DERIN

Digital Education Readiness
in Maritime and Inland Navigation

Co-funded by the
Erasmus+ Programme
of the European Union

Train the Trainers' Handbook

Materials for trainers
VR360 training

A handbook for trainers
to encourage them to create their own
e-learning/online/model teaching materials
for maritime and inland navigation
education and training

31 May 2023

Document ID:	Handbook	
Activity:	T2.1. Train the Trainers' Toolkit for Capacity Building	
Author / Project Partner:	Date:	Version:
Natalija Kavran/FPZ Zvonko Kavran/FPZ Vlatka Stupalo/FPZ	01/08/2021	Ver. 0.1
FPZ, CER	21/09/2021	Ver. 0.2
FPZ, CER, STC	03/12/2021	Ver. 0.3
FPZ, CER, STC, MQC-TUV, ENS, LMA	24/01/2022	Ver. 1.0
FPZ, CER, STC, MQC-TUV, ENS, LMA	10/03/2022	Ver. 1.1
FPZ, CER, STC, MQC-TUV, ENS, LMA	12/04/2022	Ver. 1.2
FPZ, CER, STC, MQC-TUV, ENS, LMA	06/05/2022	Ver. 1.3
FPZ, CER, STC, MQC-TUV, ENS, LMA	03/06/2022	Ver. 2.0
FPZ, CER, STC, MQC-TUV, ENS, LMA	20/06/2022	Ver. 2.1
FPZ, CER, STC, MQC-TUV, ENS, LMA	08/07/2022	Ver. 2.2
FPZ, CER, STC, MQC-TUV, ENS, LMA	26/09/2022	Ver. 2.3
FPZ, CER, STC, MQC-TUV, ENS, LMA	09/05/2023	Ver. 3.1
FPZ, CER, STC, MQC-TUV, ENS, LMA	31/05/2023	Ver. 3.2

CONTENT

LIST OF ABBREVIATIONS

Abbreviation	Definition
4K resolution	Horizontal resolutions of around 4,000 pixels. K = kilo
AAC	Augmentative and Alternative Communication
AED	Automated External Defibrillator
AR	Augmented Reality
AVC	Advanced Video Coding
BA	Breathing Apparatus
CABA	Compressed Air operated Breathing Apparatus
CEDEFOP	European Centre for the Development of Vocational Training
CEFR	Common European Framework of Reference for Languages
CER	CERONAV – Romanian Maritime Training Centre
CESNI	European Committee for drawing up Standards in the field of Inland Navigation
CMINET	Course Manuals for Inland Navigation Education and Training
CODEC	Device or program that compresses data to enable faster transmission and decompresses received dana
COVID-19	Coronavirus disease 2019 caused by the SARS-CoV-2 virus
CPR	Cardiopulmonary Resuscitation
CPU	Central Processing Unit
Danube SKILLS	Increased institutional capacity in Danube navigation by boosting joint transnational competences and skills in education and public development services
DERIN	Digital Education Readiness in Maritime and Inland Navigation
DeriNetwork	Network of maritime and inland waterway trainers which aims to share knowledge and cooperation between professionals in the field of digital training and to promote relevant practises across Europe
DigComp	Digital Competence Framework for Citizens
DigCompEdu	European Framework for the Digital Competence of Educators
DigCompOrg	European Framework for Digitally-Competent Educational Organisations
E&T	Education and training
EDSC	European Digital Skills Certificate
ENS	Estonian Nautical School
ES QIN	European Standard for Qualifications in Inland Navigation
EU	European Union
EWITA	European Web Platforms and Training Concepts for Intermodal Inland Waterway Transport

FAT64	64-bit File Allocation Table
FE	Fire Extinguisher
FPZ	Faculty of Transport and Traffic Sciences of University of Zagreb
GB	Gigabyte
GPU	Graphics Processing Unit
HDR photo	High Dynamic Range photo
HE	Higher Education
HEVC	High Efficiency Video Coding
HINT	Harmonized Inland Navigation Transport through education and information technology
HMT	Head Mounted Tablet
ICT	Information Communication Technologies
IMO	International Maritime Organization
IMO MC	IMO Model Courses
ISRBC	International Sava River Basin Commission
IWT	Inland Waterway Transport
IWTCOMP	Competency Based Inland Waterway Transport Education & Training
LA	Propane Alarm
LCD	Liquid-Crystal Display
LED	Light Emiting Diode
LMA	Latvian Maritime Academy
LNG	Liquefied Natural Gas
LTT	Learning, Teaching, Training
MAH	Stichting Dunamare Onderwijsgroep
MB/s	Megabytes per Second
MOK	Maritiem op Koers
MP4	Moving Picture Expert Group-4
MQC-TUV	Maritime Qualification Center, Technical University of Varna
MTP	Maritime Tech Platform
NB	Latin *nota bene*. Mark well.
NELI	Cooperation network for logistics and nautical education focusing on Inland Waterway Transport in the Danube corridor supported by innovative solutions
OECD	Organisation for Economic Cooperation and Development
PROMINENT	Promoting Innovation in the Inland Waterways Transport sector
RELAR	Remote learning and examination by using AR in maritime VET education

ROCSTAR	Remote Operations, Coaching and Skills Training using Assisted Reality
ROI	Return On Investment
SaaS platform	Type of Software as a Service that users access via the internet
SBK	Schiffer-Berufskolleg Rhein
STC	Stichting STC-Group
STCW	International Convention on Standards of Training, Certification and Watchkeeping for Seafarers
TP	Target planer (target vessel)
TSS	Traffic Separation Scheme
TTIET	Train the Trainer course material for Inland Navigation Education and Training
UHS	Ultra High-Speed
VBR	Variable Bit Rate
VET	Vocational Education and Training
VR	Virtual Reality
VTS	Vessel Traffic Services
WBL	Work-Based Learning
WP	Waypoints

1 INTRODUCTION

The motivation behind the DERIN project is to improve national education and training capacity and to build cooperation and skills in the use of innovative digital education in water transport. In the last decade, the water transport sector has seen a tremendous introduction of innovative technologies and the development of modern study programmes whose content is strictly aligned with European and global standards. Faced with the global impact of COVID-19, education and training institutions have increased their efforts to protect their trainees through new strategies to develop innovative courses.

To be up to the task, training staff must have the knowledge and skills to make full use of innovative multimedia tools and applications.

The DERIN project was motivated by the latest findings and needs in maritime and inland navigation training and addresses the need to strengthen training capacity through capacity building and collaboration. Several needs have been identified:

- Promote modernisation of education and learning in line with European Union strategies,
- Improving the professional competences and skills of education personnel through capacity building in innovative pedagogical approaches, methodologies, and multimedia technologies,
- Improving educational infrastructure as a basis for wider integration of modern innovative principles and technologies into teaching and learning; and
- Strengthening the education infrastructure through continuous professional development and capacity building of trainers.

1.1 Project target groups

The target groups of the project are:

- **Trainers**/lecturers who will improve their knowledge and teaching skills in conjunction with innovative multimedia technology - the benefits of increased quality and relevance will accrue to both training institutions and trainees by improving their digital literacy and critical thinking skills.
- **Trainees** will develop their soft skills: problem solving, decision making, planning, organisation, time management - new knowledge and skills will enable them to improve their digital literacy and other key skills and achieve higher professional qualifications.

The handbook addresses the need of trainers to use a reliable learning system based on innovative multimedia tools and applications that meet the needs of training different types of groups in different environments.

To share knowledge and strengthen cooperation between professionals in the field of digital education in maritime and inland navigation and to promote relevant practises across Europe, a network of trainers, the DeriNetwork, has been established. Read more about the network in chapter 7 of this handbook.

1.2 Aim of the handbook

This toolkit is a handbook, i.e. a guide, aimed at trainers to acquire competences for blended and online training. This toolkit identifies skills, qualities and attributes required to work successfully with trainees. The identification of these qualities has been aligned

with curriculum development. The materials for trainers for learning modules and technologies selected for adaptation to innovative multimedia tools are therefore part of this toolkit.

The main objective of this handbook is to provide the participants of the Train the Trainer course, who are themselves trainers or want to become trainers, with some practical guidelines for the design and delivery of e-learning solutions and for the use of innovative devices.

1.3 Objectives of the handbook

The main objectives of this toolkit / handbook / guidance materials are:

- train the teaching staff of maritime and inland navigation institutes to keep up with the latest developments in digital teaching methodology, pedagogical approaches, and technology; and
- to raise the general awareness of all stakeholders in the water transport sector of the need to improve the quality of teaching and training using the latest technological achievements and digital education, and to encourage them to actively participate in achieving these improvements.

1.4 Further project outcomes

In preparing this handbook, other project activities and outputs were also considered, and their content complements this handbook. These deliverables are:

- **Report on questionnaire for stakeholders** – this report is the result of an online questionnaire used to collect information on the use of AR / VR technologies in maritime and inland navigation education and training to explore the potential of AR / VR technologies to improve communication with stakeholders and to identify expert-predicted outcomes.
- **Policy recommendations and guidelines** – this framework aims to provide support and advice to decision-makers at all levels for the further implementation of innovative multimedia educational tools and applications and the development of digital competences in waterborne transport.

These deliverables and this handbook address the need of trainers and trainees to use a reliable learning system based on innovative multimedia tools and applications. It considers the needs of different groups in different environments and uses different innovative devices and technologies that are suitable and relevant for all levels of trainers (experienced and new trainers). These deliverables are available on the project website [1]. General information can be found at website of Erasmus+ EU programme for education, training, youth and sport [2].

The handbook provides trainers with concrete suggestions and guidelines to improve their knowledge and skills, while engaging them in substantive discussions on various concepts, theories and issues related to training and familiarising them with the latest innovative technologies for training.

2 DIGITAL COMPETENCES

Digital competence is one of the key competences for Lifelong Learning. It was first defined in 2006 and, following an update of the Council Recommendation in 2018, reads as follows [3]:

"Digital competence involves the confident, critical and responsible use of, and engagement with, digital technologies for learning, at work, and for participation in society. It includes information and data literacy, communication and collaboration, media literacy, digital content creation (including programming), safety (including digital well-being and competences related to cybersecurity), intellectual property related questions, problem solving and critical thinking."

2.1 DigComp

The Digital Competence Framework for Citizens, also known as DigComp, provides a common language to identify and describe the key areas of digital competence. Since 2013, DigComp has been used for a variety of purposes, particularly in the context of employment, education and training, and lifelong learning. [4]

DigComp 2.0 [5] identifies the key components of digital competence in 5 areas:

1. information and data literacy
2. communication and collaboration
3. digital content creation
4. safety
5. problem solving.

2.1.1 Self-assessment tool on Digital Skills and Jobs Platform

With the Digital Skills and Jobs Platform[6] every EU citizen can access a digital skills self-assessment tool to learn more about their digital skills and find out what next steps they can take to improve them. The tool is based on DigComp and is available in all EU languages.

2.1.2 MyDigiSkills

Another tool that citizens can use to self-reflect on their digital literacy in each of the five areas of the DigComp is called MyDigiSkills [7].

2.2 DigCompEdu

The European Framework for the Digital Competence of Educators, also known as DigCompEdu [8], is a framework that describes what it means for educators to be digitally competent. It provides a general frame of reference to support the development of specific digital competences of educators in Europe. [9]

DigCompEdu is aimed at educators at all levels of education, from early childhood to higher and adult education, including general and vocational education, special needs education and non-formal learning. [9]

DigCompEdu describes 22 competences divided into six areas (Figure 1). The focus is not on technical skills, but the framework [10] aims to detail how digital technologies can be used to improve and innovate education and training.

The six DigCompEdu areas focus on different aspects of educators' professional activities:

1. **Area 1** addresses the broader professional environment, i.e., educators' use of digital technologies in professional interactions with colleagues, learners, parents, and other interested parties, for their own individual professional development and for the collective good of the organisation.
2. **Area 2** addresses the competences required to use, create, and share digital resources for learning effectively and responsibly.
3. **Area 3** is dedicated to managing and orchestrating the use of digital technologies in teaching and learning.
4. **Area 4** addresses the use of digital strategies to improve assessment.
5. **Area 5** focuses on the potential of digital technologies for learner-centred teaching and learning strategies.
6. **Areas 6** describes the specific pedagogical competencies required to facilitate students' digital competence.

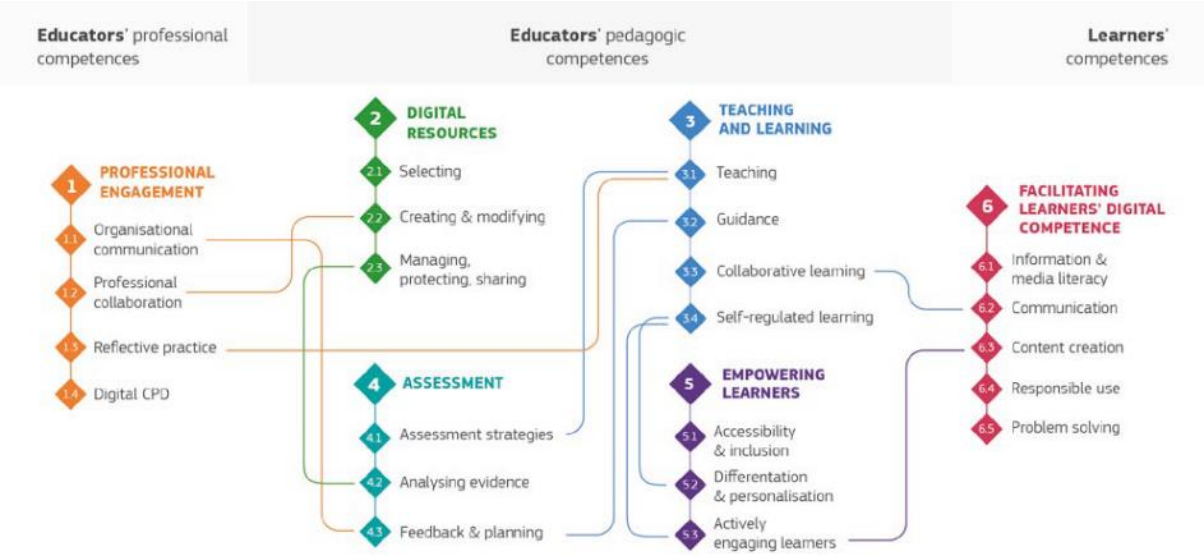


Figure 1. The DigCompEdu competences and their connections
Source:[9]

Visual illustration of DigCompEdu Framework is showed in the following Figure 3 while overview of key concepts used in DigCompEdu is shown in the Figure 3.

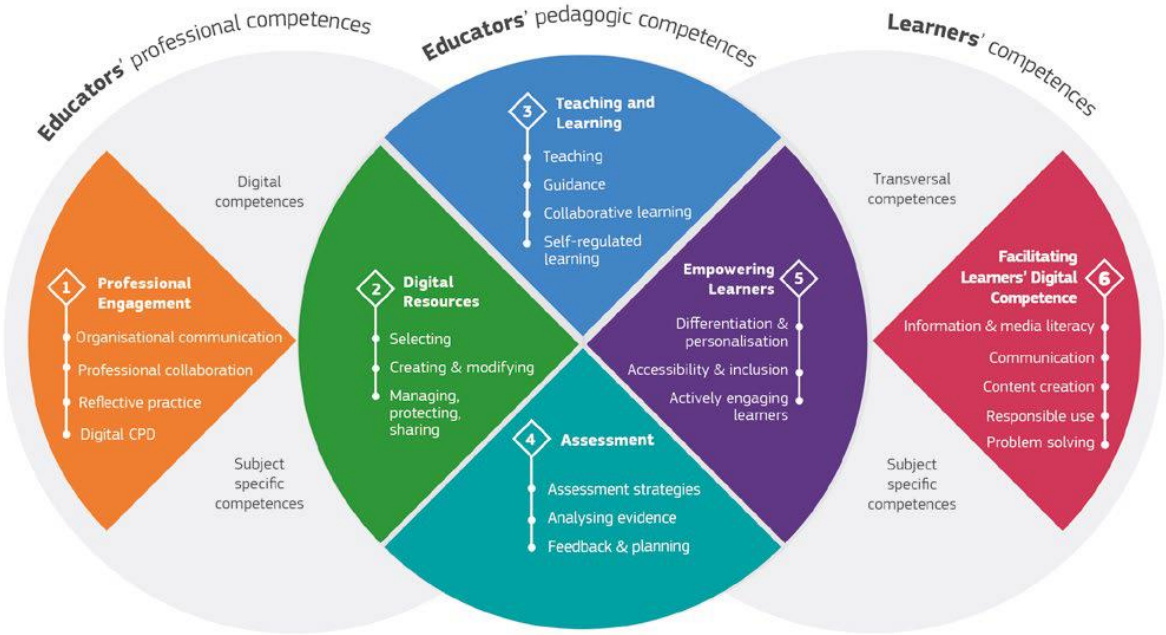


Figure 2. Synthesis of the DigCompEdu framework (areas and scope)
Source: [9]

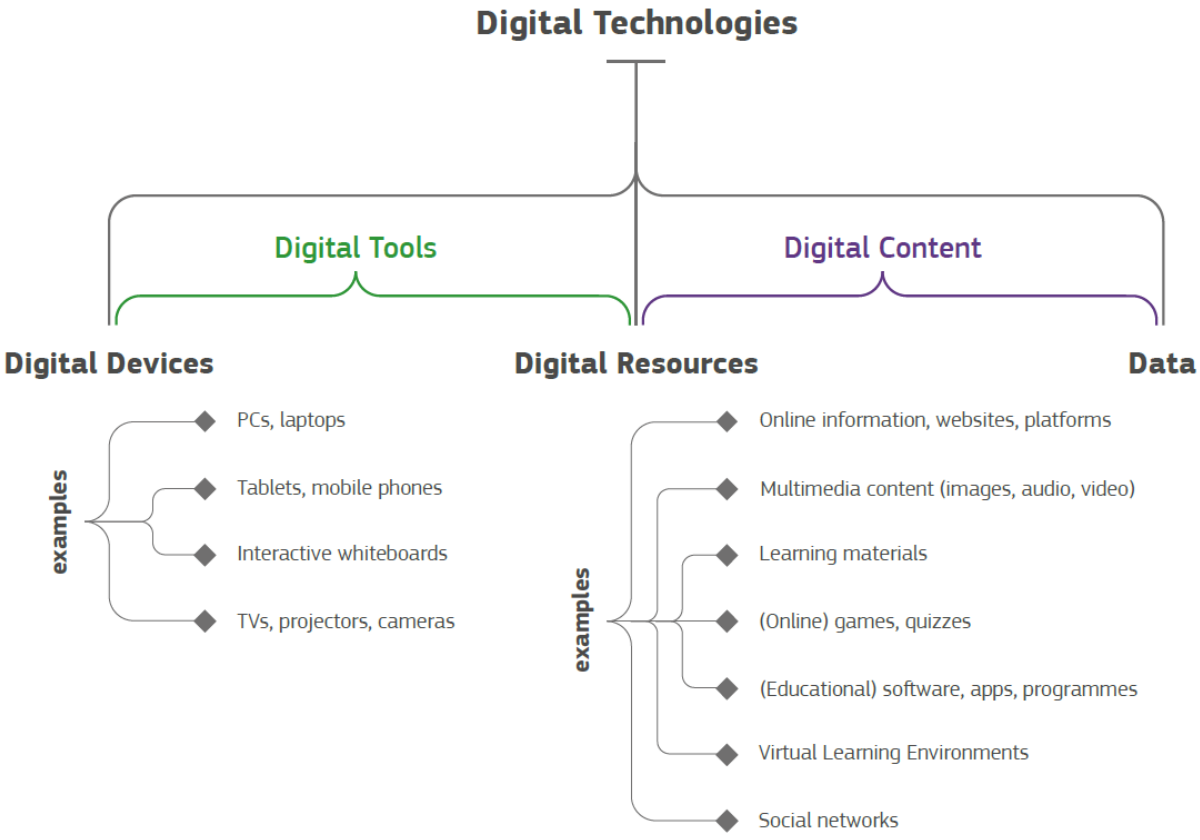


Figure 3. Overview of key concepts used in DigCompEdu
Source: [9]

To support continuous professional development, a progression model (Figure 4) is proposed to help educators understand their personal strengths and weaknesses by

describing different stages or levels of digital competence development.[1] This model is not intended to be a normative framework or performance assessment tool.

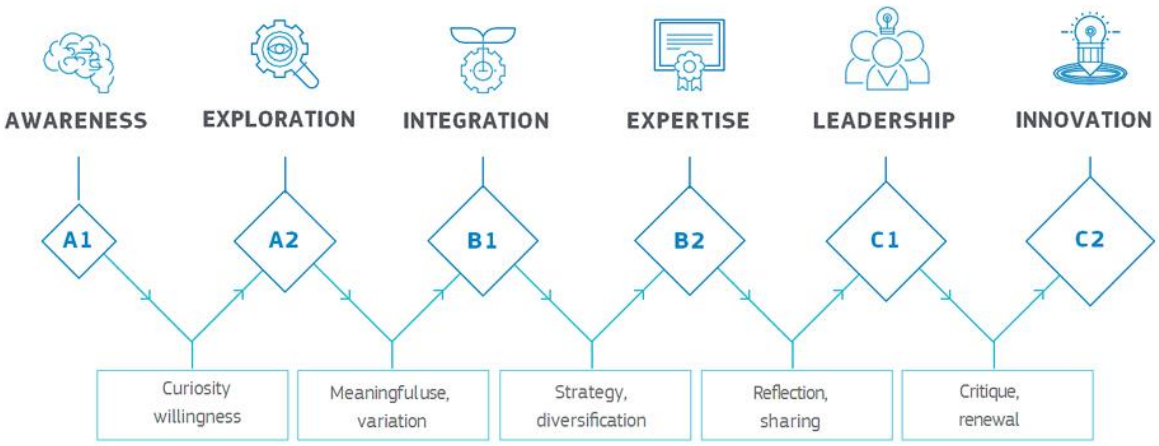


Figure 4. DigCompEdu progression model
Source: [9]

2.2.1 Self-reflection tool for teachers

SELFIEforTEACHERS [11] is an online self-reflection tool for primary and secondary teachers based on DigCompEdu. By answering the tool's 32 questions, teachers can identify their strengths and deficits and design their learning pathways to further develop their digital competences. The tool allows teachers to start a self-reflection themselves at any time or to complete a self-reflection initiated by a group (i.e. a group of teachers, a school, an institution, a regional authority) by accepting an invitation. The tool is available in all official EU languages, see [12].

Another online tool for teacher self-assessment is the tool TET-SAT [13]. This tool assesses four dimensions of digital pedagogical competence: digital pedagogy, digital content use and production, digital communication and collaboration, and digital citizenship.

2.2.2 CheckIn tool for higher education

CheckIn for Higher Education is a self-reflection tool on digital competences for teachers in higher and further education. By answering the 25 questions, teachers receive feedback with useful tips to help them recognise their personal strengths and identify areas where they can improve their use of digital technologies for teaching and learning. Currently this tool is available in English [14] and Spanish [15].

2.3 DigCompOrg

While DigCompEdu supports digital competence building in a professional context, the *European Framework for Digitally-Competent Educational Organisations*, also known as DigCompOrg, supports capacity building within an educational organisation.

[1] For simplicity, these levels of competence are linked to the six levels of the Common European Framework of Reference for Languages (CEFR), which range from A1 to C2.

