å løfte kvaliteten på undervisning innen krevende kystnavigasjon – både sett fra institusjonene og næringens side. Samtidig har det vært et ønske fra Kystverket å effektivisere og kvalitetssikre regimet knyttet til utsteding av Farledsbevis. Utvikling av bedre simulatorteknologi og geografiske databaser for simulatorene har nå gjort det mulig å utvikle langt mer relevante øvelser innen navigasjon på Norskekysten.

5. Kursbevis

Etter gjennomført kurs og bestått eksamen vil det bli utstedt et eget kursbevis som er godkjent av Kystverket. Basert på dette vil Kystverket kunne utstede Kadettfarledsbevis.

6. Gyldighet

Gyldigheten av kurset er 5 år for å kunne benytte dette til søknad om Kadettfarledsbevis

7. Inntakskrav

Elev ved Maritim Teknisk Fagskole, Student ved Maritim Høyskole eller innehar gyldig navigatørsertifikat i henhold til STCW.

8. Krav til simulatorer og instruktører

Simulatorøvelsene som er beskrevet i dette kurset skal foregå på simulatorbroer med følgende minimumskrav:

- En bro som gjør det mulig å se aktenom tvers på begge sider. I tillegg skal broen være utstyrt med visuell kanal som gjør det mulig å se rett akterut.

- Ha fullverdig instrumentering i henhold til de kravene som er pålagt et moderne fartøy (min. GMDSS-A1)

- Ha styresystem som gjør manuell styring med rormann mulig.

- Matematiske modeller for minimum 4 forskjellige fartøy som er relevante for kystseilas i Norge.

- Minst en geografisk database, eller flere sammenhengende databaser som dekker minst 100nm av Norskekysten.

- Mulighet for simulering av forskjellige miljøpåvirkning (visuelt og fysisk), samt feilmodus på skipsmodell og instrumentering.

Under treningen skal det maksimalt være tre studenter på hver bru. Simulatorinstruktører og kursansvarlige skal minst ha utdanning på ledelsesnivå i henhold til STCW-95 med Dekksoffisersertifikat kl. 1 eller 2. Instruktørene skal også kunne dokumentere god erfaring fra seilas på Norskekysten, samt erfaring fra undervisning på navigasjonssimulator og i nautiske fag. Institusjonen som skal kjøre kurset skal være godkjent i henhold til NOKUT og Sjøfartsdirektoratets bestemmelser for generell utdanning av nautiske studenter. I tillegg kreves det at Kystverkets Senter for los og VTS har godkjent den enkelte institusjons konsept for dette modellkurset.

9. Undervisningsmateriell og litteratur

Institusjonen skal besørge tilgjengelighet av nødvendig materiell:

- Nautiske publikasjoner, kart, og lignende.

- Oppdatert og operativt simulatorutstyr.

- Lærebok / kompendium i tema som blir gjennomgått på kurset.

10. Evaluering

Simulatoreksamen skal inneholde både planlegging og gjennomføring av seilasen. For endelig eksamen på simulator skal det benyttes statslos som sensor. Kandidaten skal gjøres kjent med hvilket geografisk område og hvilket skip han skal seile seneste 24 timer før øvelsen.

Kursplan og timeplan

Timer(45min)	Teori	Simulator
4	Kystverket, farvannsregler, meldingstjenesten. Regler for lostjeneste og farledsbevis i Norge.	
6	Farvannslære og oppmerking på Norskekysten.	Familiarisering simulator og relevante geografiske områder
6	Optisk posisjonering	Optisk seilas med føring av bestikk og optisk kontroll
4	Sikker posisjonering ved bruk av radar	Radarseilas med føring av bestikk og radarkontroll.
4	Planlegging av seilas basert på ROT ved kursforandring.	Trening på gjennomføring av kursforandringer basert på ROT
4	Radarens begrensninger og muligheter ved kystnavigasjon	Trening på bruk av radar for stedfesting og sikkert bestikk. Herunder seilas i dårlig sikt (mørke, tåke, regn og snø).
4	Kvalitet, dekning og oppdatering på ENC og papirkart.	
4	Elektronisk stedfesting i kystnavigasjon (radar, satellitt, ekkolodd).	Trening på bruk av elektroniske sensorer for posisjonsbestemmelse.
8	Elektroniske kart. Begrensning og muligheter i kystnavigasjon	Trening på planlegging og gjennomføring av seilas ved bruk av ECDIS i trange farvann og med introduksjon av feil på navigasjonssystem.
4	Seilas med los, losteknikker og brorutiner.	Seilas i begrenset farvann med oppløp mot ankringsplass eller terminal.
4	Norske sjøtrafikksentral tjenester, seilingbestemmelser og kommunikasjon(SMCP)	Seilas i Sjøtrafikksentralen sitt virkeområde. Trening på kommunikasjon og seilas.
6	Teoretisk utsjekk av seilingsplan og kartarbeid. (muntlig) med los tilstede	Simulatorbasert eksamen / utsjekk med los tilstede.