The primary purposes of DigCompOrg framework are:[16]

- to promote self-reflection and self-assessment within educational organisations as they progressively deepen their commitment to digital learning and pedagogy
- to enable policy makers to design, implement and evaluate policies for the integration and effective use of digital learning technologies.

2.3.1 SELFIE for schools

SELFIE [17] (***S****elf-reflection on* ***E****ffective* ***L****earning by* ***F****ostering the use of* ***I****nnovative* ***E****ducational technologies*) is a free tool designed to help schools incorporate digital technologies into teaching, learning and assessment. The tool anonymously collects the views of students, teachers and school leaders on how technology is used in their school. This is done through short statements and questions and a simple 1-5 response scale. The questions and statements take about 20 minutes to complete.

2.3.2 SELFIE for work-based learning

SELFIE for work-based learning [18] (WBL) is a free online tool that helps schools and companies in the field of Vocational Education and Training (VET) to make the best use of digital technologies for teaching, learning, and training. It was developed by the European Commission together with many key stakeholders. SELFIE WBL is an extension of the existing SELFIE tool, which was launched in October 2018, while WBL was launched in 2021. [19]

SELFIE WBL gathers the opinions of school leaders, teachers, in companies' trainers and learners, who answer a series of questions in eight different areas (leadership, collaboration and networking, infrastructure and equipment, continuing professional development, pedagogy - support and resources, pedagogy - implementation in the classroom, assessment practices, learners digital competence). These questions can be customised to ensure SELFIE meets your needs. Based on the results, companies and schools receive a customised report showing how the technology is being used in the training programmes. Based on this report, the school and company can create a digital action plan and regularly review and improve it.

2.4 European Digital Skills Certificate

The Digital Education Action Plan (2021-2027) Action 9 [20] proposes to:

"Develop a European Digital Skills Certificate (EDSC) that may be recognised and accepted by governments, employers and other stakeholders across Europe. This would allow Europeans to indicate their level of digital competences, corresponding to the Digital Competence Framework proficiency levels".

As a result of this in 2022 the *European Digital Skills Certificate Feasibility Study* was published [21]. The consultation took place through the *Digital Competence Certification Community of Practice* established by All Digital, and open to all stakeholders.

3 E-LEARNING METHODOLOGIES AND GOOD PRACTICES

3.1 A guide for designing and delivering e-learning solutions

In 2021 *Food and Agriculture Organization of the United Nations* published second edition of the guide called ***E-learning methodologies and good practices: A guide for designing and delivering e-learning solutions***. This guide builds on and replaces the 2011 publication. The digital version of the guide is available as a .pdf and as an interactive version [22].

This guide focuses on courses aimed at developing professional competences and targeted professional profiles. The focus is on e-learning solutions suitable for context development, considering technological constraints such as limited hardware capacity and low bandwidth internet connections. Although much of what is covered in this document can also be applied to e-learning in primary and secondary education, these guidelines have been developed mainly for e-learning aimed at adult learners, i.e., learners who have completed their formal education but are still motivated to expand their knowledge and competences. Adult learners have some characteristics that differ from those of full-time students and that influence the design of learning programmes. Adult trainers [22]:

- need to know the benefits of learning (why they should learn something).
- like to learn from experience
- approach learning as problem solving
- learn better when they can see the immediate value and application of the content
- prefer to learn at a time, place and pace that is comfortable for them.

The guide is divided into four main sections and includes a glossary, a bibliography and several templates, checklists, and tables. Below is an abbreviated summary:

- **Part I: Introduction**[2]
  Chapter 1: Getting Started
  Chapter 2: What Is Needed to Develop E-Learning?
- **Part II: Designing an E-Learning Programme**[3]
  Chapter 3: Analysing Learning Needs
  Chapter 4: Organizing Your Content
  Chapter 5: Defining Delivery, Instructional and Evaluation Methods
- **Part III: Creating E-Learning Content**[4]
  Chapter 6: The Process of Content Development
  Chapter 7: Using Instructional Techniques for Content Development
  Chapter 8: Courseware Development

[2] Part I (Chapters 1 and 2) presents the characteristics of e-learning, the benefits, the activities, and the resources needed to develop an e-learning project. It is primarily aimed at those responsible for training and capacity development, as well as those who wish to start an e-learning project or integrate e-learning components into their organisation's capacity development programmes.

[3] The part II (Chapters 3, 4 and 5) provides guidance on designing an e-learning course (from needs analysis to setting learning objectives and sequencing to selecting learning strategies and formats for delivery). This part is primarily aimed at trainers and instructional designers who want to create learning projects that meet learners' needs by choosing between different methods and delivery formats.

[4] Part III (Chapters 6, 7 and 8) provides detailed guidance on creating interactive content (from using learning strategies and media to developing educational software). This chapter is aimed at instructional designers and subject matter experts involved in content development, as well as those who want to learn more about the methods and tools used to create e-learning content.

- **Part IV: Managing and Facilitating Learners' Activities**[5]
  Chapter 9: Delivering an Online Facilitated Course
  Chapter 10: Learning Platforms
- Bibliography
- Glossary
- **Tools** (templates, tables, and checklists)

3.2 E-learning content in inland navigation education and training

An overview of didactic materials, mainly curricula and course manuals, produced for the training of IWT personnel, together with links to the websites where these documents can be found and in which language, was one of the deliverables of the EU-funded project called Competing [23] in 2020.

After identifying the main relevant didactic materials in Annex 1 [24] (D 3.1 of the Competing project), these results were subjected to a comparative analysis with existing competence standards for IWT personnel, such as the CESNI Standards of competences. The comparative analysis was carried out separately for curricula (Annex 2 of D 3.1.) and textbooks (Annex 3 of D 3.1.).

The types of materials identified vary. Some are non-interactive resources such as documents, PowerPoint presentations or videos that the learner can only read or watch but not perform any other actions, while others are stand-alone interactive learning materials that provide explanations, examples, interactivity, questions and feedback, glossaries, etc. To access some materials, you need to register and log in. One of the platforms is the open source platform INeS [25], which offers online training on inland waterways to all interested stakeholders, be it for the Danube region (INeS Danube [26]) or other European regions.

Selected didactic materials have been developed in education and training institutes, such as: CER, OuR, MAH, SBK in the framework of the European projects, such as: NELI [27], EWITA [28], Danube SKILLS [29][28], Smart-Qu@lification [30], Ler(n)en de Euregio [31], TTIET [32], CMINET [33], HINT [34], LNG Masterplan [35], PROMINENT [36], IWTCOMP [37], MOK [38] and by the International Sava River Basin Commission [39].

Another document worth mentioning, which is not mentioned in the aforementioned documents, is the Manual of Danube Navigation by viadanube [40].

3.3 E-learning content in maritime education and training

There are some great initiatives in the maritime sector to digitise maritime educational content and develop digital skills. Of all these initiatives, here are some examples:

- Maritime Tech Platform (MTP)
- Emergency First Response Mixed Reality Training
- RELAR (Remote learning and examination by using AR in maritime VET education)
- ROCSTAR (Remote Operations, Coaching and Skills Training using Assisted Reality)
- Smart Realities
- Virtual Reality Safety Training at APM Terminals MedPort Tangier.

[5] Part IV (Chapters 9 and 10) provides an overview of online collaborative learning and the learning platforms used to deliver online courses. This is aimed at capacity development managers, facilitators and instructional designers who want to know how to deliver a facilitated online course and how learning platforms can support course delivery, knowledge sharing and communication between participants.

3.3.1 Maritime Tech Platform

In terms of content, we see that the maritime sector is facing major changes in which digitalisation and automation are playing an increasingly important role. For example, design and development of ships is increasingly done on computers with 3D drawings and digital twin technology; all equipment and machinery on a ship is networked so that data can be collected for predictive maintenance; and AR is used to remotely assist the technician on board a ship with maintenance. Digitalisation requires innovation in companies, but also in training and education. Furthermore, it is important to prepare trainees and workers well for these developments, which also requires attention to the social skills of trainees and workers.

This leads to several concrete ideas on how maritime education can innovate together with business. MTP *(Maritime Tech Platform*) [41] was launched by a consortium dedicated to developing hybrid learning environments and digital learning resources. It is intended to be the platform where companies in the region can ask their project questions about digitalisation. The goal for the future is for MTP to become the platform for innovative maritime collaboration in the region (South Holland), with the main theme of increasing maritime digitalisation in the ship lifecycle. STC Group and Da Vinci University are the leading partners, but the initiative consists of 36 partners from industry, educational institutions, and governments. The aim of this collaboration is to train a new generation of people for business who will be and remain of value in an increasingly digital world. The platform provides a place where all stakeholders can meet and learn from each other. This promotes the connection with the business world and thus the quality of education and its trainees.

The platform is built on 3 lines of action:

- Hybrid learning environments: Reversed Campus and MTP Digital
- Innovative Education: Workforce of the future
- Applied research around the digital lifecycle of ships

The following is being developed as part of MTP Digital:

- **Digital Twin / IoT, Maritime Tech Platform (MTP**): The MTP Digital Team is developing a digital twin of the AB INITIO. The AB INITIO is a training vessel with the latest technologies on board and is also being used as a sailing field laboratory as part of the MTP project. The digital twin being developed is a visualised version of the engine that can be viewed as a 3D hologram with smart glasses and used for training purposes. At the same time, the digital twin helps trainees monitor the vessel's operating parameters in real time and study the influence of various parameters on the vessel's behaviour in a safe environment.

Figure 5. 3D model of AB Initio ship for virtual reality simulation
Source: STC Group

- **VR Ship Discovery Tool**: uses the 3D model of the AbInitio ship to familiarise trainees with the ship's components in an interactive way. During this immersive experience, trainees can virtually enter the ship and

visually inspect the engine rooms and other important parts of the ship. The app interacts with the user by presenting them with various technical information about the different components of the ship and asking them various relevant questions that get trainees thinking and promote learning in a very engaging way.

- **MTP VR360**: provides story-based immersive learning scenarios using VR360 techniques for training: teachers and trainers create training and teaching materials using 360-degree films and the Warp VR platform. In a 4-day workshop they are trained to develop their own learning material. The solution proposed by WarpVR is an easy-to-learn tool with a very intuitive drag-and-drop graphical user interface and a good help system. However, teachers and trainers need to prepare well the learning objectives and the script to be followed in the scenario to create good learning content.

3.3.2 Emergency First Response Mixed Reality Training

Emergency First Response Mixed Reality Training is an initiative of the Rhine and Inland Waterways Department of STC Group in the Netherlands. Together with the Dutch start-up Velicus, a pilot project was carried out to learn first aid techniques using Hololens Smart Glass and mixed reality technology. This tool, a Hololens app, helps trainees learn cardiopulmonary resuscitation (CPR) in a safe environment. CPR is a life-saving technique that is useful in many emergencies, such as a heart attack or near drowning when a person's breathing or heartbeat has stopped. HoloLens 2 projects a lifelike digital victim over the CPR dummy. The user gets feedback on their actions, so they know exactly what they are doing and what they are not doing well. With this tool, trainees learn how to put someone in the right position. They can watch a full explanation of resuscitation in 3D with comprehensive instructions and go through all the steps of CPR and use an AED. The tool developed by Velicus also includes an exam module.

Figure 6. STC Group trainee performing CPR
during the pilot project Emergency First Response Mixed Reality Training
Source: STC Group

3.3.3 RELAR

The RELAR project [42] (*REmote Learning and examination by using AR in maritime VET education*) explores the possibilities of distance learning with the help of Assisted Reality, a technology derived from Augmented Reality, and a Head Mounted Tablet

(HMT-1). The aim is to make maritime vocational training more resilient so that we can act more quickly in times of crisis and ensure continuity of the learning process.

Is the captain sick and another crew member must steer the ship into port? Does a student have the task of checking a pump and the instructor is not around? Assisted Reality offers the possibility to get support from a distance from an experienced expert. With this remote function, distances no longer matter in vocational training or on board, help is available in seconds and many travel kilometres are saved.

Setting up a communication protocol for remote assistance ensures efficient interaction between trainer and trainee. The IMO's Standard Marine Communication Phrases serve as a model for creating a reliable and efficient communication protocol that can be used in assisted reality. The RELAR initiative has created a framework and architecture that serve as guidelines and best practises for educational institutions wishing to use these techniques internally.

RELAR partners have also started creating learning content for assisted reality. There are already 3 demo scenarios in development where RELAR partners will use these learning methods for different qualifications such as: Maritime Engineer, Shipyard Technician and Logistics Assistant.

3.3.4 ROCSTAR

In the past, organisations have often adopted remote technologies without realising how the technology would change existing ways of working for the better, resulting in low uptake. STC Group, together with various partners around the world, is taking a different approach. The ROCSTAR (*Remote Operations, Coaching and Skills Training using Assisted Reality*) learning methodology uses the RELAR architecture to develop digital workflows, coaching and skills training scenarios that can be used with head-mounted tablets and fit into any organisation. STC Group, the founder of ROCSTAR, is working with international partners, industrial companies, VET and technical universities to create digital learning materials that can be used in different sectors for onboarding, training and supporting workers. In implementing ROCSTAR, a team of experts works together to identify a set of business problems or pain points that can be solved using the technology. The team is defining the pilot programme and required resources and begins developing digital learning content in the form of digital workflows, coaching and training scenarios. By implementing a well-designed pilot programme, the ROCSTAR team seeks to problem-solve to identify challenges and outcomes of device use before a wider roll-out. In this way, the implementing organisation can fine-tune the programme. As the programme and its content are tailored to the specific needs of workers, it will also lead to greater return on investment (ROI) and higher adoption rates. ROCSTAR is available for any size of organisations and any industry sector. Organisations that would like to test ROCSTAR can contact STC Group at any time to start a collaboration.

Figure 7. Maritime engineer trainee using the ROCSTAR method in Rotterdam
Source: STC Group

3.3.5 Smart realities

Smart Realities is a versatile solution from Wärtsilä Voyage that can be used for almost any technology in navigation, engineering, and other educational and training settings. Smart Realities can be added as an extension to an existing simulator to complement it with a bridge-wing scenario and other layouts or set up as a stand-alone or portable solution.

Smart Realities goes beyond the standard joypad, controls, and monitors to provide a highly immersive training experience. It combines mathematical, physical, and environmental models with the latest virtual and augmented reality to put trainees on a virtual bridge or in a engine room, making training as real as possible. Using a range of VR headsets, a console and the Wärtsilä Voyage software, trainees can virtually sail or perform maintenance tasks. The software provider can create different visual and mathematical models for different ships or ship equipment if required. With this tool, trainees can complete practical exercises in an immersive environment without the need for expensive simulators or boarding real ships.

Figure 8. Smart Realities VR tug simulation
during Smart Vision 2022 event in Rotterdam, The Netherlands
Source: STC Group

3.3.6 Virtual Reality Safety Training at APM Terminals MedPort Tangier

APM Terminals MedPort Tangier (TM2) started integrating virtual reality technology extensively into its safety training courses from 2020. The training modules cover about 14 topics and provide a rich training experience that allows participants to imagine and react to almost real-life scenarios, such as falling from a great height or even surviving a severe fire. Adding a new level of interaction to training has a remarkable impact on safety behaviour, culture and performance.

For more information, please visit www.apmterminals.com/medport-tangier [43] and https://youtu.be/rjCC8Web3Es [44].

4 APPLYING VR AND AR TECHNOLOGIES IN EDUCATION AND TRAINING

Modern technologies such as virtual and augmented reality allow the real world to be explored in a virtual environment and visual objects to be superimposed on the surrounding reality.

What is virtual reality and augmented reality? One of the definitions of virtual and augmented reality is as follows:

- Virtual reality (VR) is an artificial environment experienced through sensory stimuli (such as sights and sounds) provided by a computer, in which one's actions partially determine what happens in the environment [45], while
- Augmented virtuality (AR) is an enhanced version of reality created using technology that overlays digital information on top of an image of something viewed through a device (such as a smartphone camera) [46].

Augmented reality, unlike virtual reality which creates a completely artificial environment, uses the existing environment and places new information over it [47]. The basic principle of how AR works is [48]:

- a camera is used to find a marker in the real world, and the information about it is transmitted to a computer or smartphone.
- the computer programme replaces the found mark with a virtual object (text, music, video, 3D models, etc.) and displays it on the screen,
- the camera then tracks the movements of the marker, and the programme allows the user to control the objects.

According to Edgar Dale's cone of experience [49], we remember about 10% of what we have read, while we retain 90% of what we have experienced ourselves. Therefore, VR and/or AR facilitates the recall of read content at the highest level. For training purposes, it enables an increase in learning efficiency. The trainee can put himself in a real situation and analyse how he can react in a certain situation and what the consequences of the different reactions are.

VR / AR technologies offers a whole new level of presentation of learning and training materials. However, for these technological developments to be used in education and training, they must be accessible to learners. Access to such materials can be through high-tech and expensive devices, such as special 3D glasses and their controllers like Oculus Quest (Figure 67) and other similar devices of this kind, or through much cheaper and less technological but available devices like 3D VR Box (Figure 9), Google Cardboard for Android/iOS (Figure 10) and other similar devices that use a smartphone for display.

Figure 9. VR Box, Virtual Reality Universal Smartphone Headset
Source: [50]

Figure 10. Google Cardboard
Source: [51]

Although VR and AR are becoming a cost-friendly, accessible, and effective technology that will secure the skills and necessary knowledge of highly qualified personnel of the future. Today, it is still relatively complex and expensive to equip each trainee with a VR and/or AR system for distance learning. The solution is to install the equipment in the laboratories and the trainers can connect remotely.

The elaboration of courses using the technologies VR / AR will make it possible to offer training and education programmes for maritime and inland navigation from all parts of the world. Trainees will use them to work independently on specific practical tasks and acquire certain professional skills.[6]

4.1 Creation of digital educational content

VR and AR are effective ways to create simulations and games. Simulations and games are one of the types of e-learning content that are a highly interactive form of e-learning. Simulating human interaction in real physical scenarios allows learners to learn by doing (hands-on training).

Education apps VR / AR offer teachers the ability to create their own content and lesson plans with built-in studios to create their own desired presentations. They help educators plan learning experiences that take advantage of the most effective learning environments.

When resources allow, virtual reality can also be used in production of [22]:

- *Case-based scenarios* built around a plausible situation. Usually, the scenario is a situation that presents a realistic challenge. Unlike storytelling, in this approach the learner is the main actor who must respond to the challenge by making a series of choices and decisions. For each option, learners receive feedback, or
- *Serious Learning Games* – a type of experiential simulation that includes a competitive component, a challenging goal and a set of rules and constraints (for more information on scoring in VR scenarios see Annex 5)

A guide (worksheet) for writing story-based immersive scenarios has been produced by WarpVR and can be downloaded from their website (see Annex 6 for more information). It is a good tool to learn how to write good stories, i.e. to define a story that can then be translated into a training scenario in the virtual environment.

4.2 Learning outcomes

The learning outcomes of the course will only be achieved if trainees and trainers are familiar with the technologies of VR / AR and the course is well adapted to the use of VR / AR. In addition, trainers should be sufficiently prepared to work with VR / AR. A possible solution for a wider use of VR / AR technologies in the education and training process is the following:

1. Institutional framework for course preparation or adaptation
2. Additional courses for course preparation or adaptation (how to type of courses).

[6] For more information about the skills and jobs of the future see: 1. (OECD). Skills and Work [52]; 2. (OECD). Skills for jobs[53]; 3. (OECD) Library. Getting Skills Right [54]; 4. (CEDEFOP). Skill Forecast [55].

As a result of the training/education, the trainer acquires:

- *Knowledge of:* basic concepts of virtual and augmented reality, design features and operating principles of VR / AR devices, basics of working with platforms to create VR / AR content.
- *Ability*: apply acquired knowledge in designing VR systems, importing modules into VR / AR development environment, selecting development tools and creating virtual and augmented reality applications.
- *Skills*: using VR / AR devices, creating/running applications with immersive content.

4.3 Basic competences for applying VR/AR technologies

Trainers should have the necessary skills, qualities, and attributes to work successfully with trainees. To be able to use the technologies of VR / AR, trainers should have a higher level of digital skills and competences.[7]

Categories and basic digital competences required for the use of virtual and augmented reality technologies in education and training are:

- Information and data literacy
  - searching and filtering data, information, and digital content
  - validation of data, information, and digital content
  - management of data, information, and digital content
- Communication and collaboration
  - communicating using digital technologies
  - sharing data, information and content using digital technologies
  - compliance with the rules of conduct in the digital environment
- Digital content creation
  - digital content development
  - copyright
  - programming
- Safety and cyber security
  - protection of devices
  - protection of personal data
  - protection of the environment
- Problem solving
  - solving a technical problem
  - identifying the need and finding a technical solution.

According to the scope of this handbook, the necessary digital competences for trainers to use virtual and augmented reality technologies in education and training are:

- Application of VR / AR technologies in curriculum design
- Creating digital educational content
- Planning the environment for the use of digital technologies
- Carrying out the teaching process using digital technologies.

[7] For more information on educators' competences see DigitALAD Handbook [56].

5 DIGITAL TOOLS

In this chapter digital tools (Figure 3) that can help trainers to personalise, manage, protect, share, and improve their learning materials and methods by providing innovative training using VR technologies are mentioned and described.

These digital tools were used by the project partners in the development of the learning modules described in chapter 6. Information on the brand of equipment procured and used in the project can be found at the end in Annex 1. As there is a wide range of equipment on the market, the DERIN project team purchased the equipment that they felt offered the best value for money within the available budget. The equipment specifications listed in this chapter are factors that were considered when deciding which equipment to purchase. Some of the equipment mentioned here was not purchased as part of the project as it was already owned by the project partners. However, these devices were used to create the learning materials.

Therefore, this chapter is divided into activities where these devices were used and describes how they were used. We hope that this chapter will be useful to trainers when they start procuring equipment for development of their virtual training scenarios.

5.1 Filming

For filming you will need a camera, microphone, tripod, spotlight and memory card for the camera

When the 360-degree camera was procured (see Annex 1 for information on exactly which devices were procured and used), general information was evaluated to ensure that the devices were equipped with the required functions:

- high video resolution 4K or higher (4K wide angle)
- 360° recording function, professional lens
- connection of an internal or external microphone
- image stabilisation – Flow State Stabilization
- robust, versatile recording modes
- rugged
- waterproof to 5m
- auto frame
- hyperlapse
- point to track
- voice control
- slow motion
- HDR Photo + Video
- Night Shot
- video in MP4 file format, memory card
- equipped with invisible selfie stick, rotating handle, extension rod
- compatible with Android or Apple software for mobile app
- Wifi and bluetooth connections.

The camera is used to film scenes for the learning modules in VR. Each scene is filmed in 360° and can be used for indoor or outdoor shots. The camera has an internal microphone that can be used and supports an external microphone connected via a USB-C adapter or via Bluetooth connection, which can be purchased separately.

Check what micro SD memory cards are compatible with the camera. In procuring the microSD memory card (see Annex 1 for more details), general information was evaluated to ensure that the card has required specifications:

- speed class: UHS -I V30 (up to 160MB/s read and 90MB/s write speeds for fast shooting and transfers)
- capacity: maximum 1T , min. 256GB
- format card: exFAT(FAT64).

After using the camera, here are a few lessons learnt:

- Use a mobile app to control the camera remotely (start, stop, etc.). Use desktop app only for editing.
- Check what micro SD cards are compatible with the camera.
- If the shooting takes place in a darkened room, a spotlight is also needed.
- The distance between the camera and the trainer/console/screen should be 1.5 metres.
- If you are using an internal microphone, you should not stand more than 1.5 m away from the camera. An external microphone is needed if you are filming in a noisy environment or if you are standing more than 1.5 m away from the camera. We recommend always using an external (Bluetooth) microphone to ensure high sound quality, as the built-in microphone is not very good.
- Pay attention to sounds from the background. It is always good to have some sounds that fit the situation to make the scenario seem more serious. However, make sure they are not too loud, as this can easily ruin your video and make it difficult for trainees to hear or understand the main point.
- Position the camera at the trainer's eye level, you will probably need a tripod for this. Where the camera is, there are also the eyes of the spectator, i.e., if you want the trainee to look directly into the eyes of the trainer while wearing a VR headset, you will need to mount the camera on the tripod at the level of the trainer's eyes. If you want the trainee to sit like in a classroom, you need to lower the position of the camera. Play with the height depending on your scenario.
- Filming in different locations is possible.
- The tripod becomes visible in VR surroundings when you look down. So that the tripod is not visible in this case, the logo of the DERIN project was used.
- Do not change the camera height during the shoot, because trainees will feel that things are getting bigger or smaller, higher, or lower during the scenario. Only change the height if you want to give the impression that you are sitting down.
- Clean the camera lenses between scenes. If the lens is accidentally touched, your video will be recorded with fingerprints or blurred.
- Hide during filming. With 360° cameras there is no way to "hide behind the camera" as they record the entire space around them. So, make sure there is somewhere to hide and not interrupt the scene you have in mind.
- If you have other trainers in your scenario, tell them to look directly into the camera lens, because when the trainees see the scenario, it will look like the trainer is looking directly at them and talking to them, which makes the scenario more realistic.
- Shoot each scene at least twice, just to be safe and have more choice when editing.
- Film extra seconds at the end of each scene where the trainer or room remains in the last position. This is necessary to create a video loop. After the end of a scene,

the trainees need some time to read the question you are going to ask them and decide on an answer. During this time, it will not look realistic if the video freezes. Therefore, you can set up a loop that repeats until the player moves on to the next scene.

5.2 Editing video

To edit the video, you will need a powerful desktop computer, editing software and a video transcoder.

For visual rendering, the desktop computer must have dedicated graphics cards, such as:

- nVidia RTX, GTX series
- AMD Radeon series

The software for editing was not additionally procured as it was included with the camera. This software was used to edit the video. As the video was quite large, it was converted to a smaller mp4 format (at 3840x1920 px, the size for 1 minute of video is about 500MB). Free video transcoder software was used to transcode the video into a lower resolution format for editing (see Annex 1 for more details).

On VR we can use either a 5K monoscopic or a 4K stereoscopic display, depending on which video you upload. Monoscopic videos show the same video for both eyes. Stereoscopic videos show a slightly different video for each eye to create a more 3D-like experience. This is especially helpful when gaming with special VR headsets like the Oculus Quest 2 or the Pico G2 4K.

- Monoscopic: H.265 - 5120 x 2560 pixels (5K)
- Stereoscopic: H.265 - 3840 x 3840 pixels (4K)

Video	Monoscopic 360°	Stereoscopic 360°
Resolution:	at least 3840 x 1920 pixels, preferably 5120 x 2560 pixels	at least 3840 x 3840 pixels, preferably 5120 x 5120 pixels (top/bottom format)
Frame rate:	at least 25 fps, preferably 30 fps	at least 25 fps, preferably 30 fps
Container:	MP4	MP4
Codec:	H.264 (AVC) or H.265 (HEVC)	H.264 or H.265
Bitrate:	variable bitrate (VBR), at least 150 Mbps	variable bitrate (VBR), at least 150 Mbps
Audio: Codec:	AAC, stereo, sampling rate 48, bit rate 320	AAC, stereo, sampling rate 48, bit rate 320

5.3 Developing virtual training scenarios

When developing VR scenarios, the hardware to be used and its technical characteristics should be the following:

- A user-friendly SaaS platform with great flexibility to create, distribute and analyse interactive training scenarios based on 360° videos and a story-based approach that combines cognitive, experiential, and behavioural learning to maximise impact.
- Store, load, distribute and analyse VR training scenarios to provide assessments and feedback for evaluation purposes.

After filming a 360° video, transcoding the video, and converting it to mp4, you need to upload it somewhere. A central platform/hub is required for the creation, distribution, and analysis of real and immersive training scenarios (see Annex 1 for information on exactly what platform/hub was procured and used).

When selecting the platform/hub, it is helpful if it is intuitive and easy to use. Check what kind of information/support the hub offers, e.g. answers by email/determined calls with its experts to questions the scenario developer might have, tutorials, recommendations for equipment to use, etc.

For the development of the virtual training scenarios, the trainer must have a manager role on the platform/hub (Figure 63) assigned by the licence holder. In developing the virtual training scenarios, we have learnt the following lessons:

- before you start, first click on an existing scenario (Figure 64) so you understand what you need to do. You will then see the scenarios that have already been published. This is good for inspiration.
- when creating the cover image, pay attention to the specific dimensions you need
- the maximum number of scenes (Figure 65) can be set with your licence. About 30 scenes may be sufficient for a module.
- create your scenario as an idea sketch first (sketch on paper what the scenario should look like, focus on the learning objectives).
- type of scenes are Information / Multiple Choice / Direction / Automatic Transition / Hotspot / End. Hotspots are the only scenes where you can do something, interact with the environment, e.g., press a button.
- the timeline of the scenario is normally shown as a flow (Figure 66).

5.4 VR headset

For execution of training, you need a VR headset. When the VR headset was procured (see Annex 1 for information on exactly which devices were procured and used), general information was evaluated to ensure that the devices were equipped with the required functions:

- crystal clear display fast-switch - 4K LCD or LED
- fast CPU, GPU
- comfortable to wear
- allows room-scale play, seated or standing
- compatible with software
- USB ports, 3DOF tracking, audio, memory
- controller for both hands
- supports 6 degrees of freedom for head and hand tracking
- audio: built-in speakers and microphone; also compatible with 3.5 mm headphones
- battery life: between 2-3 hours, depending on the type of content you use.

6 LEARNING MODULES

In today's reality, most trainees are young people or even teenagers who work with digital technologies and electronic formats daily. This is an advantage for the easier perception of learning materials presented through digital technologies.

At the same time, however, for the natural, purely psychological perception of the material, a presenter must be present. The moderator can be represented in the 3D film as a real person or by an avatar, which should be as close as possible to a real person; you can even create a digital copy of one of the trainers. To achieve the goals set, the environment of VR must be so close to reality that objects can be clearly recognised and up to 6 axes of freedom can be executed with over 95% realism.

The principles and methods described in IMO MC 6.09 [57] and IMO MC 6.10 [58] are used to plan an effective learning environment and to implement the learning process by using digital technologies.

NB! At the beginning it should be explained to the trainees that the DIGITAL TECHNOLOGY PLUS the HARDWARE UNITS, on which it is presented, is a TOOL (and not an alternative reality) for achieving the learning objectives - the acquisition of the necessary knowledge and skills to acquire the relevant competences.

VR / AR / Digital technologies are TOOLS!

The project partners have selected three learning modules that can be adapted to innovative multimedia tools, applications and resources and still meet the requirements of STCW 2010 as amended and ES QIN 2020. The selected modules are:

1. Familiarisation with the Engine – part of the model course 2.0
2. Familiarisation with the Bridge – part of the model course 1.22
3. Fire Prevention and Basic Fire Fighting – Use of breathing apparatus for fighting fires – part of the model course 1.20.

The learning outcomes of these learning modules (hours per lessen, types of e-learning content, list of materials available to the trainee, learning objectives, instructional methods, level of evaluation, communication and collaboration tools used for e-learning, learning platform, equipment needed etc.) are listed at the end of the handbook in Annexes 2, 3, 4 and 5. The learning outcomes were created based on the FAO eLearning Academy's Guide [22] for designing and delivering e-learning solutions.

To play the scenario, you need to download the application WARP VR to your smartphone[8], computer, tablet or VR. Interested parties can access the scenarios via the links at [59] and [60]:

1. Familiarisation with the Engine
2. Familiarisation with the Bridge
3. Fire Prevention and Basic Fire Fighting.

[8] The scenarios developed in this project are suitable for all smartphones with more than 3 GB of memory.

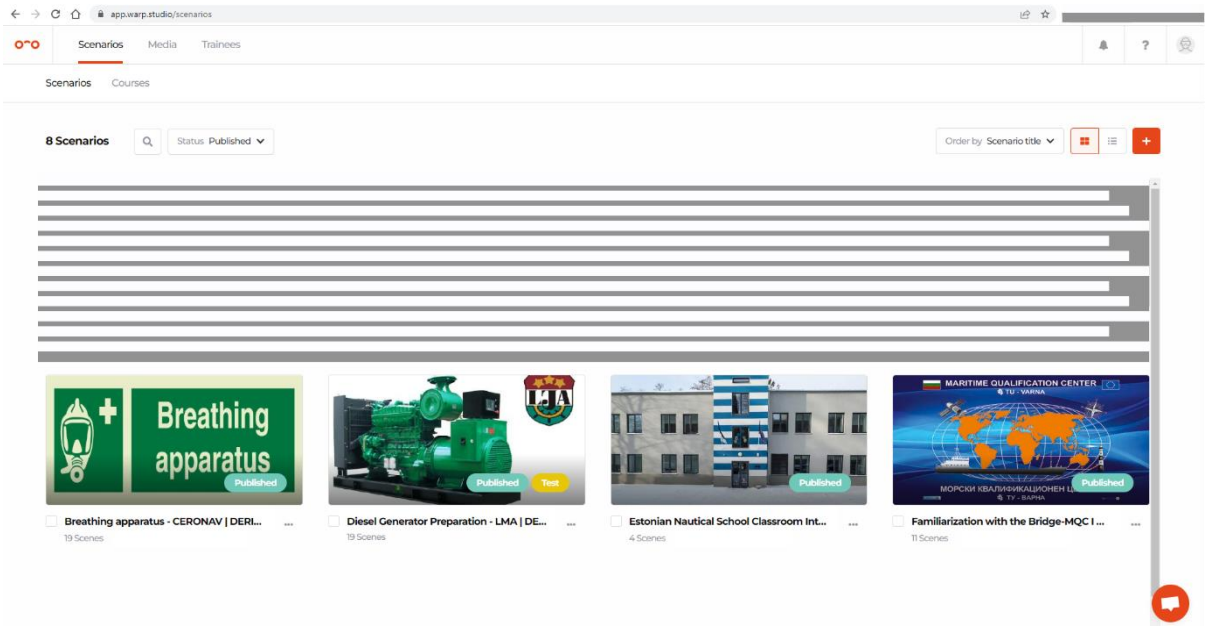


Figure 11. DERIN project scenarios in Warp VR studio

You can also see videos of all these learning modules on the project's YouTube page: https://www.youtube.com/@DERINPROJECT [61].

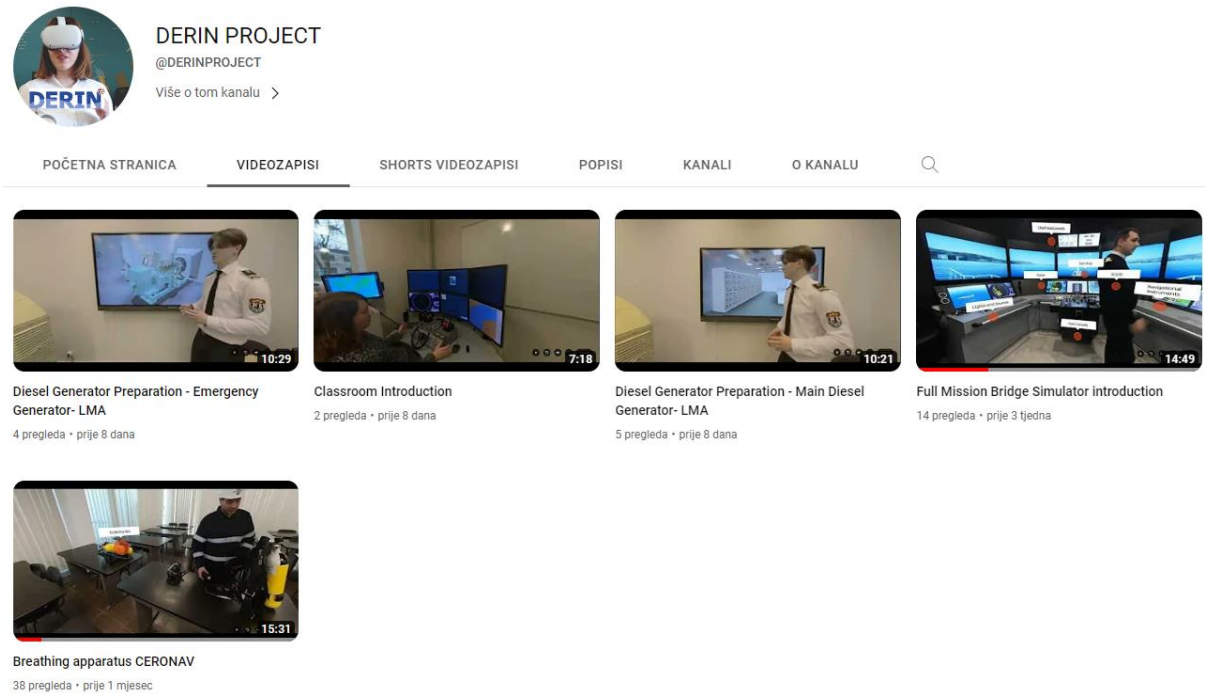


Figure 12. DERIN project YouTube page
Source: [61]

6.1 Familiarisation with the Engine

This module is based on the IMO model course 2.07 [62]. For more information, please contact Mr. Maksims Vorobjovs by email: maksims.vorobjovs@latja.lv

Interested parties can access to this scenario via links at [59] or [60].

6.1.1 Multimedia learning material

The IMO Model Course 2.07 contains a minimum amount of material in line with the syllabus and can be supplemented for a better understanding of the systems. Most of the training material will be presented in general terms and the rest will be implemented at the hardware level.

The trainer will use a mix of teaching methods to maximise learning. The curriculum is formulated in terms of learning objectives and each objective defines what the trainee should be able to do as a learning outcome.

6.1.2 Scenario using VR device

The Engine Room Simulator Course includes several levels where trainees work with a simulator to perform tasks relevant to their duties on board. The Virtual Reality (VR) module, specifically "Familiarisation with the Engine", presents a scenario in which the instructor demonstrates the various components of the engine room. Through virtual participation, trainees can familiarise themselves with the engine room environment and become familiar with its layout and various components.

The scenarios considered in this chapter are basic scenarios. The trainer can change and add to the scenarios, limited by possibilities of hardware, software and variability. The main objective of the session is to familiarise the trainer with the tools and software of VR. The trainer needs to know how to run the exercises in the VR environment.

The main objective of this course is to familiarise the trainees with the main and auxiliary systems of the engine room using the VR set. The training consists of a series of tasks that the trainees performs as instructed by the trainer and then repeats independently. The tasks are steps to prepare the machine for a particular mode of operation.

The VR scenario offers the flexibility of repetition and self-directed learning. Course participants can repeat specific steps as needed or revisit the entire scenario to deepen their understanding and improve their skills. This iterative process allows them to master the original procedure and ensure they are well prepared to perform the task safely in real-life scenarios.

By using VR technology, the scenario bridges the gap between theoretical knowledge and practical application. Students can visualise the engine room and its components, develop a better understanding of its functions and grasp the importance of proper controls and procedures for a safe and efficient generator start.

The VR Scenario *Familiarisation with the Engine* provides comprehensive training for trainees to learn how to start a marine diesel generator. It begins with an introduction to the concept of generator starting, allowing trainees to choose between an emergency generator and a diesel power plant. Through a series of interactive steps, such as familiarising themselves with the layout and components of the engine room, understanding the importance of checking fluid levels and learning the correct procedures for starting and stopping the generator using batteries or hydraulic systems, trainees gain

hands-on experience in a virtual environment. The scenario also includes checkpoints where trainees can receive feedback on their answers and review the lessons as needed. By immersing themselves in this VR training, trainees can develop the knowledge and skills required to safely and effectively start a marine diesel generator, improve their understanding of engine room operations and promote a culture of safety in the maritime industry.

The VR scenario also offers the flexibility of repetition and self-paced learning. Trainees can repeat specific steps as needed or revisit the entire scenario to deepen their understanding and improve their skills. This iterative process allows them to master the original procedure and ensure they are well prepared to perform the task safely in real-life scenarios.

By using VR technology, the scenario bridges the gap between theoretical knowledge and practical application. Trainees can visualise the engine room and its components, develop a better understanding of its functions and grasp the importance of proper controls and procedures for a safe and efficient generator start.

Figure 13. Diesel generator engine
Source: RTU - LMA laboratory/ Maksims Vorobjovs

6.1.3 Train the trainer session

The train-the-trainer session should be accompanied by detailed documentation, diagrams and instructions for starting the marine diesel generator, which are essential for developing the VR scenario. These materials provide the necessary information and guidelines to ensure accuracy and realism in the virtual training experience.

6.2 Familiarisation with the Bridge

This module is based on the IMO model course 1.22 [63]. For more information, please contact Mr Petar Gembeshev by email: petar.gembeshev@tu-varna.bg.

Interested parties can access to this scenario via link at [60].

6.2.1 Multimedia learning material

Within IMO Model Course 1.22 there is a range of lectures and demonstration materials in line with the syllabus. Most of the learning material is presented in a general approach, with the remainder tailored to the specific type of equipment.

The presentation of concepts and methods can be repeated in a variety of ways, as needed, until the trainer is satisfied that the trainee has achieved each specific learning objective. The syllabus is structured in terms of learning objectives and each objective states what the *trainee must be able to do* as a learning outcome.

Figure 14. Full Mission Bridge 360 Degrees (front view)
Source: MQC TU-Varna

6.2.2 Scenario using VR device

The main objective of the session *Familiarisation with the Bridge using VR device* is to familiarise trainees with the layout of the bridge and console, where the different instruments and controls are located and how to operate them.

A trainer voice introduces the bridge: main console, navigational instruments, lights and sounds, radar, overhead panels, conning, ECDIS, and GMDSS to the trainees.

Figure 15. VR Perspective view of Full Mission Bridge 360 Degrees
Source: MQC TU-Varna

Figure 16. VR front view of Full Mission Bridge 360 Degrees, Console, and Instruments
Source: MQC TU-Varna

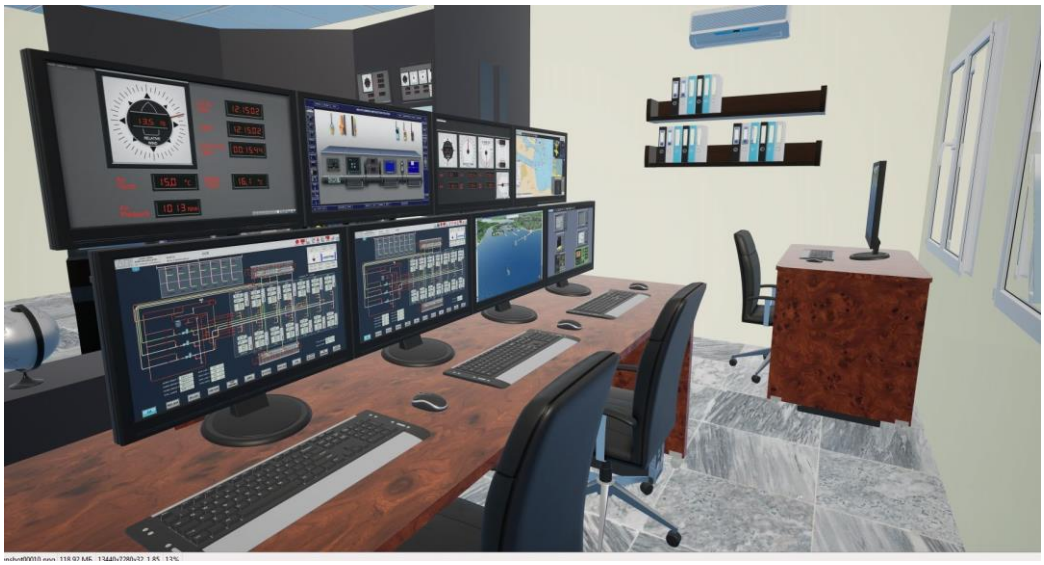


Figure 17. VR view of Trainer station
Source: MQC TU-Varna

6.2.3 Train the trainer session

This handbook reflects the views of the course designers on methodology and organisation and what they consider relevant and important based on their experience as trainers. Although the guidance given should be of use initially, the course designers should work out their own methods and ideas, refining and developing what is successful and discarding ideas that do not work.

Preparation and planning make an important contribution to the effective presentation of the course. If necessary, learning objectives should be adapted to consider the capabilities and limitations of the simulator and the equipment used.

The practical exercises and demonstrations on the simulator form the main content of the course.

6.2.4 Examination of exercises

Each newly created exercise scenario should be checked and examined by trainer different from the designer. After the precheck of the scenario and applied corrections, if any, the exercise is loaded into the simulator for full performance. This operation should be done by the designer and a senior trainer as a supervisor, all the remarks occurred during the exercise must be discussed and if needed corrections made to achieve all the goals.

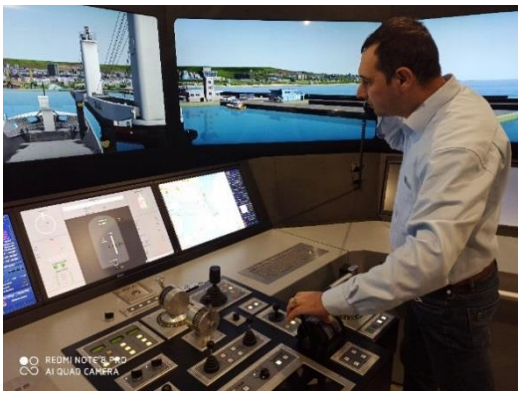


Figure 18. Exercise testing, Test trainer

Figure 19. Exercise Assessing, Senior Test trainer

Source: MQC TU-Varna

6.2.5 Monitoring of exercises

During the exercises, the trainer is responsible for monitoring and controlling the target vessels (target planers), recording the exercise, and preparing a summary for debriefing. The second trainer should supervise the trainees at work. His/her task depends on the skills and competences of the trainees.

The Assessment Tool Software Module (Figure 20) can be used to log the trainer's work during the ongoing exercise. All his data will be used later in the debriefing for the purpose of analysis.

Figure 20. Assessment Tool Software Module Screen
Source: MQC TU-Varna

6.2.6 Creating an exercise

Exercises are the most common element in this course. And they are a powerful tool for the trainer. Therefore, most of the parameters and values should be considered at the beginning of the scenario planning phase before the physical creation takes place in the software. All detailed information must be listed in terms of spatial, time, object, feature and value. Each scenario is written in textual and graphical form in a file and reviewed by another trainer. Then the designer can proceed with the physical creation in the software as follows:

- Select the environment (port or area from the library).
- Select the type of objects and their starting positions:
    - Sea objects - trainee vessel/s, TPs, buoys.
    - Set the vector tug(s) and its/their connection.
    - Apply the parameters of TP (vessel/s from the library, inserting WPs, setting speed and type of movement (stop at the last WP / go around / go to the last WP and disappear).
    - Land objects (bollards, port facility objects)
    - Static (type of bollards, fenders, vessels, etc.)
- Selection of connections - if necessary
- Setting realistic weather conditions (sea state, wind, wave direction and length, tides, clouds, rain, fog, thunder, time period).