Totalt 58 timer hvor ca. 40 timer skal være på simulator. Timefordelingen i planen er veiledende og kan dekkes av teoretisk og praktisk undervisning.

5

Detaljert fagplan

Regelverk og administrative regimer

- Introduksjon til administrative organer og ansvarsområde.

- Gjennomgang av det til enhver tid gjeldende regelverk for seilas på norskekysten. Dette inkluderer blant annet lov og forskrift knyttet til losplikt, anløpsforskrift og meldingsplikt til myndighetene, sjøtrafikk i bestemte farvann.

- Internasjonale og nasjonale sjøveisregler vedrørende seilas i trange farvann.

Farvannslære

- Kjennskap til hoved og bileder på Norskekysten.

- Innføring i kartinformasjon av spesiell interesse for kystnavigasjon. I dette ligger også elektronisk kartgrunnlag (ENC) og Zones Of Confidence (ZOC).

- Introduksjon til områder med spesielle navigasjonsmessige utfordringer. I dette ligger områder som er eksponert for vanskelige miljø og strømforhold, trafikkforhold, meldingssystem. - Innføring i los beskrivelser (Den norske los) og andre viktige publikasjoner av relevans for navigasjon langs norskekysten.

Optisk posisjonering

- Gjennomgang av forskjellige former for optisk posisjonering og feilteori.

- Planlegging av sikker seilas i kystfarvann.

- Føring av bestikk basert på optiske observasjoner (papir- og elektroniske kart).

- Utprøving av teknikker i simulator, inkludert seilas i mørke og dårlig sikt.

Elektronisk navigasjon

- Gjennomgang av radarens begrensninger i kystnære strøk og vanskelige miljøforhold.

-Gjennomgang av parallell indeks (PI), VRM og EBL teknikk ved radarnavigasjon

- Planlegging av kursforandringer i trange farvann, med spesiell vekt på svingerateberegning (Rate Of Turn – ROT).

- Bevisstgjøring på og bruk av skipets manøverdiagrammer i trange farvann, samt påvirkning av gruntvannseffekt(Squat). Eksempel fra minst to forskjellige fartøy med forskjellig manøver karakteristikk som benyttes under simulatorøvinger.

- Utprøving av teknikkene i simulator

- Gjennomgang av ytelse på navigasjonssystemer, inkludert GNSS og gyrosystem. Inkludert identifisering av integritets- og nøyaktighetsproblematikk på disse.

- Begrensninger og muligheter ved bruk av elektroniske kartsystem (ECDIS / ECS), inkludert begrensninger i kartgrunnlag.

- Bruk av ECDIS i DR (Dead Reckoning) modus

- Gjennomgang av problemstillinger knyttet til bruk av autopilot med banestyring.

- Utprøving av forskjellige former for feil på elektroniske systemer på simulator, samt elektronisk seilas under vanskelige siktforhold.

Losing

- Introduksjon til lostjenesten i Norge.

- Gjennomgang av losens vanlige teknikker for seilas.

- Gjennomgang av standardiserte ror- og manøverordrer.

- Seilas med los og rormann på simulator, inkludert innseiling mot ankringsposisjon og relevant terminal.

VTS og seilingsbestemmelser

- Introduksjon til Sjøtrafikksentralene og deres ansvarsområde i Norge.