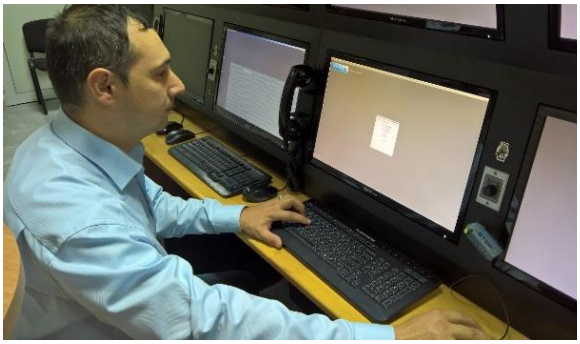


Figure 21. Starting Nautis Software

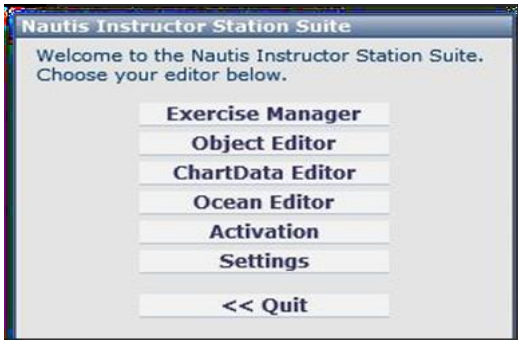


Figure 22. Main menu Options

Source: MQC TU-Varna

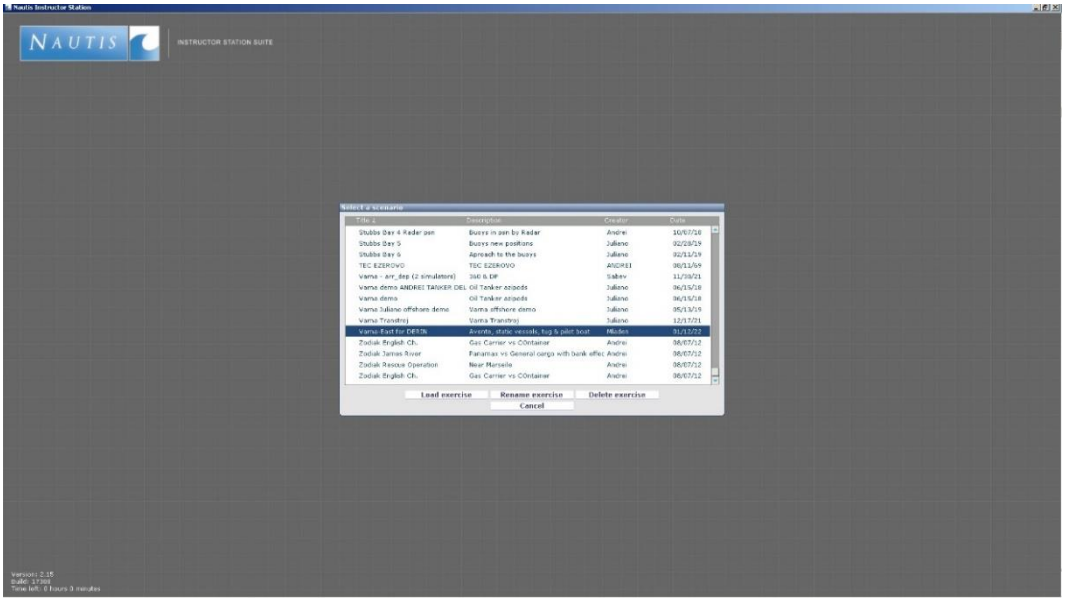


Figure 23. Select Environment

Source: MQC TU-Varna

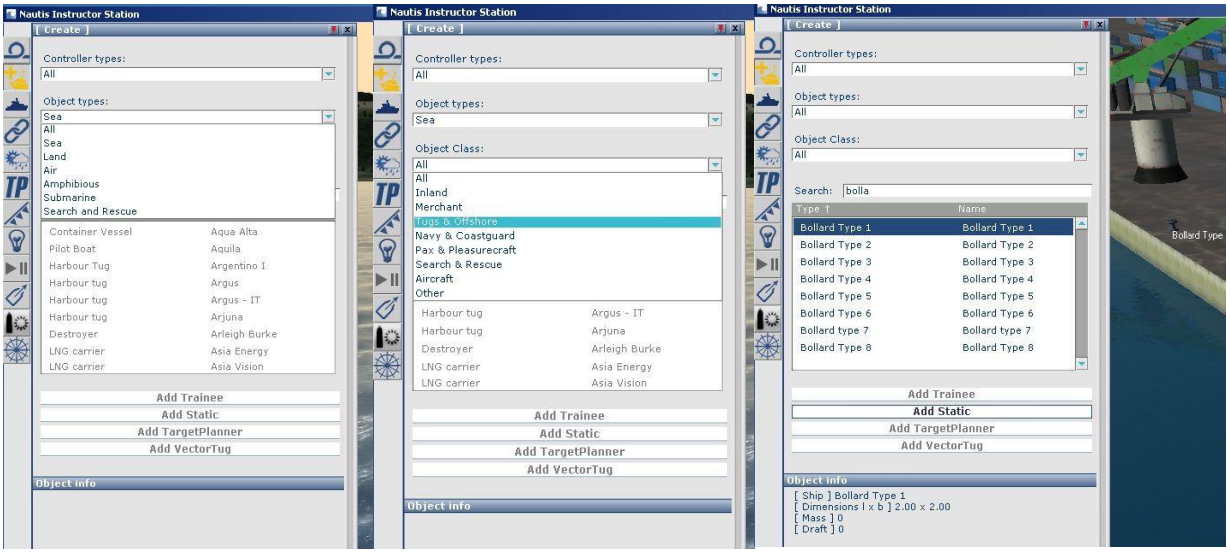


Figure 24. Adding Objects and Features in the Environment

Source: MQC TU-Varna

Figure 25. Adding Target planner, Set movement parameters
Source: MQC TU-Varna

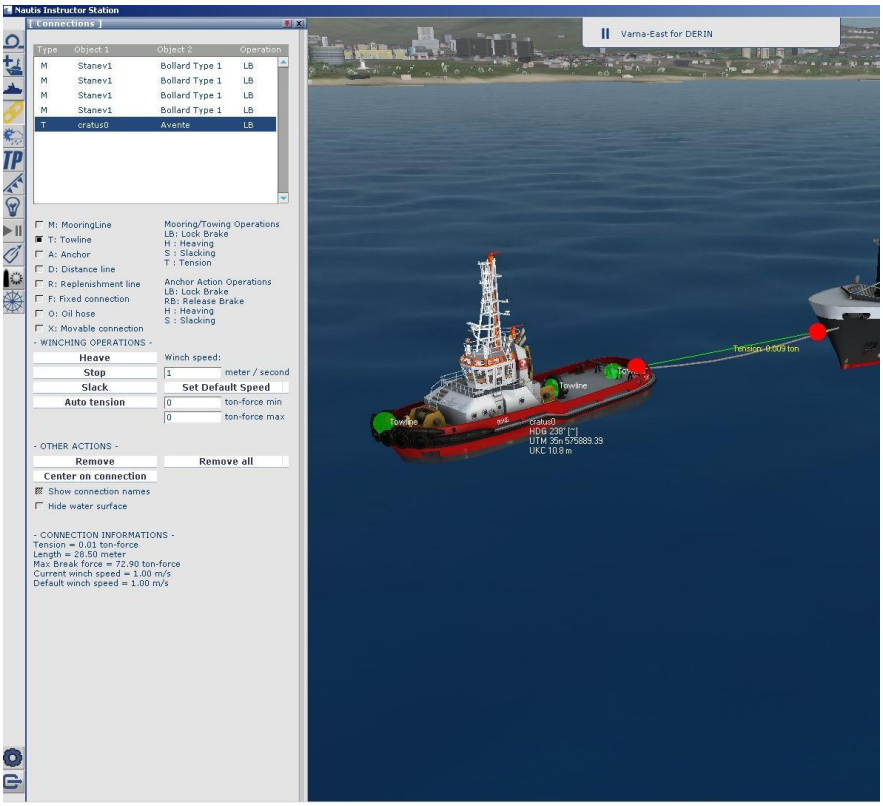


Figure 26. Select Connections type & point, Set connection parameters
Source: MQC TU-Varna

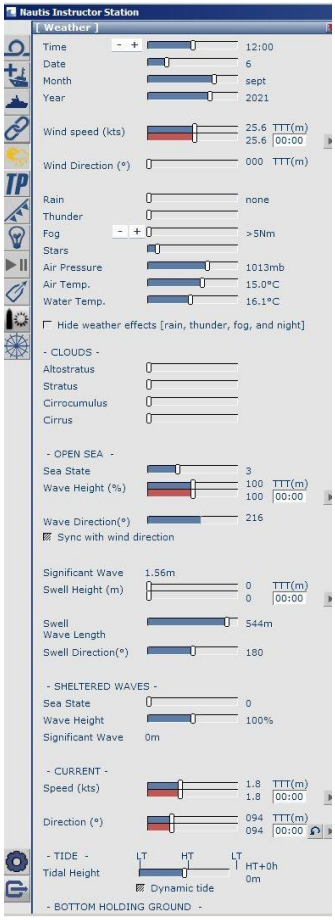


Figure 27. Set Weather Conditions

If a particular vessel is to be included in the exercise scenario but is not present in the Nautis software library as a default model, dynamics, propulsion, stability, etc., there is an "Object Editor" menu that provides the exercise designer with the necessary tools to modify each vessel.

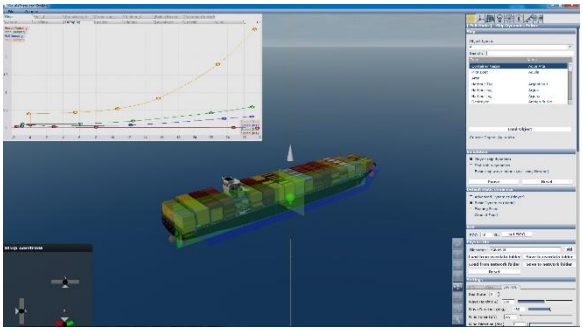


Figure 28. Changing of Dynamic characteristics, *Object Editor menu*

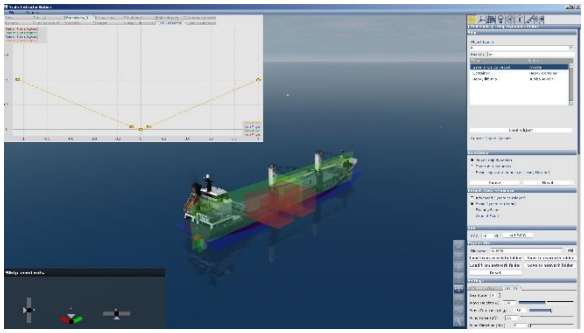


Figure 29. Changing of Propulsion characteristics, *Object Editor menu*

Source: MQC TU-Varna

After you have carried out all the above steps, the result should be a finished exercise scenario. For this scenario to be included in the existing library scenarios, it should be saved with an appropriate name, a short description and an author name.

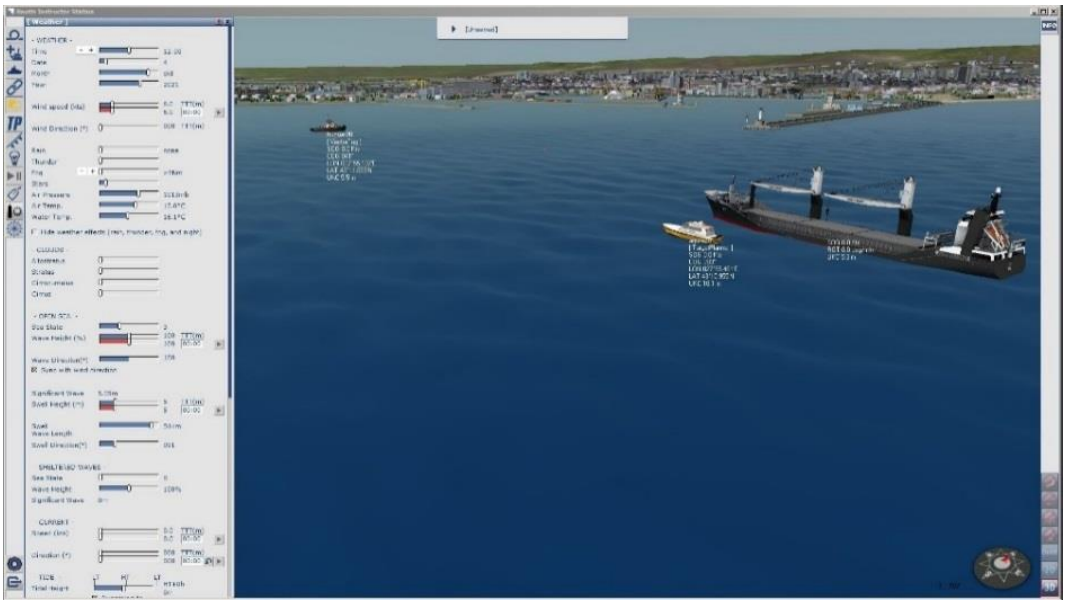


Figure 30. Exercise Created, On Pause

Source: MQC TU-Varna

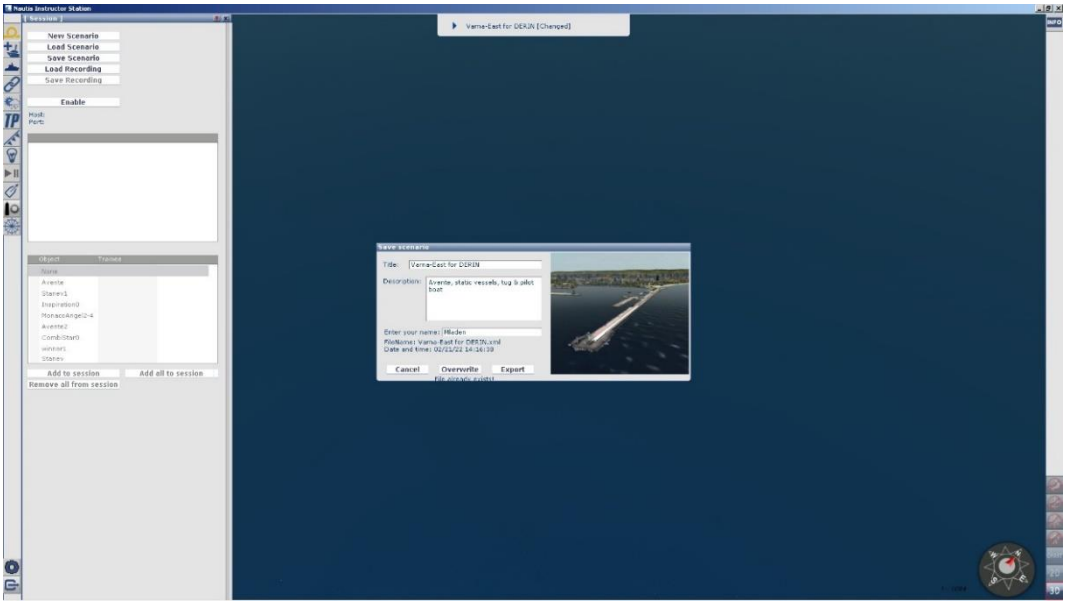


Figure 31. Exercise Title, Description and Author
Source: MQC TU-Varna

6.2.6.1.1 Connecting the console

The Full Mission Bridge 360 Degrees and the trainer station should be switched on, the Nautis software must be started on the trainer station.

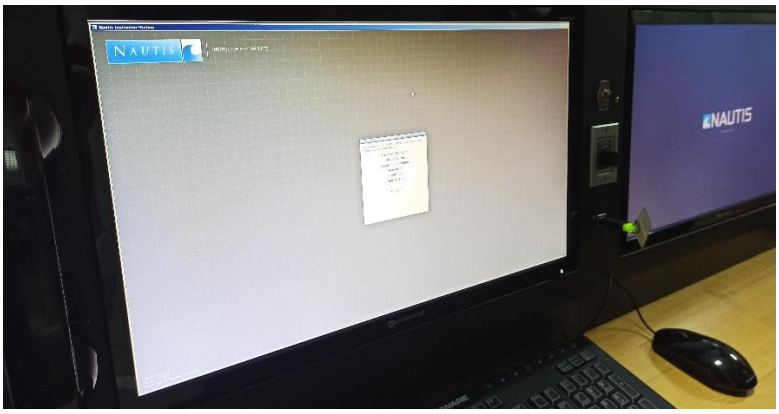


Figure 32.
Nautis Software started

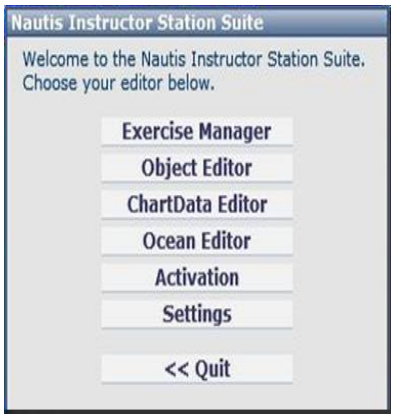


Figure 33.
Nautis Main menu

Source: MQC TU-Varna

After starting the Nautis software, the trainer must load an existing scenario (exercise) from the library (already created and saved) or create and load a new scenario. Once the exercise is loaded, the Nautis software automatically sends pings[9] to the training station(s) (Full Mission Bridge 360 Degrees) for connection.

[9] A ping is a short, high-pitched ringing sound. It means that you exercise is ready to use.

Figure 34. Selecting Trainer Mode

Figure 35. Connecting to Trainer station

Figure 36. Connecting the Console

Source: MQC TU-Varna

When the training vessel is selected from the "field" of all vessels involved in the exercise, a red dot starts flashing in front of the selected ship on the trainer station. If the trainer station successfully establishes the protocol connection, the colour of the dot changes to green.

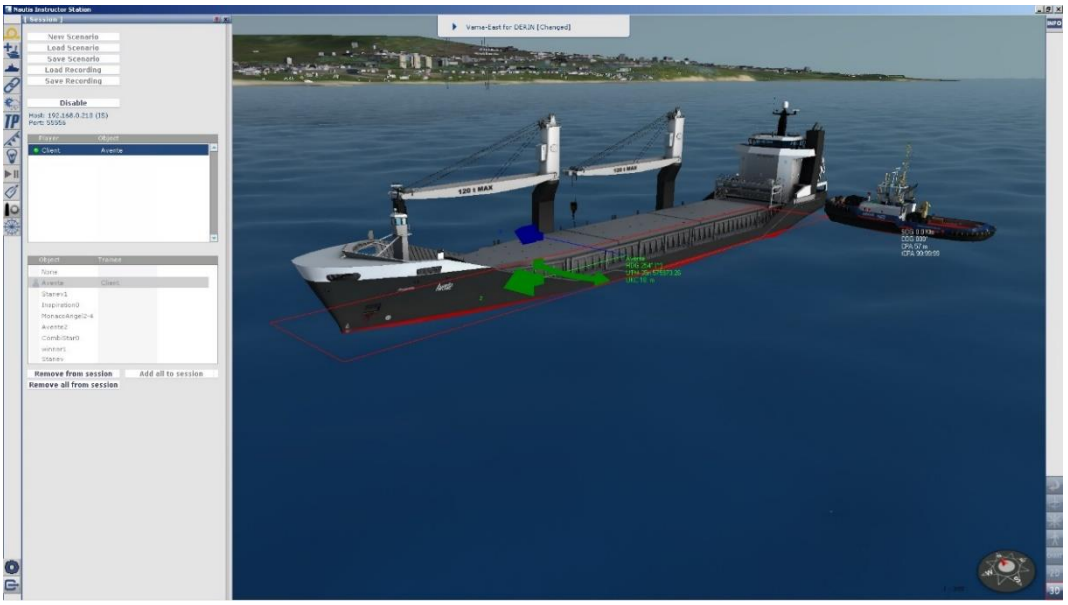


Figure 37. Connecting the Trainee station

Source: MQC TU-Varna

Figure 38. Bridge Connected to Trainer station, Environment selected; Exercise loaded

Source: MQC TU-Varna

6.2.6.1.2 Executing the exercise with the trainees

The main objective of the exercises is to provide trainees with a thorough understanding of how manoeuvre data is obtained so that they can make better use of this information. The trainees should also be able to improve or enhance this data on board the vessels after completing the course.

When conducting the exercises, it is of utmost importance that the initial course and speed are exact and well established before the manoeuvre begins. Otherwise, the results cannot be compared with other data from the same manoeuvre. If possible, some of these manoeuvres must be performed by two vessels, one with a fixed pitch propeller and one with a controllable pitch propeller. At least one manoeuvre should be repeated with the loaded and the ballasted vessel to demonstrate the difference in behaviour.

All types of standard manoeuvres should be simulated in all realistic weather conditions, with an additional emergency added by the trainer according to the syllabus.

Figure 40. Ongoing Exercise
Source: MQC TU-Varna

Figure 39. Ongoing Exercise (Trainer station) Trainer in role of: VTS, Pilot Service & Tug Master

6.2.6.1.3 Debriefing

Debriefing is an important phase of a simulation because it is here that the lessons learnt are consolidated.

The amount of time spent debriefing can vary from exercise to exercise and should be between 25 and 30 per cent of the total time spent on simulator exercises. There are different ways to support debriefing, e.g. playback. In the assessment tool software, the entire exercise is recorded, and each sequence is available for discussion.

The trainer refers to the summary made during the exercise to raise important points and to guide the discussion among the trainees. He should avoid imposing his own opinion but ensure that the trainees always use safe and correct procedures.

Figure 41. Debriefing after Exercise

Figure 42. Guidance on Specific subject areas

Source: MQC TU-Varna

6.2.7 Ideas for future exercise - Coastal scenario

The exercises should give as realistic an impression as possible. Exceptions can be made for the demonstration of some effects.

At the beginning, the exercises should be simple so that the trainees can appreciate the realism of the simulator. As the course progresses, the exercises should become more complicated.

During the course, different types of scenarios should be created and successfully performed.

Coastal scenario

The coastal scenario is used for the familiarisation exercises, which are designed to familiarise the trainees with the layout and equipment of the bridge and to give them their first practical experience of handling the ship. The coastal scenario is also used for the manoeuvring trials, which should have an area where shallow water manoeuvres can be carried out.

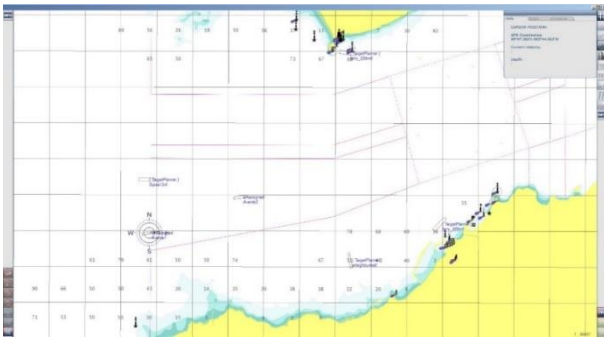


Figure 43. Chart view of Coastal Scenario

Figure 44. 3D view of Coastal Scenario

Source: MQC TU-Varna

6.2.7.1 Restricted-water scenario

This scenario should begin where the coastal scenario ends and gradually narrow. The scenario should end at the harbour scenario. The restricted water scenario is used most of the time and should include TSS and VTS.