- Gjennomgang av meldeplikt, kommunikasjonsrutiner.

- Gjennomgang av TSS og seilingsbestemmelser i og utenfor territorialfarvannet.

Forkortelser

AIS = Automatic Identification

ARPA = Automatic Radar Plotting Aid

GNSS = Global Navigation Satellite System

DR = Dead Reckoning

ECDIS = Electronic Chart Display and Information System

ECS = Electronic Chart System

EFS = Etterretninger For Sjøfarende

ENC = Electronic Nautical Chart

GMDSS = Global Maritime Distress and Safety System

IALA = International Association of Lighthouse Authorities

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NOKUT = Nasjonalt Organ for Kvalitet i UTdanningen

PI = Parallell Indeksering

RACON = RAdar beaCON

ROT = Rate Of Turn

SMCP = Standard Maritime Communication Phrases

STCW = Standard of Training, Certification and Watchkeeping

TSS = Traffic Separation Scheme

VTS = Vessel Traffic Services

ZOC = Zones of Confidence

Simulatorøvinger

Simulator øvinger gjennomføres normalt med 2 til 3 studenter på hver bro med tildelte roller. Øvelser skal gjennomføres med en grundig debrief etter hver gjennomføring. Det må være samsvar mellom teori og praktiske øvelser. Simulatorøvingene begynner med optisk seilas uten elektroniske hjelpemidler for videre gradvis økt kompleksitet og vanskelighetsgrad med både farvannstype og instrumentbruk. Det skal veksles mellom dag og nattseilas. En statslos skal være eksaminator for endelig eksamen på simulator.

8.5 Appendix E - Interview guide

INTERVIEW PART ONE – PLANNING AND VOYAGE

The object of this part is to allow the subject to explain in their own words what the subject thinks about their own plan and their own performance in the simulator.

Q1: Now that you have planned and executed a voyage in the simulator, what do you think about the plan and the voyage?

Depending on the voyage there might be a number of possible directions to take this part of the interview. Therefore, I will not include more pre-planned questions in this part.

INTERVIEW PART TWO – THEORETICAL UNDERSTANDING OF COASTAL NAVIGATIONAL TECHNIQUES

The objective of this part is to find out whether the subject has a theoretical understanding of classic coastal navigational techniques

Q1: Please describe what using heading point means and the advantages and disadvantages of this technique.

Q2: Please describe what using cross bearings means and the advantages and disadvantages of this technique.

Q3: Please describe what using a four-point bearing means and the advantages and disadvantages of this technique.

Q4: Please describe what a running fix bearing means and the advantages and disadvantages of this technique.

Q5: Please describe what using half-a-point bearing/technique means and the advantages and disadvantages of this technique.

Q6: Please describe the six-minute rule

Q7: Please describe how you would use a radar distance as a turn indicator in coastal navigation.

INTERVJUGUIDE

INTERVJU DEL 1 – PLANLEGGING OG SEILAS

Hensikten med denne delen av intervjuet er å la kandidaten beskrive med egne ord hva vedkommende syntes om egen plan og gjennomføring av seilas i simulator.

Q1: Nå som du har planlagt en seilas og seilt denne i simulatoren, hva synes du om den planen du hadde og hvordan det gikk med selve seilasen?

Avhengig av plan og resultater i simulatoren så kan denne delen av intervjuet gå i utallige retninger. Jeg kommer derfor ikke til å ha med flere forhåndsplanlagte spørsmål her.

INTERVJU DEL 2 – TEORETISK FORSTÅELSE FOR TEKNIKKER SOM BENYTTES I KYSTNAVIGASJON

Hensikten med denne delen av intervjuet er å kartlegge den teoretiske forståelsen til kandidaten for de klassiske navigasjonsteknikkene som kan brukes ved kystseilas.

Q1: Vennligst forklar hva som menes med stevn, og hva som er fordeler og ulemper med denne teknikken.

Q2: Vennligst forklar hva som menes med krysspeiling, og hva som er fordeler og ulemper med denne teknikken.

Q3: Vennligst forklar hva som menes med en firestrek, og hva som er fordeler og ulemper ved denne teknikken.

Q4: Vennligst forklar hva som menes med flyttet stedlinje, og hva som er fordeler og ulemper med denne teknikken.

Q5: Vennligst forklar hva som menes med halvstrek, og hva som er fordeler og ulemper med denne teknikken.

Q6: Vennligst forklar seks minutters regelen.

Q7: Vennligst forklar hvordan du vil bruke en radar avstand som tørn indikator i kystnavigasjon.

8.6 Appendix F – Participants information and consent form

Are you interested in taking part in the research project

"The learning effect of the coastal navigation course taught av HVL"?

Purpose of the project
You are invited to participate in a master thesis research project where the main purpose is to identify if there are any noticeable differences in coastal navigational skills between students at HVL who have attended the coastal navigation course, and students who have not attended the course. In this informational letter we will inform you of the goals for the project, and how participating in this project will affect you.

Which institution is responsible for the research project?

Western Norway University of Applied Sciences (HVL) is responsible for the project (data controller).

Why are you being asked to participate?

The reason for asking you to join this study is because you are one of the graduating students from the nautical science bachelor program at HVL in 2023.

What does participation involve for you?

If you volunteer for the study and your name is drawn among the recipients, you will be part of a three phased session at SIMSEA with voyage planning, voyage execution in the simulator, and a interview after completing the simulator voyage. You will be given the task to plan a coastal voyage (maximum planning time 30 minutes), then you will execute the plan by sailing it in the simulator (approximately 1 hour of sailing), and then there will be a 30-45 minute interview related to the planning and execution of the voyage.

Participation is voluntary
Participation in the project is voluntary. If you chose to participate, you can withdraw your consent at any time without giving a reason. All information about you will then be made anonymous. There will be no negative consequences for you if you chose not to participate or later decide to withdraw.

Your personal privacy – how we will store and use your personal data
We will only use your personal data for the purpose(s) specified here and we will process your personal data in accordance with data protection legislation (the GDPR).

- *The master thesis will be written by Espen Skare with Margareta Lützhöft and Meric Karahalil as supervisors. The raw material will be processed and analysed by Espen Skare, and the supervisors will have access to notes and analysis with numerical identification linking the notes to a specific individual.*
- *All collected data will be stored in password protected areas, and the list with names and numerical identification will be stored in a password protected area at another area than the collected data.*
- *In the final product it will not be possible to identify any individuals, as the study is a comparison between two groups.*

What will happen to your personal data at the end of the research project?

The planned end date of the project is *upon the approval of the master thesis. All collected data will be deleted after the completion of the project, meaning that the data should be deleted no later than 15.08.2023.*

Your rights

So long as you can be identified in the collected data, you have the right to:

- access the personal data that is being processed about you
- request that your personal data is deleted
- request that incorrect personal data about you is corrected/rectified
- receive a copy of your personal data (data portability), and
- send a complaint to the Norwegian Data Protection Authority regarding the processing of your personal data

What gives us the right to process your personal data?

We will process your personal data based on your consent.

Based on an agreement with *Western Norway University of Applied Sciences (HVL),* The Data Protection Services of Sikt – Norwegian Agency for Shared Services in Education and Research has assessed that the processing of personal data in this project meets requirements in data protection legislation.

Where can I find out more?

If you have questions about the project, or want to exercise your rights, contact:

- Western Norway University of Applied Sciences: Espen Skare - student «Master i maritime operasjoner»
    - Telephone: +47 99 71 76 25
    - E-mail: espen.skare@hvl.no

- Western Norway University of Applied Sciences: Margareta Lützhöft – supervisor for master thesis
    - Telephone: +47 94 79 37 96
    - E-mail: margareta.holtensdotter.luetzhoeft@hvl.no

- Our Data Protection Officer: Trine Anikken Larsen
    - Telephone: +47 55 58 76 82

- E-mail: trine.ankikken.larsen@hvl.no

If you have questions about how data protection has been assessed in this project by Sikt, contact:

- email: (personverntjenester@sikt.no) or by telephone: +47 73 98 40 40.

Yours sincerely,

Espen Skare