There must be realistic weather conditions.

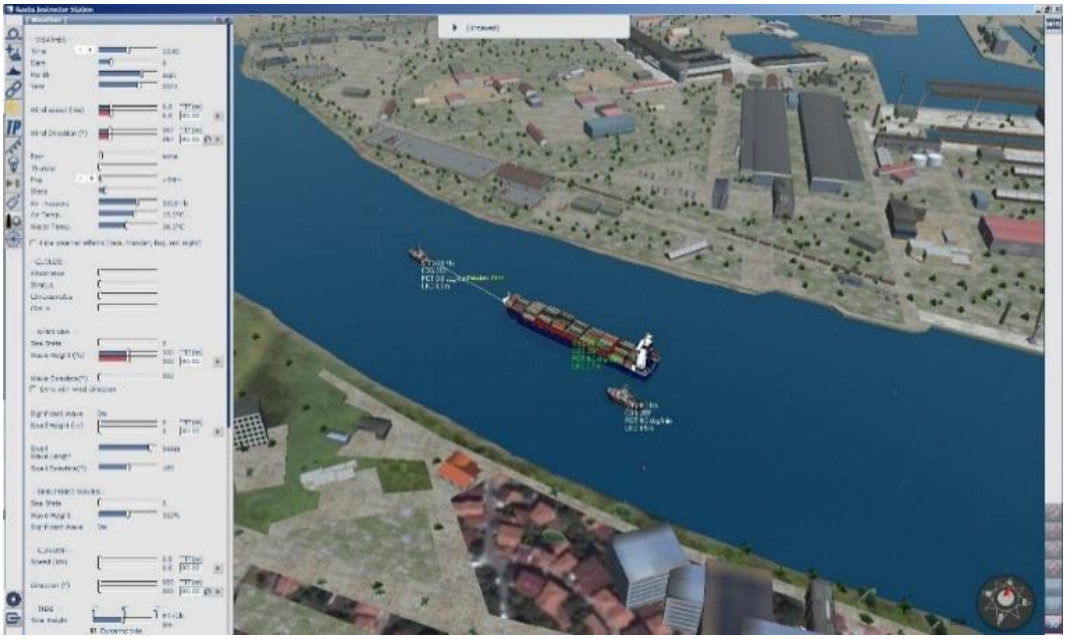


Figure 45. Restricted Waters Scenario (Channel 1, Port Varna), Weather Menu
Source: MQC TU-Varna

6.2.7.2 Harbour scenario

The harbour scenario should start at the docks and pass-through narrow channels into the restricted water scenario.

A certain number of objects must be present in the environment to fulfil the specific tasks for this type of scenario. These include tugs, pilot boats, bollards, connections and their parameter values, cargoes at the quays, vessels moored along the pier if required, fenders, cranes, etc.

There must be realistic weather conditions.

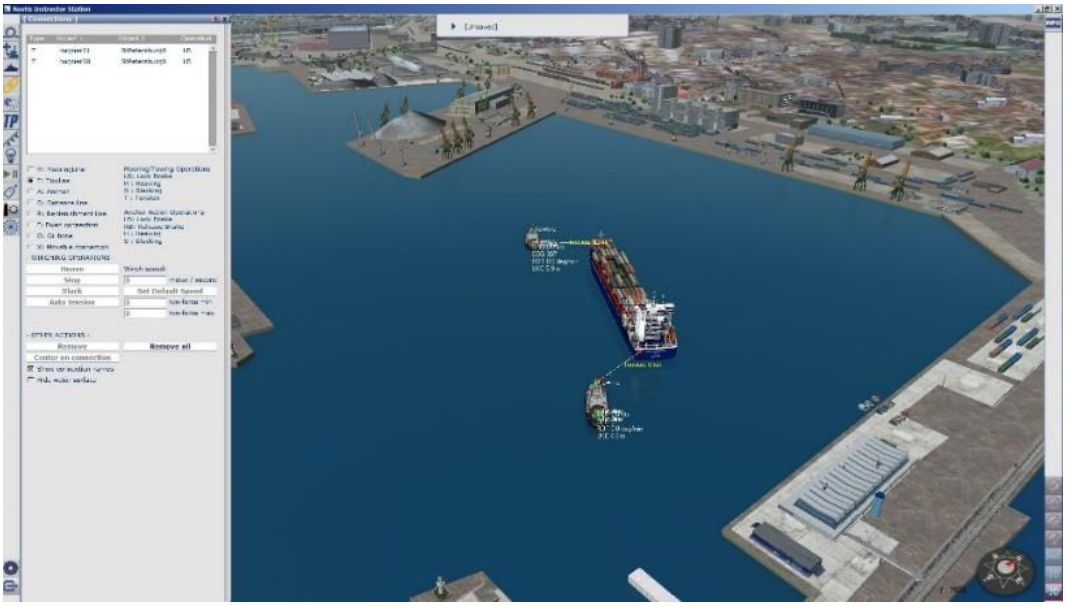


Figure 46. Harbour Scenario (Port Varna-East), Connections Menu
Source: MQC TU-Varna

6.2.7.3 Wind and current effects

The trainer shows the trainees how wind and current affect the manoeuvrability of the ship. It is advisable to do some of these exercises with those under "Standard manoeuvres" [64] (90% of Vmax; Turning circle manoeuvre to both starboard and port with 35° rudder angle or the maximum rudder angle permissible at the test speed; 10°/10° Zig-zag test & 20°/20° Zig-zag test; Full astern stopping test). By plotting the results of the same manoeuvre under different conditions, trainees will get a visual impression of the effects.

Within the wind and current effect, the specific parameters for the area must be applied to make the environment more realistic.

Figure 47. Wind and Current Effects Applied, Weather Menu
Source: MQC TU-Varna

Figure 48. Wind and Current Effects on Bridge
Source: MQC TU-Varna

6.2.7.4 Anchoring and single-buoy mooring

The trainer should emphasise the importance of making plans for anchoring and mooring to a single buoy. Trainees must use the manoeuvre data when planning the approach. The plan should include details of approach courses and trajectories, wheel-over positions, and points at which to reduce speed and reverse engines. It should also include the method for monitoring progress and determining when these positions have been reached.

The plan should also include a contingency plan describing the actions to be taken if something goes wrong.

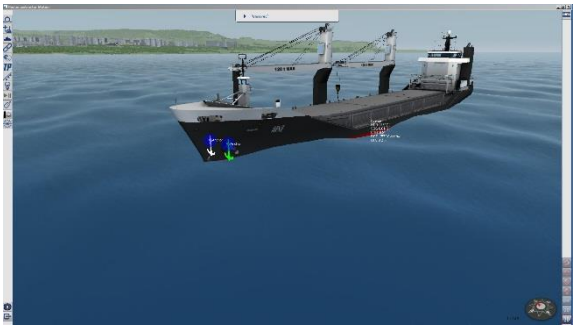


Figure 49. Initial position for Anchoring, Anchors activated, *Connections Menu (hidden)*

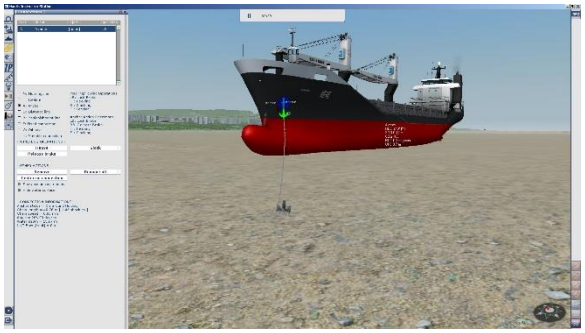


Figure 50. Anchor dropped, water removed, *Connections Menu*

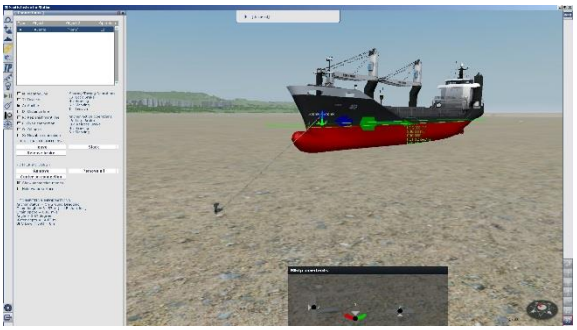


Figure 51. Anchor chain laying, water removed, *Connections Menu*

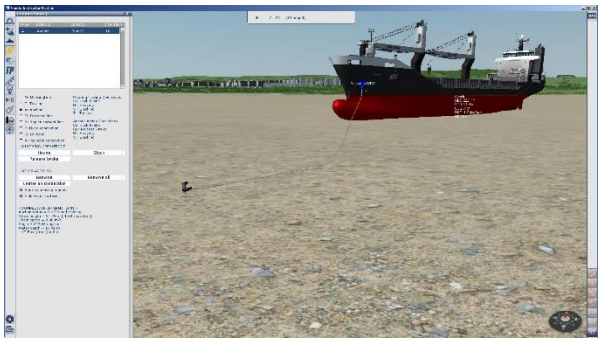


Figure 52. Vessel at Anchor, water removed, *Connections Menu*

Source: MQC TU-Varna

Figure 53. Single-buoy mooring
Source: MQC TU-Varna

6.3 Fire Prevention and Fire Fighting

This module is based on IMO Model Course 1.20 [65], paragraphs 3.17 and 3.18, which has been adapted so that VR scenarios can be created and used in training exercises. For more information, please contact Mr Dragos Filimon by email: dragosfilimon@ceronav.ro

A mobile device is necessary for the course/ scenario To play the scenario you need to download the WARP VR application to your smartphone, tablet or VR headest.

Interested parties can access to this scenario via link at [59].

6.3.1 Multimedia learning material on use of breathing apparatus for fighting fires

6.3.1.1 Breathing Apparatus

This part is based on IMO Model Course 1.20, paragraph 3.17. The training exercise includes the following tasks:

1. describes a self-contained compressed air operated breathing apparatus (CABA)
2. demonstrates the correct way to put on the face mask of a CABA and check that it is airtight
3. lists the checks that must be carried out on a CABA before it is used and after it has been strapped on
4. demonstrates the correct breathing technique to achieve low air consumption at a given effort when using a CABA
5. explains the reasons for not being in a toxic atmosphere until the CABA air cylinders are empty
6. explains that the pressure gauge is read at regular intervals during use and what action to take if the warning signal appears on a CABA that the air pressure is low.

Examples of exercise:

1. Describe a self-contained compressed air operated breathing apparatus (CABA)

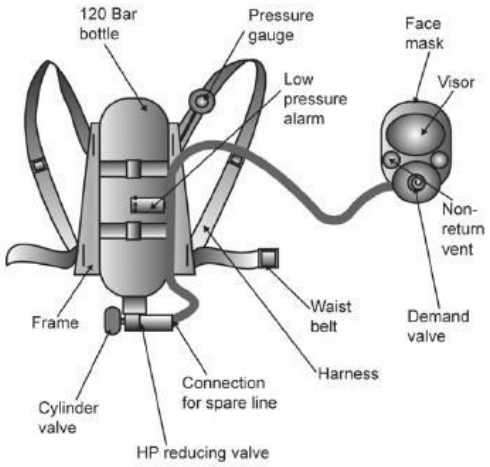


Figure 54. Self-contained compressed air operated breathing apparatus
Source: [67]

2. Demonstrate the correct way to put on the face mask of a CABA and check that it is airtight.

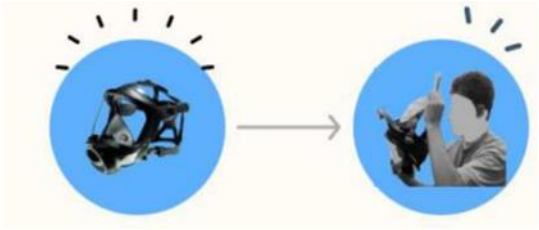


Figure 55. How to put face mask of a CABA
Source: [68]

- Step 1: Check the integrity of the mask.
- Step 2: Loosen the straps.
- Step 3: Pull the mask over your head.
- Step 4: Tighten the straps in the correct order.
- Step 5: Check the air tightness.

3. List the checks that must be carried out on a CABA before it is used and after it has been strapped on.

Figure 56. Strapping CABA
Source: [68]

- Check the integrity of the CABA set.
- Open the valve and check for pressure.
- Close the valve and check for leaks.
- Test the LP alarm.

- Wear the breathing apparatus (BA).
- Check and adjust the tightness.

4. Demonstrate the correct breathing technique to achieve low air consumption at a given effort when using a CABA.

Trainee will be shown various breathing techniques:
1. In through the nose Out through the nose.
2. In through the nose Out through the mouth.
3. In through the nose Out through the mouth, in case of emergency.

Trainee needs to identify each technique and select the advantages and disadvantages of each method from a drop-down menu.

5. Explain the reasons for not being in a toxic atmosphere until the CABA air cylinders are empty.

Choose the correct answers from a drop-down menu:
- What is a toxic atmosphere?
- Could you endanger your life?
- Do you need to be rescued?
- Could you put the rescuers in danger?

6. Explain that the pressure gauge is read at regular intervals during use and what action to take if the warning signal appears on a CABA that the air pressure is low.

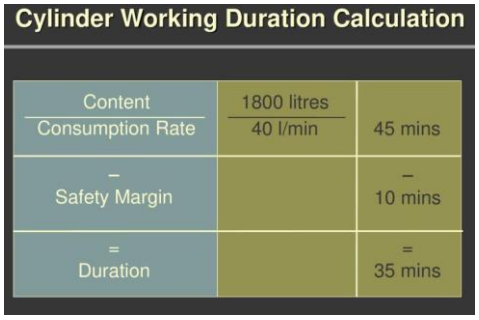


Figure 57. Cylinder Working Duration Calculation
Source: CERONAV

Given a pressure and the CABA volume, calculate the volume of air available. Select the correct answers from a drop-down menu.
- 1200 l
- 1000 l
- 1600 l

What do you do when the LP alarm goes off? Select the correct option.
- Evacuate
- Move on if safe to do so
- Call for help

6.3.1.2 Drills in smoke filled spaces

This part is based on IMO Model Course 1.20, paragraphs 3.18. The training exercises include the following:

1. demonstrates how to check and use the compressed air operated breathing apparatus (CABA)
2. demonstrates entering a small room using CABA, when the room is filled with non-toxic artificial smoke

3. demonstrates using the lifeline as a signal line in a smoke-filled room while wearing CABA
4. participates in a team exercise communicating with other team members while wearing CABA
5. demonstrates using different types of portable fire extinguishers on fires in a smoke-filled room while wearing CABA
6. demonstrates extinguishing an extensive fire, while wearing CABA, in smoky enclosed spaces, including an accommodation room or simulated engine room, using as required: water (jet, spray or mist), foam, powder.

Examples of exercise:

---

1. Demonstrates how to check and use the compressed air powered breathing apparatus (CABA)

Select the correct steps for BA tests. Dropdown menu followed by explanatory videos.

- Check integrity
- Check for pressures
- Check for leaks
- How to don the BA
- Don the mask
- Connect and breathe

---

2. Demonstrates entering a small room using CABA, when the room is filled with non-toxic artificial smoke

Figure 58. Entering a small room using CABA
Source: [69]

Get the correct answers followed by a video demo. This is how you carry out the following steps:

- Door checks
- Door opening position
- Entry position
- Technique of entering the room.

---

3. Demonstrates using the lifeline as a signal line in a smoke-filled room while wearing CABA

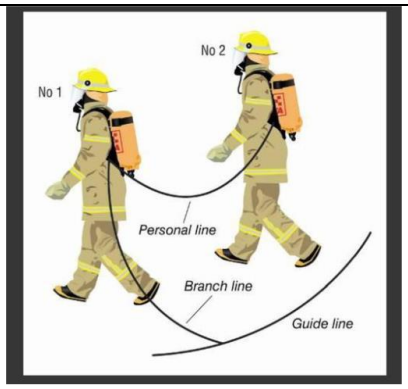


Figure 59. Lifeline use
Source: CERONAV

What does this mean? Choose the correct answer.

- 1 pull of the line ?
- 2 pulls of the line ?
- 3 pulls on the line ?
- 4 pulls on the line ?

4. Participates in a team exercise communicating with other team members while wearing CABA

Figure 60. Communicating with other team members while wearing CABA
Source: [70]

Choose the right examples. Listen to a real example of communication in fire and give answers or choose the correct understanding of the messages.

- How should one communicate?
- What equipment should be used?
- What words should be used?
- Non-verbal communication?

5. Demonstrates using different types of portable fire extinguishers on fires in a smoke-filled room while wearing CABA

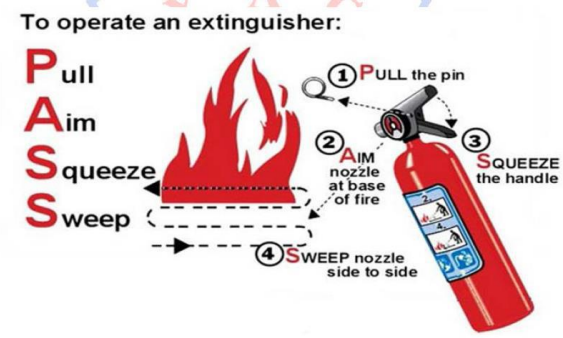


Figure 61.Use of fire extinguisher
Source:CERONAV

Select the correct video sequence.

- Identify different types of FE
- Select the correct FE

- Test it
- How do you attack the fire?

6. **Demonstrates extinguishing an extensive fire, while wearing CABA, in smoky enclosed spaces, including an accommodation room or simulated engine room, using as required: water (jet, spray or mist), foam, powder.**

Figure 62. Extinguishing an extensive fire, while wearing CABA
Source: [71]

Select the correct video sequence:
- How do you use the fire hose?
- What are the settings of the water jet?
- Where do you aim?

6.3.2 Scenario using VR device – Use of breathing apparatus for fighting fires

The BA scenario is designed to familiarise students with the components and use of the breathing apparatus. The scenario also includes some demonstrations of basic operational procedures and shows how to wear and move around with the BA. During the scenario, students are immersed in the VR environment and can interact by selecting different items or answering quiz questions.

6.3.3 Train the trainer session

Equipment and materials needed for the session:
- VR headset – Oculus Quest 2 or similar model
- Insta360 camera
- Tripod for camera height adjustment
- Internet connection
- WarpVR registration for access
- Display screen (TV or projector)

7 NETWORK OF TRAINERS

During the project, the partners organised several multiplier events to disseminate the project results and discuss ways to introduce digital training in maritime and inland navigation.

To reach a wider audience, potential future trainers, with the news of the project, a network of trainers was established, the **DeriNetwork**.

The aims of the DeriNetwork are:

- To develop and support practical arrangements for the preparation, training, and participation of maritime and inland waterway trainers in international, national, regional, and sectoral events.
- Act as a network to promote cooperation and collaboration between maritime and inland navigation E&T institutions providing or using digital training in Europe.
- To stimulate the further use of multimedia tools and applications, especially in the context of the crisis COVID -19.

This network of maritime and inland waterway trainers aims to share knowledge and cooperation between professionals in the field of digital training and to promote relevant practises across Europe.

7.1 LinkedIn group

As the project partners use LinkedIn as a medium to network with other professionals in their field of work, it was decided that this site should be used as a platform to promote cooperation and collaboration between professionals working in the field of digital training in the maritime and inland waterway sectors.

Following this conclusion, a LinkedIn group was created under the name *DeriNetwork* (https://www.linkedin.com/showcase/derin-network) and all partners became members. The project partners then invited local/national and regional stakeholders of the water transport sector as well as professionals from other VET and HE institutions to follow this group and become members using the hashtag #DeriNetwork or #DeriNetWork.

7.2 Mission statement

DeriNetwork wants to:

- Make training more attractive, improve learning and retention of what is learned, and ensure application of training in the workplace to improve performance, with the goal of increasing navigational safety and workforce mobility.
- Improve the capacity and efficiency of education and training by providing quality training for maritime and inland waterway personnel using the latest (computer-based) technologies.
- Use of VR and AR in maritime and inland navigation training to achieve a level of gamification that engages trainees' brains and makes the learning process more interactive and easier. Training becomes visual: real-life experiences are transferred to the digital world. Learning becomes safer: trainees can familiarise themselves with complex situations and risky environments and they can practise in real-life scenarios.

8 CONCLUSION

The main reason for the development of e-learning is that it can reach a wide audience, including trainees who are geographically dispersed, have little time and/or resources for travel, are busy with work or family commitments that do not allow them to attend courses at specific dates with a fixed schedule.

E-learning offers the flexibility to train anytime, anywhere. It allows training to be easily (and inexpensively) spread out over time so that it takes place over a longer period of time, thereby increasing its effectiveness. E-learning also enables the use of a variety of teaching methods, the combination of collaborative activities with individual training, and the personalisation of training pathways based on trainees' needs.

This handbook attempts to meet the needs of trainers for a reliable learning system based on innovative multimedia tools and applications that meet the needs of training different groups in different environments.

Trainers need to adapt to the demands of digital education in this field. This view embraces the quality and transferability of skills over time and in context through the development of effective digital, open, and innovative educational methods. The use of multimedia tools in maritime E&T innovates the learning approach and enriches the teaching material.

The handbook provides an overview of the required digital competence of trainers, which is one of the key competences for lifelong learning, as well as an overview of methods and best practises in maritime E&T and IWT training.

The methodology used in this handbook is fully applicable and replicable to other VET and HE institutions outside the DERIN project partnership that aim to develop, enhance, strengthen, and build capacity of trainers' competences. The learning outcomes of the course will only be achieved if trainers are sufficiently prepared to work with VR/AR and the course is well adapted to the use of VR / AR. Trainers should have sufficient digital literacy skills to use AR/VR technologies in curriculum design, create digital educational content, plan the environment for the use of digital technologies and conduct the teaching process using digital technologies.

We trust that this handbook will ensure the sustainability of the intellectual outcomes of the DERIN project and that the results will have a great impact on both trainers/lecturers and trainees/students and encourage trainers to create their own e-learning/online/model teaching materials for maritime and inland navigation education and training.

REFERENCES

[1] *Derin project web site.* Available at: http://www.derinnet.eu, 20. 6. 2022.

[2] *Derin project Grant.* Erasmus project. Available at: https://erasmus-plus.ec.europa.eu/projects/eplus-project-details#project/2020-1-RO01-KA226-VET-095726, 20. 6. 2022.

[3] European Commission, Directorate-General for Education, Youth, Sport and Culture. *Key competences for lifelong learning*. Publications Office, 2019. Available at: https://data.europa.eu/doi/10.2766/569540, 9. 5. 2022.

[4] Vuorikari, R., Kluzer, S. and Punie, Y., *DigComp 2.2: The Digital Competence Framework for Citizens - With new examples of knowledge, skills and attitudes*, EUR 31006 EN, Publications Office of the European Union, Luxembourg, 2022, ISBN 978-92-76-48882-8 (online), 978-92-76-48883-5 (print), doi:10.2760/115376 (online), 10.2760/490274 (print), JRC128415.

[5] Vuorikari R, Punie Y, Carretero Gomez S and Van Den Brande G. DigComp 2.0: *The Digital Competence Framework for Citizens. Update Phase 1: the Conceptual Reference Model*. EUR 27948 EN. Luxembourg (Luxembourg): Publications Office of the European Union; 2016. JRC101254

[6] European Commission. Digital Skills & Jobs Platform. *Self-assessment tool on Digital Skills and Jobs Platform*. Available at: https://digital-skills-jobs.europa.eu/digitalskills/screen/home, 9. 5. 2022

[7] ALL DIGITAL. DigCompSAT project of the Joint Research Council of the European Commission. *MyDigiSkills assessment tool.* Available at: https://mydigiskills.eu/, 9. 5. 2022

[8] EU Science Hub. *The European Framework for the Digital Competence of Educators.* Available at: https://joint-research-centre.ec.europa.eu/digcompedu _en, 9. 5. 2022

[9] Punie, Y., editor(s), Redecker, C., *European Framework for the Digital Competence of Educators: DigCompEdu*, EUR 28775 EN, Publications Office of the European Union, Luxembourg, 2017, ISBN 978-92-79-73718-3 (print),978-92-79-73494-6 (pdf), doi:10.2760/178382 (print), 10.2760/159770 (online), JRC107466.

[10] *DigcompEDU web*. https://digital-competence.eu/digcompedu/front, 9. 5. 2022

[11] European Education Area. *Self-reflection tool: SELFIE for TEACHERS*. Available at: https://education.ec.europa.eu/selfie-for-teachers, 9. 5. 2022

[12] European Commission Joint Research Centre (JRC). *Digital Competence Framework for Educators. SELFIEforTEACHERS.* Available at: https://educators-go-digital.jrc.ec.europa.eu, 9. 5. 2022

[13] MENTEP (Mentoring Technology-Enhanced Pedagogy). *Self-assessment tool: TET-SAT.* Available at: http://mentep.eun.org/tet-sat. 9. 5. 2022

[14] EU Survey. *DigCompEdu CheckIn for Higher Education (English).* Available at: https://ec.europa.eu/eusurvey/runner/CheckIn_HE_v2021_EN, 9. 5. 2022

[15] EU Survey. *DigCompEdu CheckIn for Higher Education (Spanish).* Available at: https://ec.europa.eu/eusurvey/runner/CheckIn_HE_v2021_ES, 9. 5. 2022

[16] Joint Research Centre, Institute for Prospective Technological Studies, Devine, J., Punie, Y., Kampylis, P., *Promoting effective digital-age learning: a European framework for digitally competent educational organisations*, Publications Office, 2015, https://data.europa.eu/doi/10.2791/54070

[17] European Education Area. *SELFIE (Self-reflection on Effective Learning by Fostering the use of Innovative Educational technologies*). Available at: https://education.ec.europa.eu/selfie, 9. 5. 2022

[18] European Education Area. SELFIE for work-based learning. Available at: https://education.ec.europa.eu/selfie/selfie-for-work-based-learning, 9. 5. 2022

[19] Hippe, R., Brolpito, A. and Broek, S., *SELFIE for work-based learning,* EUR 30836 EN, Publications Office of the European Union, Luxembourg, 2021, ISBN 978-92-76-41928-0 (online), doi:10.2760/336883 (online), JRC126317.

[20] *Digital Education Action Plan 2021-2027.* European Commission. Available at: https://ec.europa.eu/education/education-in-the-eu/digital-education-action-plan_en, 9. 5. 2022

[21] Centeno, C., European Digital Skills Certificate Feasibility Study, Publications Office of the European Union, Luxembourg, 2022, ISBN 978-92-76-48565-0 (online), doi:10.2760/645292 (online), JRC128423.

[22] Food and Agriculture Organization of the United Nations. *A guide for designing and delivering e-learning solutions from the FAO elearning Academy*, 2nd ed., Rome, 2021. Available at: https://www.fao.org/3/i2516e/i2516e.pdf; https://www.fao.org/3/i2516e/online/i2516e.html#(InteractiveVersion), 9.5.2022

[23] *Competence Based Education and Training for Inland* Navigation (COMPETING), Erasmus+ project (2019-2022), Available at: https://www.iwt-competencies.eu, 8. 7. 2022

[24] *Evaluation of previous examples on course manuals addressed to inland navigation personnel in order to comply with the CESNI standards of competences (D 3.1),* COMPETING. 2020, Available at: https://www.iwt-competencies.eu/wp-content/uploads/2020/07/COMPETING-Report-3.1_130720-1.pdfc

[25] INeS *Inland Navigation eLearning System*. Available at: www.ines.info, 8. 7. 2022

[26] *INeS Danube*. Available at: http://www.ines-danube.info, 8. 7. 2022

[27] NELI – *Cooperation network for logistics and nautical education focusing on Inland Waterway Transport in the Danube corridor supported by innovative solutions* (2009-2012). Funding Programme: South East Europe Transnational Cooperation Programme. Available at: http://www.neliproject.eu

[28] EWITA – *European Web Platforms and Training Concepts for Intermodal Inland Waterway Transport* (2008-2010). Funding Programme: Marco Polo II-Programme. Available at: www.ewita.info

[29] DANUBE SKILLS - *Increased institutional capacity in Danube navigation by boosting joint transnational competences and skills in education and public development*

services (2017-2019) hhttps://www.interreg-danube.eu/approved-projects/danube-skills/outputs, 8. 7. 2022

[30] Smart-Qu@lification. *Competence center ship and port*. Available at: https://sbkr.moodleschule.de/, 8. 7. 2022

[31] Ler(n)ende Euregio - *Standard Inland Navigation Communication Phrases*. Available at: http://www.lerende-euregio.com/, 8. 7. 2022

[32] TTNT – *Train the Trainer Course for Inland Navigation Simulator Training.* Funding Programme: Leonardo da Vinci Programme. Available at: https://www.edinna.eu/projects/

[33] CMINET - *Course Manuals for Inland Navigation Education and Training* (2012-2015). Funding Programme: Leonardo da Vinci Programme. Available at: https://www.edinna.eu/projects/

[34] HINT – *Harmonized Inland Navigation Transport through education and information technology* (2012-2014). Funding Programme: South East Europe Transnational Cooperation Programme. http://www.hintproject.net/

[35] LNG *Masterplan for Rhine-Main-Danube* (2013-2015). Funding Programme: EU TEN-T programme Available at: http://www.lngmasterplan.eu/, 8. 7. 2022

[36] PROMINENT – *Innovation and greening in the European inland navigation sector*. (2015-2018). Funding Programme: Horizon 2020 programme. Available at: https://www.prominent-iwt.eu/, 8. 7. 2022

[37] IWTCOMP – *The Competency Based Inland Waterway Transport Education & Training* (2016-2019). Funding Programme: Erasmus+. Available at: https://www.edinna.eu/iwtcomp, 8. 7. 2022

[38] MOK – *Maritiem op Koers.* Available at: https://mok.anewspring.nl, 8. 7. 2022

[39] *Manual on the Sava River Navigation.* International Sava River Basin Commission, Zagreb, 2018. Available at: https://www.savacommission.org/UserDocsImages/05_documents_publications/navigation/manual_on_the_sava_river_navigation.pdf, 9. 5. 2022

[40] *Manual of Danube Navigation.* viadonau 2019. Available at: https://www.viadonau.org/fileadmin/user_upload/Manual_on_Danube_Navigation.pdf, 9. 5. 2022

[41] Maritime Tech Platform (MTP). Available at: https://www.maritiemtech platform.nl, 6. 7. 2022

[42] RELAR (Remote learning and examination by using AR in maritime VET education) Erasmus+ project (2021-2023), Available at: https://erasmus-plus.ec.europa.eu/projects/search/details/2020-1-NL01-KA226-VET-083043, 6. 7. 2022

[43] APM Terminals. *MedPort Tangier.* Available at: www.apmterminals.com/medport-tangier, 3. 4. 2023

[44] YouTube. *APM Terminals. Virtual Reality Safety Training at APM Terminals MedPort Tangier.* Available at: https://youtu.be/rjCC8Web3Es, 3. 4. 2023

[45] Merriam-Webster Dictionary. *Virtual reality.* Available at: https://www.merriam-webster.com/dictionary/virtual%20reality, 9 May 2022

[46] Merriam-Webster Dictionary. *Augmented reality.* Available at: https://www.merriam-webster.com/dictionary/augmented%20reality, 9. 5. 2022

[47] TechTarget. *Augmented reality (AR).* Available at: https://www.techtarget.com/whatis/definition/augmented-reality-AR, 9. 5. 2022

[48] Syrovatskyi, O.V., Semerikov, S.O., Modlo, Ye.O., Yechkalo, Yu.V., Zelinska, S.O. (2018): *Augmented reality software design for educational purposes.* Proceedings of the 1st Student Workshop on Computer Science & Software Engineering (CS&SE@SW 2018), Kryvyi Rih, Ukraine, 2018. CEUR Workshop Proceedings, 193–225.

[49] Anderson H M. Dale's Cone of Experience (summary) University of Kentucky Available at: https://www.queensu.ca/teachingandlearning/modules/active/documents/Dales_Cone_of_Experience_summary.pdf, 14. 1. 2022.

[50] Amazon.eg. *Virtual Reality Headset Universal 3D Glasses Adjust Cardboard VR BOX with BlueTooth Gamepad Remote Controller.* Available at: https://m.media-amazon.com/images/I/41CLCM9AHiL._AC_SY580_.jpg, 8. 7. 2022.

[51] MUO. *The 10 Best Virtual Reality iPhone Apps for Google Cardboard*. Available at: https://www.makeuseof.com/tag/10-best-ios-virtual-reality-apps-google-cardboard/, 20. 6. 2022.

[52] Organisation for Economic Cooperation and Development (OECD). *Skills and Work.* https://www.oecd.org/employment/skills-and-work, 14. 1. 2022.

[53] Organisation for Economic Cooperation and Development (OECD). *Skills for jobs*. https://www.oecdskillsforjobsdatabase.org, 14. 1. 2022.

[54] Organisation for Economic Cooperation and Development (OECD) Library. *Getting Skills Right*. Available at: https://www.oecd-ilibrary.org/employment/getting-skills-right_25206125, 14. 1. 2022.

[55] European Centre for the Development of Vocational Training (CEDEFOP). *Skill Forecast.* Available at: https://www.cedefop.europa.eu/en/tools/skills-forecast, 14. 1. 2022.

[56] DigitALAD Handbook. *Adult Educators Digital Skills*. Available at: https://digitaladproject.eu/images/handbook/en/12/index.html, 3. 12. 2021.

[57] IMO Modal Course 6.09. *Training Course for instructors.* 2017 Edition. ISBN 978-92-801-16786

[58] IMO Modal Course 6.10. *Train the Simulator Trainer and Assessor*. 2012 Edition. ISBN 978-92-801-15598

[59] WarpVR. Get access to play DERIN project scenarios: 1. *Breathing apparatus – CERONAV*, 2. *Diesel Generator Preparation – LMA*, 3. *Estonian Nautical School Classroom Introduction*; https://app.warp.studio/p/229a2a2b2749821e4ddd44a7

[60] WarpVR. Get access to play DERIN project scenarios: 1. *Familiarization with the Bridge-MQC*, 2. *Diesel Generator Preparation – LMA*, 3. *Estonian Nautical School Classroom Introduction*; https://app.warp.studio/p/f1f6c1c7dbe329d82581bd4c

[61] YouTube. *DERIN Project.* Available at: https://www.youtube.com/@DERINPROJECT, 3. 4. 2023

[62] *Engine-room simulator*, 2017 Edition (Model Course 2.07), IMO Model Courses, International Maritime Organization, ISBN 9789280116762

[63] *Ship Simulator & Bridge Teamwork,* 2002 Edition (Model Course 1.22), IMO Model Courses, International Maritime Organization, ISBN 9280141627

[64] RESOLUTION MSC.137(76) (adopted on 4 December 2002). *4.2 Standard manoeuvres and associated terminology.* Available at: https://wwwcdn.imo.org/localresources/en/KnowledgeCentre/IndexofIMOResolutions/MSCResolutions/MSC.137(76).pdf, 23. 6. 2022.

[65] *Fire Prevention and Fire Fighting*, 2000 Edition (Model Course 1.20), IMO Model Courses, International Maritime Organization, ISBN 9280150812

[66] Filimon, D., Butoi, S. *Basic Fire Fighting – Training manual,* CERONAV, 2015

[67] Machinery Spaces. *Enclosed Spaces Entry - machinery space procedures -Safety precautions.* Available at: http://www.machineryspaces.com/procedure-for-enclosed-space-entry.html, 20. 1. 2023

[68] MySea Time. *Infographic: How to wear SCBA in correct way.* Available at: https://www.myseatime.com/blog/detail/infographic-how-to-wear-scba-in-correct-way, 20. 1. 2023

[69] https://www.cdnfirefighter.com/wp-content/uploads/2019/05/9b24ffca128444b8a9e46b09d3a516eb.jpg

[70] https://images.fireengineering.com/wp-content/uploads/2016/01/SCBACom2.jpg

[71] DepositPhotos. Image ID: 221906556. Available at: https://st4.depositphotos.com/12982378/22190/i/1600/depositphotos_221906556-stock photo selective focus firefighter-water-hose.jpg, , 20. 1. 2023

[72] LinkedIn. *DeriNetwork.* Available at: https://www.linkedin.com/showcase/derin-network, 10. 7. 2022

[73] Warp Studio. Book a demo. Available at: https://www.warpvr.com/book-a-demo, 7. 9. 2022

[74] Warp VR. Available at: https://www.warpvr.com, 10. 7. 2022

[75] Warp Studio. Available at: https://app.warp.studio, 10. 7. 2022

[76] Warp Studio Scene. *Familiarization with the Bridge-MQC, DERIN project.* Available at: https://app.warp.studio/scenarios/15078/cards/606755, 10.7.2022

[77] Warp Studio Scenario. *Familiarization with the Bridge-MQC, DERIN project.* Available at: https://app.warp.studio/scenarios/15078/draggable_ cards, 10.7.2022

[78] Meta Quest. *You got a Quest2 – Here's how to set it up*. Available at: https://www.oculus.com/blog/you-got-a-quest-2-heres-how-to-set-it-up, 7.9.2022

[79] B & H Foto & Electronics Corp. *Meta Quest Quest 2 Advanced All-in-One VR Headset (256GB, White).* Available at: https://www.bhphotovideo.com/c/product/1590537-REG/oculus_301_00351_01_quest_2_all_in_one_vr.html, 10.7.2022

[80] HTC Vive. *Cosmos VR Headset*. Available at: https://www.vive.com/us/product/vive-cosmos/features/, 7.9.2022.

[81] Epson. *Epson Moverio BT-40.* Available at: https://www.epson.bg/bg_BG/support/sc/epson-moverio-bt-40/s/s1881, 10.7.2022

[82] Insta 360. Insta360 ONE RS. Available at: https://www.insta360.com/product/insta360-oners, 10.7.2022

[83] Everything But Stromboli. *256GB Micro SDXC ultra-SanDisk memory card (SDSQUA4-256G-GN6MN).* Available at: https://bulkmemorycards.com/shop/microsd-cards/microsd-class-10/256gb-micro-sdxc-ultra-sandisk-memory-card, 10.7.2022

[84] Nvidia. *GeForce RTX 30 Series*. Available at: https://www.nvidia.com/en-eu/geforce/graphics-cards/30-series, 10.7.2022

[85] HandBrake Team. *HandBrake – The open-source video transcoder*. Available at: https://handbrake.fr/, 10.7.2022

[86] Warp VR. *Help centar.* Available at: https://help.warpvr.com/, 4. 3. 2023.

[87] Warp Studio Scenario. *Diesel Generator Preparation – LMA, DERIN project.* Available at: https://app.warp.studio/scenarios/17647/draggable_cards, 30. 5. 2023

[88] Warp Studio Scenario. *Familiarization with the Bridge-MQC, DERIN project.* Available at: https://app.warp.studio/scenarios/15078/draggable_cards, 30. 5. 2023 - MQSC

[89] Warp Studio Scenario. *Breathing Apparatus-CERONAV, DERIN project.* Available at: https://app.warp.studio/scenarios/13348/draggable_cards, 10.7.2022

[90] Warp Studio Scenario. *Diesel Generator Preparation – LMA, DERIN project.* Available at: https://app.warp.studio/scenarios/17647/exports/51920, 30. 5. 2023

[91] Warp Studio Scenario. *Familiarization with the Bridge-MQC, DERIN project.* Available at: https://app.warp.studio/scenarios/15078/exports/52026, 30. 5. 2023

[92] Warp Studio Scenario. *Breathing Apparatus-CERONAV, DERIN project.* Available at: https://app.warp.studio/scenarios/13348/exports/52024, 10. 7. 2022

[93] Warp Studio Scenario. *Diesel Generator Preparation – LMA, DERIN project.* Available at: https://app.warp.studio/scenarios/17647/scoring, 30. 5. 2023

[94] Warp Studio Scenario. *Familiarization with the Bridge-MQC, DERIN project.* Available at: https://app.warp.studio/scenarios/15078/scoring, 30. 5. 2023

[95] Warp Studio Scenario. *Breathing Apparatus-CERONAV, DERIN project.* Available at: https://app.warp.studio/scenarios/13348/scoring, 10. 7. 2022

[96] Warp VR Official. *Create story-based training scenarios with our worksheet.* Available at: warpvr.com/worksheet

ANNEX 1 Equipment procured and utilized within DERIN project

To create the digital content for the learning modules described in Chapter 6, the DERIN project team used the following equipment:

1. Licence for WARP VR Studio - personalized services that provide the beneficiary with a platform that allows the development of VR applications, in the form of a user license for a period of 16 months from the date of signing the contract, for maximum of 100 trainees per month and maximum of 100 scenes - Warp Studio platform, a hub for creating, distributing, and analysing real and immersive training scenarios, Warp Store – for publishing and storing the scenarios/ final products in the online store. To book a demo (WARP VR Studio) see: [73]

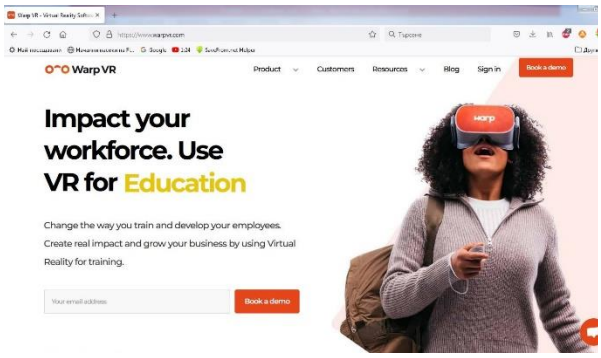


Figure 63. Wrap VR in E-Learning
Source: [74]

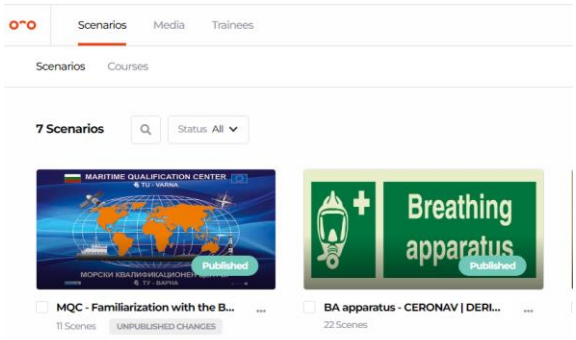


Figure 64. Scenarios in Wrap VR
Source: [75]

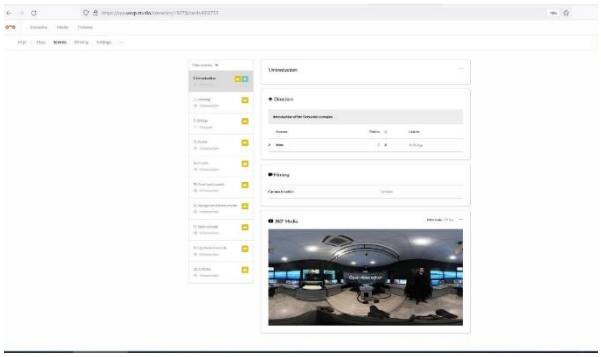


Figure 65. Scene in Wrap VR
Source: [76]

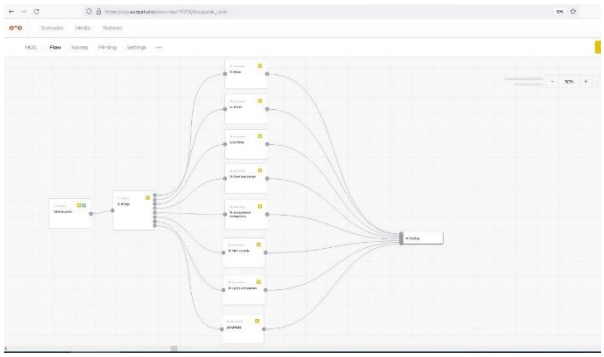


Figure 66. Scenario – Chain Diagram of Linked Scenes
Source: [77]

2. VR Set OCULUS Quest 2, Advanced All-In-One, 128GB[10]

Figure 67. Oculus Quest 2, VR Headset
Source: [79]

[10] If you want to get familiar with the equipment, see: [78].

3. HTC Vive Cosmos (Virtual Reality headset)[11] [80]
4. Epson Moverio BT 40 (augmented reality smart glasses)

Figure 68. Epson moverio BT40 Smart Glasses
Source: [81]

5. Video camera Insta360 ONE R Twin Edition, 360°, 5.7K, Waterproof, HDR – When purchasing this camera the software for editing in include, Insta360 app [82] available on Android and Apple, needed to control camera remotely

Figure 69. Video Camera Insta360
Source: [82]

6. Memory card SanDisk Extreme V30 A2 256GB, UHS-I.

Figure 70. Micro SD memory card
Source: [83]

7. Nvidia Graphic card, GeForce RTX™ 30 Series GPUs [84]
8. Video transcoder. Handbrake free software. [85]

For more information on using WarpStudio, creating, testing and publishing scenarios and courses, adding documents, uploading, linking and editing videos, assigning roles, etc., see the Warp VR Help centre [86].

[11] Note: These headsets are connected to the computer via a cable

ANNEX 2 Learning outcomes from learning modules

Familiarisation with the Engine

	Subject Area	Hrs	Types of e-learning content	List set of available materials	Learning objectives	Instructional methods	Example of the instructional methods	Level of evaluation	Components of an online course	Communication and collaboration tools for e-learning	Learning platform	Equipment needed**
1	**Familirization with the engine room**	**6.00**	**Performance support tools**	**Short movie**	**understand the main components and functions of Full engine room simultor**	**Expositive methods**	**demonstration**	**learning**	**pre-course learning activity**	**Webcasting**	**Warp VR**	**
1.1	Plant arrangement (machinery and associated systems and equioment)		Simple learning resources	presentation	familiarisation with Plant arrangement	Expositive methods	lecture	learning	cycle of learning events	Webcasting, Audio and video conferences	Warp VR	
1.2	Engine room instruments		Simple learning resources	Short movie	familiarisation with the functions of the engine control room instruments	Expositive methods	demonstration	learning	cycle of learning events	Audio and video conferences, Webcasting	Warp VR	**
1.3	Engine room Controls and alarms		Simulations and games	Short movie	familiarisation with the components and functions of the engine control room alarms and controls	Application methods	demonstration	learning	cycle of learning events	Webcasting, Audio and video conferences	Warp VR	
2	**Operation of plant machinery**	**20.00**	**Simulations and games**	**presentation**	**understand the procedures of operating plant machinery**	**Application methods**	**demonstration**	**behaviour, learners' reactions**	**cycle of learning events**	**Chat and instant messaging, Application sharing**	**Warp VR, *other**	** OHP, screen
2.1	Operational procedures		E-learning courses	presentation	understand and get familiar with the operational procedures	Collaborative methods	demostration, role play, Peer tutoring	behaviour, learners' reactions	cycle of learning events	Application sharing	Warp VR, *other	** OHP, screen
2.2	Operation of main and auxiliary machinery and systems		E-learning courses	presentation	familiarisation with operatioal procedures of main and auxiliarry machinery and systems	Collaborative methods	demostration, role play, Peer tutoring	behaviour, learners' reactions	cycle of learning events	Application sharing	Warp VR, *other	** OHP, screen
2.3	Fault detection and measures		Simulations and games	presentation	understand the fault detection and measurements	Application methods	demostration	learning	cycle of learning events	Application sharing	Warp VR, *other	**
3	**Debrifing/Assessment**	**1,00**	**Simple learning resources**	**presentation**	**briefing in an analitic approach to their actions during the exercises**	**Expositive methods, Collaborative methods**	**Peer tutoring**	**results**	**feedback and conclusion**	**Audio and video conferences**	**Warp VR, *other**	**
	TOTAL	**27.00**										

Note:
* a compatible web/remote platform for course delivery; **3D FHD or Higher res. camera, VR displaying device

Familiarisation with the Bridge

	Subject Area	Hrs	Types of e-learning content	List set of available materials	Learning objectives	Instructional methods	Example of the instructional methods	Level of evaluation	Components of an online course	Communication and collaboration tools for e-learning	Learning platform	Equipment needed**
1	**Familiarization with the bridge**	**3.50**	**Performance support tools**		**understand the main components and functions of Full mission Bridge**							
1.1	Plant arrangement	0.25	Simple learning resources	presentation	familiarisation with Plant arrangement	Expositive methods	lecture	learning	cycle of learning events	Webcasting	Warp VR	**** and OHP, screen,**
1.2	Bridge instruments	1.00	Simple learning resources	Short movie	familiarisation with the functions of the Bridge instruments	Expositive methods	demonstration	learning	cycle of learning events	Webcasting	Warp VR	******
1.3	Rudder and Engine Controls	0.75	Simple learning resources	Short movie	familiarisation with the components and functions of the Rudder and Engine Controls	Expositive methods	demonstration	learning	cycle of learning events	Webcasting	Warp VR	
1.4	Standard manoeuvres	1.50	Simple learning resources	presentation	understand the types of Standard manoeuvres and the parameters affecting the ship's manoeuvring	Expositive methods	demonstration	learning	cycle of learning events	Webcasting	Warp VR	
2	**Coastal scenario**	**10.00**			**understand the Coastal water environment parameters affecting the ship's navigation**							
2.1	Restricted-water scenario	2.50	Simulations and games	presentation	understand the Restricted-water environment parameters affecting the ship's navigation and maneuvering	Application methods	demonstration, role play, Peer tutoring	learners' reactions	assessments	Application sharing	Warp VR, *other	******
2.2	Harbour scenario	2.50	Simulations and games	presentation	understand the Harbour environment parametres affecting the ship's navigation and maneuvering	Application methods	demonstration, role play, Peer tutoring	learners' reactions	assessments	Application sharing	Warp VR, *other	
2.3	Wind and current effects	2.50	Simulations and games	presentation	understand the Wind and current effect on the ship's handling and maneuvering	Application methods	demonstration, role play, Peer tutoring	learners' reactions	assessments	Application sharing	Warp VR, *other	
2.4	Anchoring and single-buoy mooring	2.50	Simulations and games	presentation	understand the manoeuvre of Anchoring and single-buoy mooring	Application methods	demonstration, role play, Peer tutoring	learners' reactions	assessments	Application sharing	Warp VR, *other	
3	**Debriefing/ Assessment**	**1.00**	**Performance support tools**	presentation	**analytic approach (feedback)**	**Collaborative methods**	**Peer tutoring**	**results**	**feedback and conclusion**	**Audio and video conferences**	**Warp VR, *other**	**** and OHP, screen**
	TOTAL	**14.50**										

Note:
* a compatible web/remote platform for course delivery; **3D FHD or Higher res. camera, VR displaying device

Fire Prevention and Fire Fighting

	Subject Area	Hrs	Types of e-learning content	List set of available materials	Learning objectives	Instructional methods	Example of the instructional methods	Level of evaluation	Components of an online course	Communication and collaboration tools for e-learning	Learning platform	Equipment needed
1	**Introduction, Safety, and principles**	**1.0**	**E-learning courses, Simple learning resources**	**notes, presentation, ppt**	**familiarize with BA principle, role and use in firefighting**	**Expositive methods**	**presentations, images**	**learning, learners' reactions**	**pre-course learning activity, cycle of learning events**	**E-mail-based tools, Discussion forums, Blogs**	https://www.derinnet.eu/ https://www.warpvr.com/	VR glasses, PC or mobile phone with WARP app
2	**Use of breathing apparatus for fighting fires**	**3.5**	**E-learning courses**	**video, ppts, written instructions**	**understand how to use the BA**	**Application methods**	**demonstrations, practice methods, scenario based**	**behaviour, learning**	**pre-course learning activity, cycle of learning events**	**Webcasting, Audio and video conferences**		
2.1	Breathing apparatus	1.0	Simulations and games	video, technical data sheet, images, guides	familiarize with main components, tests and wearing method	Expositive methods	presentations, role play, demonstration	learning, behaviour	pre-course learning activity, cycle of learning events	E-mail-based tools, Blogs, Chat and instant messaging		
2.2	Drills in smoke-filled spaces	2.5	Simulations and games	video, ppts	familiarize with procedure of fighting fire, initial actions and tactics	Application methods	demonstrations, practice methods, scenario based	behaviour	pre-course learning activity, cycle of learning events	Webcasting, Audio and video conferences, Application sharing		
3	**Debriefing/ Assessment**	**1.0**	**Tests**	**video, tests**	**assessment of knowledge**	**Collaborative methods**	**practice methods**	**results**	**feedback and conclusion, assessments**	**Surveys and polls, Audio and video conferences**		
	TOTAL	**5.5**										

ANNEX 3 Learning module scenario flows

Familiarisation with the Engine

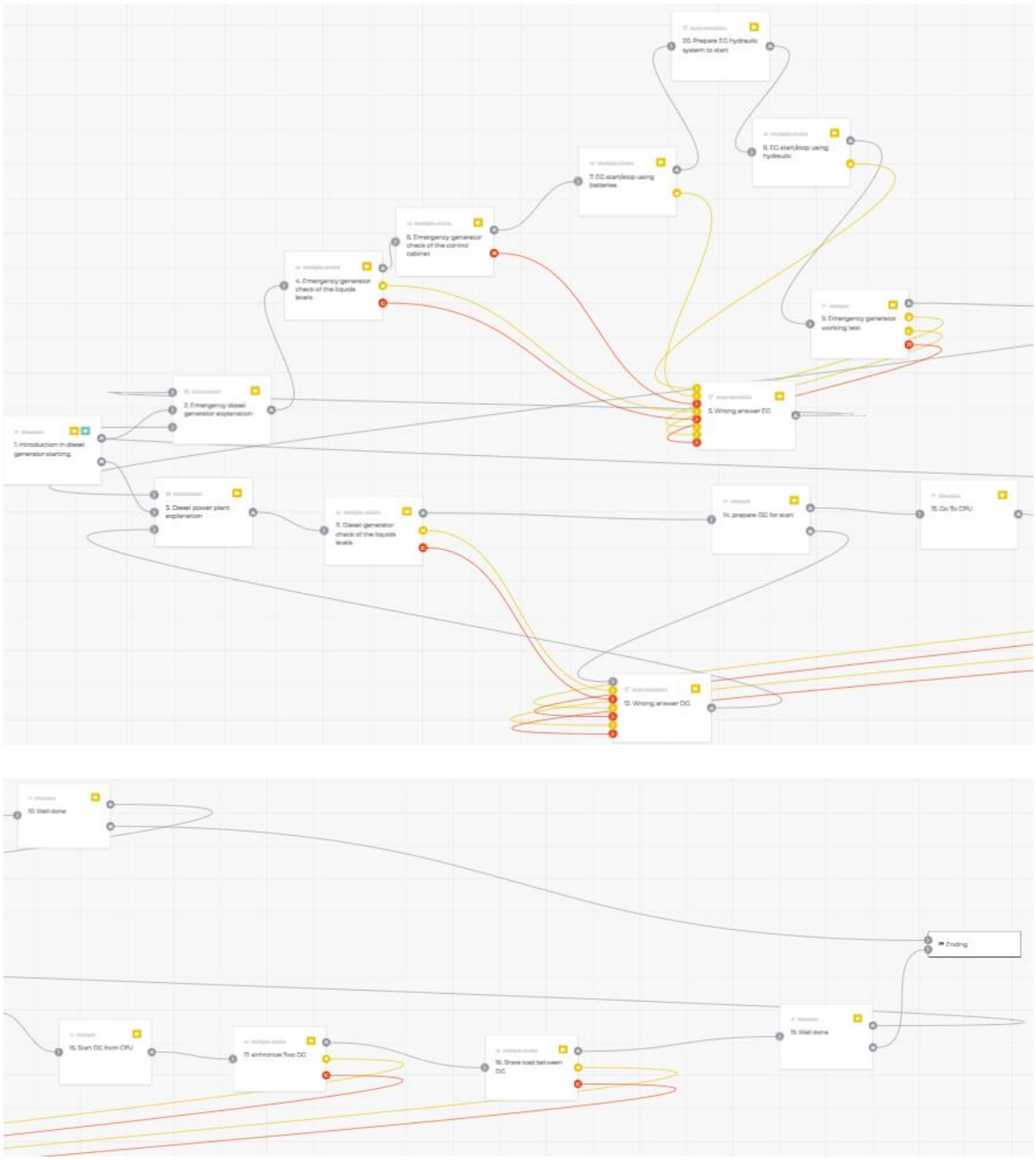


Figure 71. Scenario flow for learning module Familiarisation with the Engine
Source: [87]

Familiarisation with the Bridge

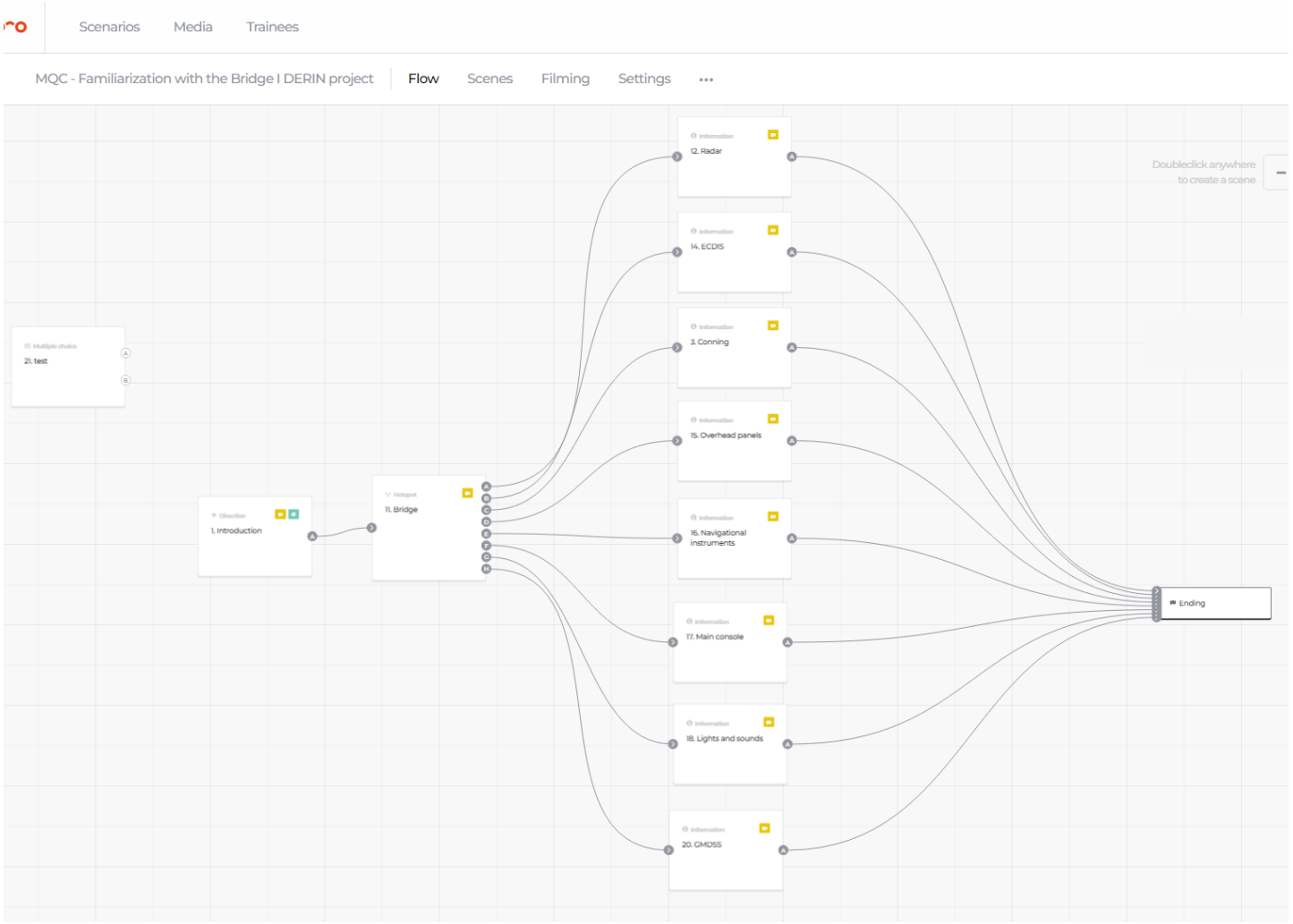


Figure 72. Scenario flow for learning module Familiarisation with the Bridge
Source: [88]

Fire Prevention and Fire Fighting

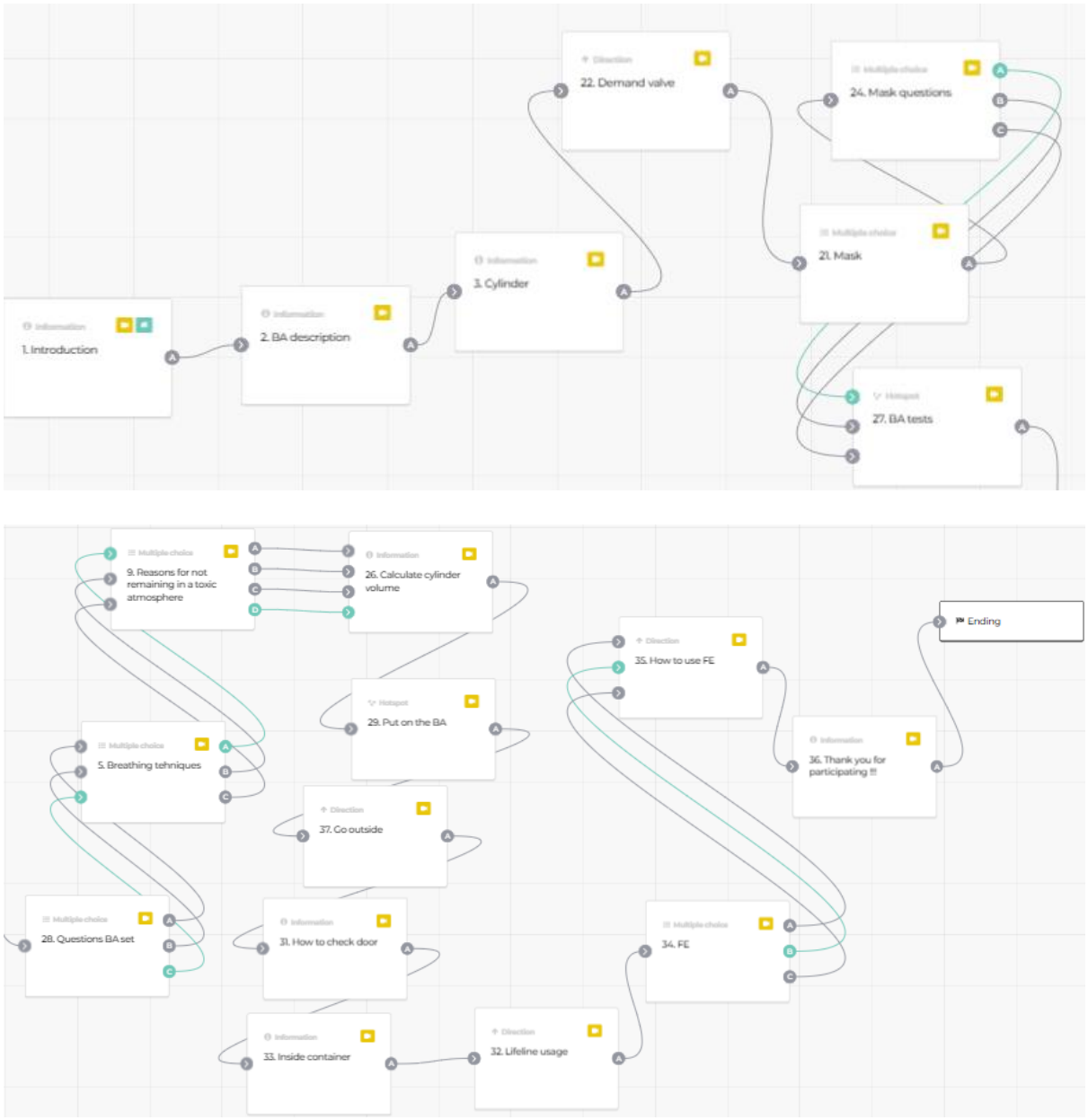


Figure 73. Scenario flow for learning module Fire Prevention and Fire Fighting
Source: [89]

ANNEX 4 Learning modules scenarios – export from Warp VR

Familiarisation with the Engine

Source: [90]

Diesel Generator Preparation - LMA | DERIN Project

Version 5 · Subtracting points

In this video described diesel generator preparation procedure before startup

19
Total scenes

15
Need filming

Contents

19 Scenes

	Scene
1	introduction in diesel generator starting
2	Emergency diesel generator explanation
3	Diesel power plant explanation

4	Emergency generator check of the liquids levels
5	Wrong answer EG
6	Emergency generator check of the control cabinet
7	EG start/stop using batteries
8	EG start/stop using hydraulic
9	Emergency generator working test
10	Well done
11	Diesel generator check of the liquids levels
12	Wrong answer DG
14	prepare DG for start
15	Go To CPU
16	Start DG from CPU
17	sinhronize Two DG
18	Share load between DG
19	Well done
20	Prepare EG hydraulic system to start

1. introduction in diesel generator starting

Direction Need filming

Done filming?

Here delegate get intro about generator, and ask choose witch of generators it will prepare for the work.

exercise prepare DG

Answer	Subtracting points
A Emergency generator	0
B Diesel Power plant	0

2. Emergency diesel generator explanation

Information Need filming

Done filming?

Here delegate get information about emergency generator generally

emergency diesel generator in general

Answer	Subtracting points
A Go to preparation task	0

3. Diesel power plant explanation

Information Need filming

Done filming?

Here delegate get information about diesel power plant generally

Diesel power plant in general

Answer	Subtracting points
A Go to preparation task	0

4. Emergency generator check of the liquids levels

Multiple choice Need filming

Done filming? ☐

Here delegate get information about what, where and how to check. He /she has self check training.

What liquids levels must be checked during emergency generator preparation process?

	Answer	Subtracting points
A	Oil level, fuel level, Cooling liquid	0
B	Cooling water level, fuel level, hydraulic oil level	1
C	Sulfur acid level in battery, cooling water level, oil level	2

5. Wrong answer EG

Auto transition Need filming

Done filming? ☐

Here instructor say "Your answer is wrong, let repeat the lesson"

	Answer	Subtracting points
A		0

6. Emergency generator check of the control cabinet

Multiple choice Need filming

Done filming? ☐

Here delegate will check voltage level of emergency generator starting battery

?What operations you must to do before start emergency generator ?

	Answer	Subtracting points
A	check battery voltage level, generator mode, oil pump, lamp check	0
B	check state of the shaft of emergency generator	2

7. EG start/stop using batteries

Multiple choice Need filming

Done filming? ☐

How you are going to start and stop emergency generator using batteries?

	Answer	Subtracting points
A	Switch generator to manual start mode, then push start button. Wait for generator start working and reach correct RPM. Then push stop button.	0
B	Push start button	1

8. EG start/stop using hydraulic

Multiple choice Need filming

Done filming? ☐

How you are going to start and stop emergency generator using hydraulic starter?

	Answer	Subtracting points
A	Switch generator to manual start mode, then pump up hydraulic oil pressure to 300 bar, then push star lever. Wait for generator start working and reach correct RPM. Then push stop button.	0
B	Push start lever	1

9. Emergency generator working test

Hotspot Need filming

Done filming? ☐

Find voltmeter, and check voltage

	Answer	Subtracting points
A	voltmeter	0
B	ampermeter	1
C	powermeter	1
D	starting lever	2

10. Well done

Direction Need filming

Done filming?

Well done, you finish emergency generator course !!!

Answer	Subtracting points
A I want to go back, and choose another course	0
B I am finished	0

11. Diesel generator check of the liquids levels

Multiple choice Need filming

Done filming?

Here delegate get information about what, where and how to check. He /she has self check training.

What liquids levels must be checked during DG preparation process?

Answer	Subtracting points
A Oil level	0
B Cooling water level, fuel level, hydraulic oil level	1
C Sulfur acid level in battery, cooling water level, oil level	2

12. Wrong answer DG

Auto transition Need filming

Done filming?

Here instructor say "Your answer is wrong, let repeat the lesson"

Answer	Subtracting points
A	0

14. prepare DG for start

Hotspot Need filming

Done filming? ☐

Chose correct tool to rotate DG manually

Answer	Subtracting points
A Rotation motor controller	0
B lever	0

15. Go To CPU

Direction Need filming

Done filming? ☐

Here you must goto CPU

Answer	Subtracting points
A Go to Real CPU	0

16. Start DG from CPU

Hotspot Need filming

Done filming? ☐

Here you will get instruction how to start DG

Answer	Subtracting points
A start dg	0

17. sinhronize Two DG

Multiple choice Need filming

Done filming? ☐

Here you can see how to sinchronize two DG from CPU

How manually synchronise two DG

	Answer	Subtracting points
A	switch to manual synhronisation, abserve phase sinhronisation indicator. Change speed of DG. Before PSI reach common position, switch on circuit breaker.	0
B	Switch on circuit breaker	1
C	Ask chief engineer for help	2

18. Share load between DG

Multiple choice Need filming

Done filming? ☐

Here you can see how share load between DG

How share load between DG

	Answer	Subtracting points
A	simultaneously after synhronization increase RPM of connected generator. Abserve Ampermeters, current must be same on all generators ampermeters.	0
B	Do nothing, it will share automatically	1
C	simultaneously after synhronization dicrease RPM of connected generator. Abserve Ampermeters, current must be same on all generators ampermeters.	2

19. Well done

Direction Need filming

Done filming? ☐

Well done, you finish main diesel generator course !!!

Answer		Subtracting points
A	I want to go back, and choose another course	0
B	I am finished	0

20. Prepare EG hydraulic system to start

Auto transition Need filming

Done filming? ☐

Answer		Subtracting points
A		0

Familiarisation with the Bridge

Source: [91]

Familiarization with the Bridge-MQC I DERIN project

Version 21 · Subtracting points

11
Total scenes

3
Need filming

Contents

11 Scenes

1. Introduction

Direction Need filming

Done filming? ☐

Introduction of the Simulator complex

Answer	Subtracting points
A Intro	0

3. Conning

Information Need filming

Done filming? ☐

Conning

Answer	Subtracting points
A Conning	0

11. Bridge

Hotspot Need filming

Done filming? ☐

Bridge

Answer	Subtracting points
A Radar	0
B ECDIS	0
C Conning	0
D Overhead panels	0
E Navigational Instruments	0
F Main console	0
G Lights and Sounds	0
H GMDSS	0

12. Radar

Information Need filming

Done filming?

Radar

Answer	Subtracting points
A Radar	0

14. ECDIS

Information Need filming

Done filming?

ECDIS

Answer	Subtracting points
A ECDIS	0

15. Overhead panels

Information Need filming

Done filming?

Overhead panels

Answer	Subtracting points
A Overhead panels	0

16. Navigational instruments

Information Need filming

Done filming?

Navigational instruments

Answer	Subtracting points
A Navigational instruments	0

17. Main console

Information Need filming

Done filming?

MAIN CONSOLE

Answer	Subtracting points
A MAIN CONSOLE	0

18. Lights and sounds

Information Need filming

Done filming?

Lights and sounds

Answer	Subtracting points
A Lights and sounds	0

20. GMDSS

Information Need filming

Done filming? ☐

GMDSS

Answer	Subtracting points
A GMDSS	0

21. test

Multiple choice Need filming

Done filming? ☐

Where is the door?

Answer	Subtracting points
A To the left	0
B To the right	0

Fire Prevention and Fire Fighting

Source: [92]

Breathing apparatus - CERONAV | DERIN Project

Version 12 • Adding points

DERIN project

19
Total scenes

19
Need filming

Contents

19 Scenes

22 Demand valve

24 Mask questions

26 Calculate cylinder volume

27 BA tests

28 Questions BA set

29 Put on the BA

31 How to check door

32 Lifeline usage

33 Inside container

34 FE

35 How to use FE

36 Thank you for participating !!!

37 Go outside

1. Introduction

Information Need filming

Done filming?

Welcome to this module dealing with the Breathing Apparatus. The breathing apparatus is part of the firefighter's equipment. Every seaman should be familiar with the use of the BA. This module is based on the IMO Model Course 1.20: Fire Prevention and Basic Fire Fighting - Use of breathing apparatus for fighting fires.

Are you ready ? Let`s go !

Answer	Adding points
A Ok	0

2. BA description

Information Need filming

Done filming?

The three main components are the high-pressure cylinder, the pressure regulator, and the inhalation connection/device. The apparatus uses a single compressed air cylinder for air storage. The cylinder is mounted onto an ergonomically designed backplate.
The high pressure in the cylinder is reduced in two steps or stages, down to a pressure that can be called breathable air. This breathing valve is a demand valve
which means that it senses the demand for inhalation of air and it opens to
permit exactly the airflow demanded. The inlet valve closes when the inhalation
stops and a spring-loaded exhalation valve in the mask open upon exhalation.

– Utilizing pressure reducer
– Steel or carbon composite cylinders
– Secondary supply hose connections for rescue and decontamination
– Available with Pneumatic gauge integrated PASS (Bodyguard 1500)

Click next to learn more about the main compnents of the BA

Answer | Adding points

A Next | 0

3. Cylinder

Information Need filming

Done filming?

The cylinder is made out of steel or composite materials. Is fitted with a valve assembly , a pressure reducer and a hand wheel.

Click next to learn more about the main compnents of the BA

Answer | Adding points

A Next | 0

5. Breathing tehniques

Multiple choice Need filming

Done filming?

Let`s talk a little bit about breathing techniques. When it comes to breathing in firefighting it is not easy to obtain the correct information. That's because breathing with
a BA is not the same as real life breathing.Here are some of the main differences:
· Limited air supply. Cylinders provide us with a specific amount of air that is going to be finished and thus must be exploited and not wasted.
· Increase of about 33% in energy expenditure. By analysing the combined effects of the BA and the PPE EN 469, Sykes1 observed an increase of about 33% in energy expenditure.
· Increase in oxygen uptake, heart rate and air consumption. Borghols et al.2 analysed how carrying heavy weights on the back influences the cardiorespiratory function. This study measured O2 uptake, heart rate and pulmonary ventilation. The authors reported they observed minimal variations when at rest and still. The results are very different in case of walking or climbing a ladder. It was found that each kilogram carried weight increases.We have established that for our health and for our and other people's safety we must optimise our
respiration when using a BA.
You can use three different breathing techniques :

In through the nose – Out through the nose
In through the nose – out through the mouth
In through the nose – out through the mouth, in case of emergency

Choose the breathing technique that allows to maximize respiratory efficiency::

	Answer	Adding points
A	In through the nose – Out through the nose	2
B	In through the nose – out through the mouth	0
C	In through the nose – out through the mouth, emergency	0

9. Reasons for not remaining in a toxic atmosphere

Done filming?

Multiple choice Need filming

Now that you know how to properly breathe, let`s see why is important not to remain in a toxic atmosphere for a long time. As you remember the BA has a LP alarm which will alert you in case that you reach the minimum content level. In case that the minimum bottle level is reached you will be informed by a powerful sound alarm.Why is this useful?

Why is not recommended to remain in a toxic atmosphere ?

	Answer	Adding points
A	Because you can endager your life	0
B	Because you will need to be rescued	0
C	Because you could endanger the rescuers	0
D	All of the above	2

21. Mask

Done filming?

Multiple choice Need filming

Click next to learn more about the main compnents of the BA

	Answer	Adding points
A	Next	0

22. Demand valve

Done filming?

Direction Need filming

Back to SCBA

	Answer	Adding points
A	Ok	0

24. Mask questions

Multiple choice Need filming

Done filming?

What is the recommended way to secure the mask ?

Answer	Adding points
A Pulling symmetrical straps together and top of the head last ?	2
B Start pulling from the chin up to the top of the head ?	0
C The order is not important , the mask should be tight strong.	0

26. Calculate cylinder volume

Information Need filming

Done filming?

Good, I see that you`ve made it to the fire ground.
Before we use the BA , first you`ll need to check if it can be used.
Grab the BA set and come closer.

Next

Answer	Adding points
A Ok	0

27. BA tests

Hotspot Need filming

Done filming?

How to check the BA set

Answer	Adding points
A Grab the BA	0

28. Questions BA set

Multiple choice Need filming

Done filming? ☐

What type of low pressure alarms should we have ?

Answer	Adding points
A Visual	0
B Audible	0
C Both	2

29. Put on the BA

Hotspot Need filming

Done filming? ☐

Good answer.

Now grab the BA set, put it on and meet me at the container's area.

Grab the mask and let`s go!

Answer	Adding points
A Mask	0

31. How to check door

Information Need filming

Done filming? ☐

How to enter the container

Now let`s see how to use the lifeline for signalling!

Answer	Adding points
A Proceed	0

32. Lifeline usage

Direction Need filming

Done filming? ☐

Lifeline

Ok, now let`s see how to extinguish a fire with the FE. Remember , if you are using a lifeline you can use it to communicate as well.

Answer	Adding points
A To the fire extinguishers.	0

33. Inside container

Information Need filming

Done filming? ☐

This is how you should move inside a room filled with smoke .

Answer	Adding points
A Press to skip to next scene	0

34. FE

Multiple choice Need filming

Done filming? ☐

Until we show you how to extinguish a fire , tell me what is a class B fire ?

Answer	Adding points
A A solid material combustion	0
B Fuels	2
C Electrical fires	0

35. How to use FE

Direction Need filming

Done filming?

Ok, I hope that you remember now how to use a FE.

Answer	Adding points
A Let´s go to the assembly point.	0

36. Thank you for participating !!!

Information Need filming

Done filming?

Press ok to end the exercise.

Answer	Adding points
A ok	0

37. Go outside

Direction Need filming

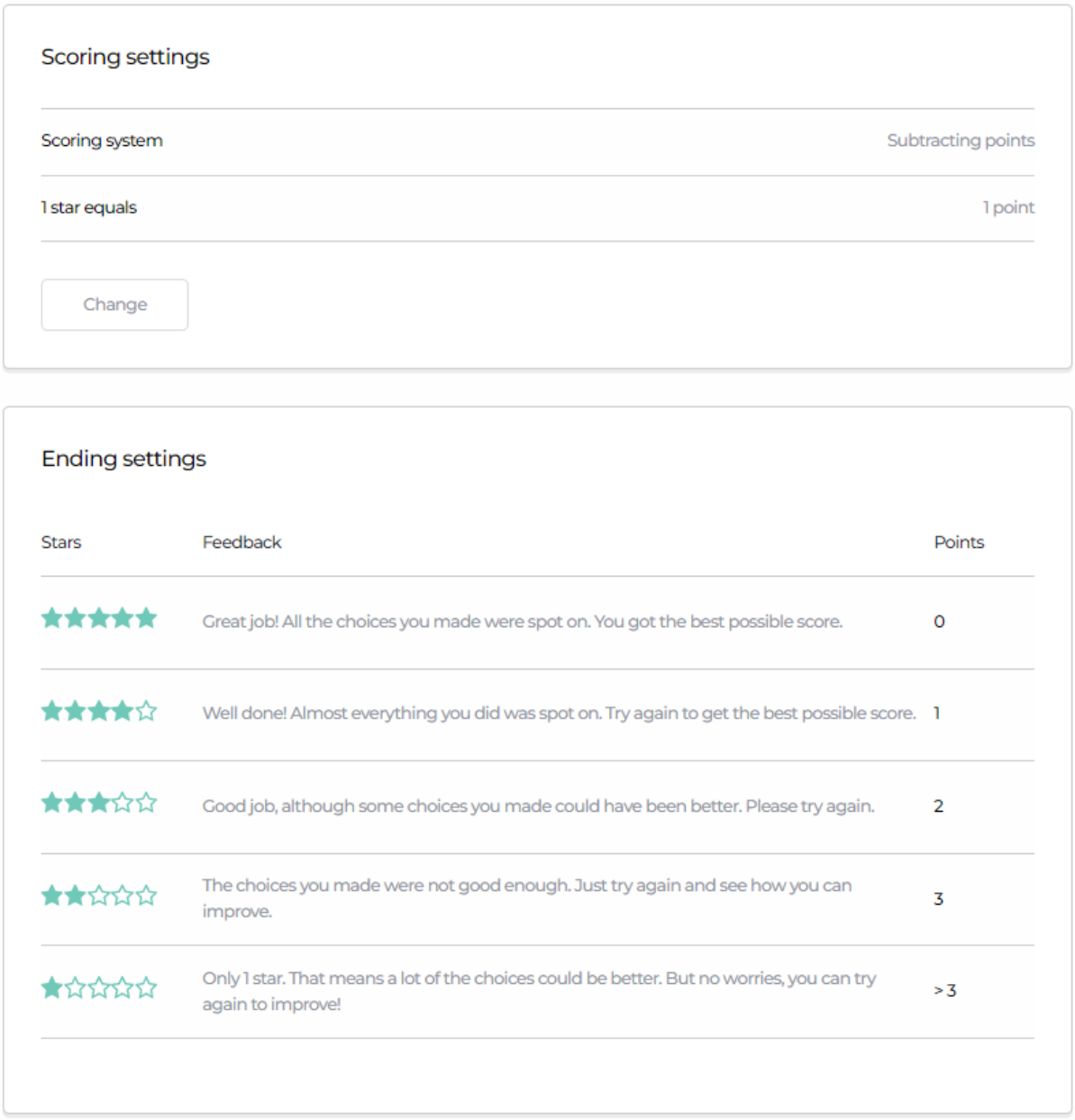
Done filming?

Now let´s go to the fireground and see how to open a door from a room where you have informations that there is a fire. Pay attention to the demonstration.

Answer	Adding points
A Let´go!	0

ANNEX 5 Learning modules - scoring

Familiarisation with the Engine



Scoring settings

Scoring system	Subtracting points
1 star equals	1 point

Change

Ending settings

Stars	Feedback	Points
★★★★★	Great job! All the choices you made were spot on. You got the best possible score.	0
★★★★☆	Well done! Almost everything you did was spot on. Try again to get the best possible score.	1
★★★☆☆	Good job, although some choices you made could have been better. Please try again.	2
★★☆☆☆	The choices you made were not good enough. Just try again and see how you can improve.	3
★☆☆☆☆	Only 1 star. That means a lot of the choices could be better. But no worries, you can try again to improve!	> 3

Figure 74. Scoring and ending settings for learning module Familiarisation with the Engine
Source: [93]

Familiarisation with the Bridge

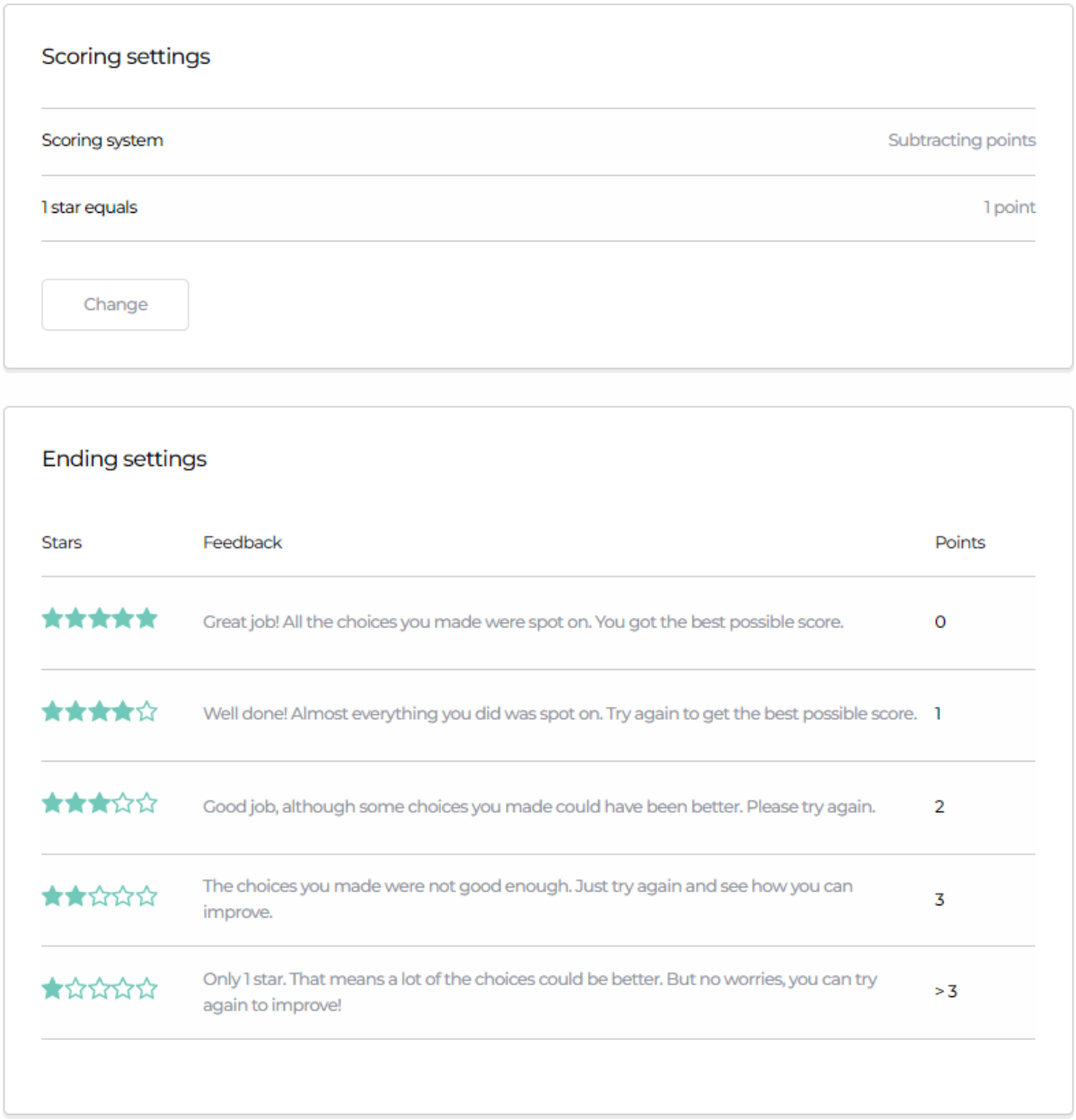


Figure 75. Scoring and ending settings for learning module Familiarisation with the Bridge
Source: [94]

Fire Prevention and Fire Fighting

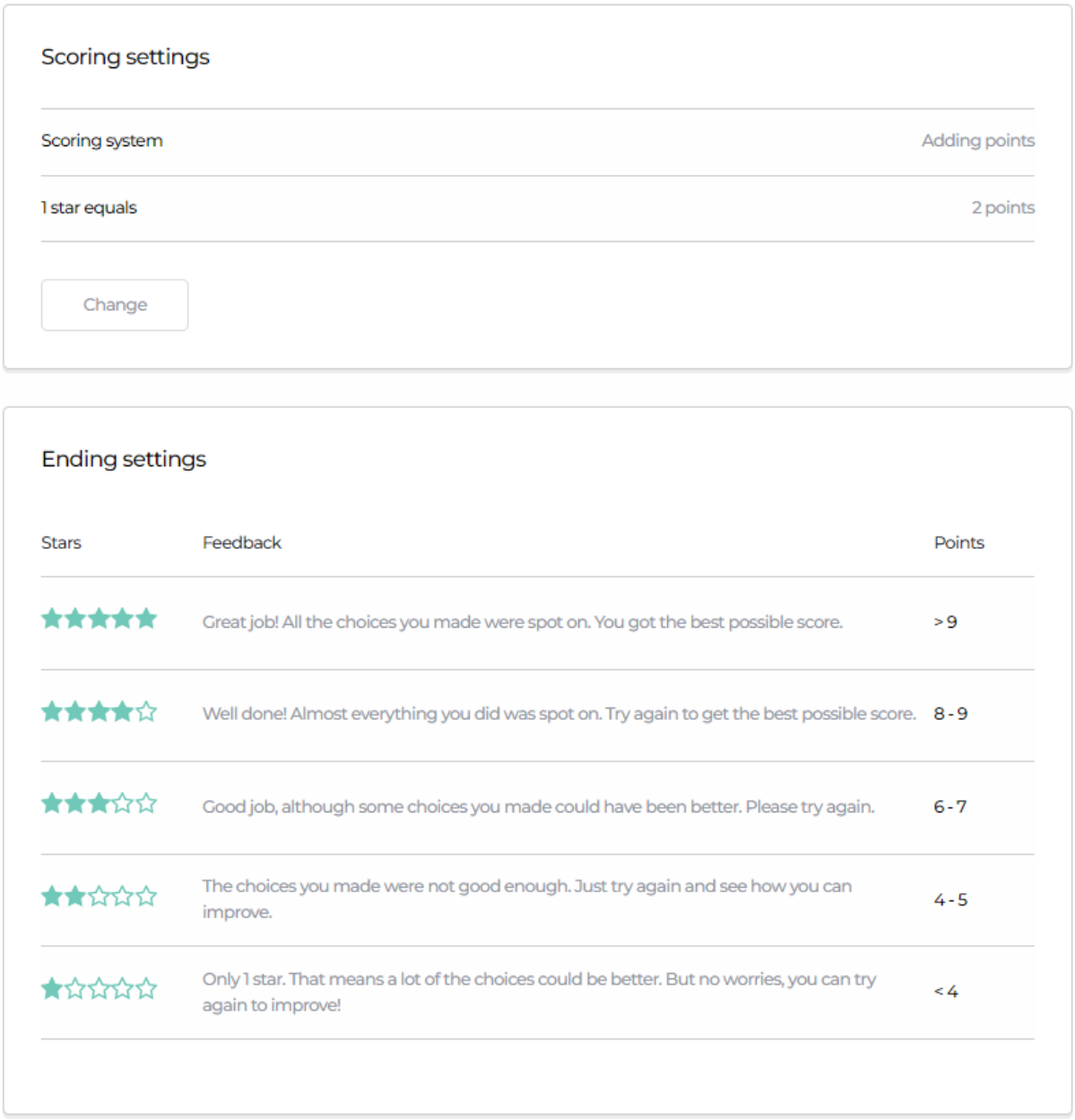


Figure 76. Scoring and ending settings for learning module Fire Prevention and Fire Fighting
Source: [95]

ANNEX 6 Worksheet for writing scenarios

WarpVR has created a worksheet for writing immersive scenarios based on the **three-act structure** often used in films, novels and plays. The worksheet divides the narrative into three distinct acts: build-up, confrontation and resolution.

Each of these acts serves a specific purpose and helps to structure a narrative in a compelling and satisfying way. This structure can also be used for non-linear stories for training.

For more information on how to use this worksheet, see warpvr.com/worksheet [96]. The layout of the worksheet is shown on the following pages.

Part 1: Set scenario drivers

Worksheet for writing story-based immersive scenarios

Warp VR

Brainstorming area	Decision area
What is the topic of this scenario? Safety, security, soft skills, onboarding, ...	*Pick a training topic*
What is the learning goal? What have they learned after playing this scenario?	*Pick a learning goal*
Who are the target audience? All engineers, new employees, everyone working in this building, ...	*Pick a target group*
What is the business reason for this scenario? Speed of training, cost savings, increased employee engagement, ...	*Pick a business impact*

Part 2a: Define story elements

Worksheet for writing story-based immersive scenarios

Warp VR

Brainstorming area	Decision area
Who is the main character of the story? Name, age, clothes, occupation, ...	*Pick a main character*
What does the main character want? Go somewhere, fix something, close a deal, ...	*Pick a goal of the main character*
Where does the story take place? Office building, busy street, at home, ...	*Pick a location where the story starts*
Are there any other characters? Name, age, clothes, occupation, ...	*Pick one or more other characters*

Part 2b: Define story elements

Worksheet for writing story-based immersive scenarios

Warp VR

Brainstorming area | Decision area

What are the obstacles? What can happen along the way?

Pick one or two main obstacles

Pick any other obstacles for in your story

What are the different outcomes of this story? Write down both successful as failed outcomes.

Pick one or two successful outcomes

Pick one or two failed outcomes

Part 3: Bring your story to life

Worksheet for writing story-based immersive scenarios

Warp VR

Set-up
Introduce the role of the player, the first objective and characters

Catalyst
The inciting incident that sets the story in motion

Rising action
Introduce changes and obstacles

Climax
The main obstacle, the most exciting moment

Solution
All the obstacles are solved

Select the location where the story starts

Write down the event that starts this story.

Select an obstacle

Select another obstacle

Select the main obstacle

Select a successful outcome

Select a failed outcome

Select the main character

Select the goal for the main character

Select one or more other characters (optional)