



Sustainable, safe and
economically feasible
energy concepts and
technologies for
European Inland
Shipping

D 4.4 Prototype of digital education and training tools

Public

Grant Agreement: 633929
(Sub)Work Package: 4.1.2
Deliverable No: D 4.4
Author: DST, STC
Version (date): 20th October 2017

Document history

Document version (date)	Comments (changes compared to previous version)	Authorised by
0.1 (19 th of July 2017)	First draft by DST	Benjamin Friedhoff
0.2 (18 th of August 2017)	Additional content by STC	Benjamin Friedhoff
0.3 (29 th of August 2017)	Amended and revised by DST	Benjamin Friedhoff
0.4 (4 th of September 2017)	Final Revision by DST	Benjamin Friedhoff
0.5 (4 th of September 2017)	Editorial changes	Jaap Gebraad
0.6 (20 th of October 2017)	Review and additional content by STC	Timon Jongkind
1.0 (23 rd of October 2017)	Final Version	Jaap Gebraad

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Abstract

PROMINENT will address the key needs for technological development, as well as the barriers to innovation and greening in the European inland navigation sector. One of the important factors in the implementation of the technical developments and innovation is the way the crew on board uses the new insights and technologies. To gain the necessary new knowledge and skills, e-learning modules can be used for both conventional learning environments in a school as for online training either on board or at home.

Within PROMINENT three e-learning modules were developed. The first topic is the *energy and cost-efficient navigation*, which covers the knowledge on interactions between water depth, current and sailing speed on resulting fuel consumption. Existing knowledge and new research done in this field has been gathered in an interactive e-learning tool. The second topic is *handling of dangerous cargo*, divided in modules for crew not having an ADN certificate, crew not sailing on ADN vessels and crew sailing with LNG as cargo. The third topic is *Vessel stability*, in which basic and advanced calculation schemes for the stability of inland vessels are provided with specific focus on container and liquid bulk cargo vessels. This tool helps to create awareness and sensitivity for vessel stability.

The e-learning modules are produced in simple English and complemented with many graphics, pictures, animations and videos. Highlights of the modules are the interactive applications. Each course is further divided into subtopics with a small quiz/exam at the end. One module is meant to last no longer than approximately 45 min and can be interrupted at any time, but preferably after every subtopic. Therefore, the modules can easily be used to learn in short or unknown time windows and are not too time consuming.

In the development of the modules care was taken to ensure that the modules run properly on any device like PCs, tablets and smartphone with reasonable requirements for bandwidth and CPU power. The modules can be implemented in various environments and learning management platforms. Content will be further evaluated and improved in the course of a pilot testing phase with test persons outside the PROMINENT consortium.

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1. The use of E-learning

PROMINENT will address the key needs for technological development, as well as the barriers to innovation and greening in the European inland navigation sector. One of the important factors in the implementation of the technical developments and innovation is the way the crew on board uses the new insights and technologies. To gain the necessary new knowledge and skills, digital education tools can be used for both conventional learning environments in a school as for online training either on board or at home.

One of the digital education tools is E-learning, which is, nowadays, highly attractive in the educational sector. Applications range from augmented learning elements during courses to stand alone lectures and from basic education to advanced training. The advantages compared to a one-way instruction from a teacher are manifold. For example the learning process can be adjusted to the pace of the learner, which gives the opportunity to proceed at the own pace and repeat difficult parts. Besides, monitoring the learning process can be done more easy, by registering the time spent on the different parts of the content and by giving automatic feedback in the tool. Finally the learning activities can be conducted independent of the learner's location, which is especially a great opportunity for students and professionals in the Inland Navigation Industry. Online e-learning modules support the learning process during practical training of students following a regular education programme or staff members who would like to update their knowledge.

Within PROMINENT three e-learning modules were developed. The first topic is the *energy and cost-efficient navigation*, which covers the knowledge on interactions between water depth, current and sailing speed on resulting fuel consumption. Existing knowledge and new research done in this field has been gathered in an interactive e-learning tool. The second topic is *handling of dangerous cargo*, divided in modules for crew not having an ADN certificate, crew not sailing on ADN vessels and crew sailing with LNG cargo. The third topic is *Vessel stability*, in which basic and advanced calculation schemes for the stability of inland vessels are provided with focus on container and liquid bulk cargo vessels. This tool helps to create awareness and sensitivity for vessel stability.

The e-learning modules developed in the framework of PROMINENT can be used as part of a regular education and training programme, or on distance for students following their practical training on board a vessel. Besides, it offers the possibility to current crew members to update or extend their knowledge.

2. Development of E-learning modules

The commercial software Adobe Captivate 9.0 was used for the development of the final module conforming to the Sharable Content Object Reference Model (SCORM) standard. This ensures that the results can be implemented in various learning management systems or without the SCORM functionalities even in any other web environment. The e-learning modules are produced in simple English and complemented with many graphics, pictures, animations and videos.

a. Target group

Defining the target group is one of the first important tasks in the process of developing an e-learning module. Based on the target group the background knowledge can be identified and the learning outcomes can be defined and gathered in the so called competence plan. Besides it is important to consider the learning process and environment of the target group. The modules can be used in a classroom environment and as additional material used by students or crew on board to repeat or intensify already learned material. To be flexible in using the e-learning modules in different situations, it is preferable to create a course of short and structured content which can be easily interrupted and continued later.

b. Competence plans

After the target group was defined, a basic competence plan for each module has been developed to clarify the aim of each e-learning module. Firstly, the already existing competences or qualifications of the target group must be clearly determined. Secondly, the learning competences can be determined and based on that the learning outcome can be defined. To specify and clarify the learning outcomes, topic questions can be formulated.

The competence plans for the modules have been developed considering the curricula of the STC and the Schiffer-Berufskolleg RHEIN with further input from the IMST and EICB. The aim was to transfer existing conventional material and to develop new material in an e-learning module. The competence plan for the module *Handling of dangerous cargo* (ADN) was developed to fill the gaps in existing materials, since some e-learning modules dealing with dangerous goods are already available. Based on the competence plan, a didactical concept has been developed for each module.

The competence plans were developed as a basis, although during the development some adjustments were made. In chapter 3, each module will be described in detail and the respective final competence plan will be shown. The competence plan is not necessarily equal to the outline of the module but in most cases quite close.

c. Material and learning tools

After the competence plan was set, suitable material was collected and sorted. Content and photo and video material were gathered from all partners and harmonized or newly created. Besides classical graphics and videos, some smaller animations or interactive elements help to explain and display the content more easily. The used software Adobe Captivate offers several options to create and develop small animations and interactive elements quite easily. An example of an interactive element is a Rollover element, which provides additional information when clicking on a specific text or image. This gives the opportunity to display additional explanations or to enlarge graphics without overloading the slide. A didactical advantage is that the student can think ahead before displaying the information, since it is not directly shown. It can only be used when needed and ignored otherwise.

All e-learning modules have an integrated voice-over and so called *closed captions* (subtitles). The voice over should give some more details and descriptions not shown on the slide and the closed captions are the written version of the voice over. Closed captions can be turned on or off according to the users preference.

d. Assessment of learning success

Achievement tests are mainly based on small quizzes at the end of each part of the module and a final exam at the end of the whole module. However, there are sometimes small questions and tasks to perform during the course. The creation of the different types of quizzes is already offered as a standard procedure in Captivate.

There are different types of question slides, with quite useful standard settings and options. Figure 1 shows an overview of the possible types of question slides. Within this project mainly four types were used, which will be explained shortly with real examples from the modules.

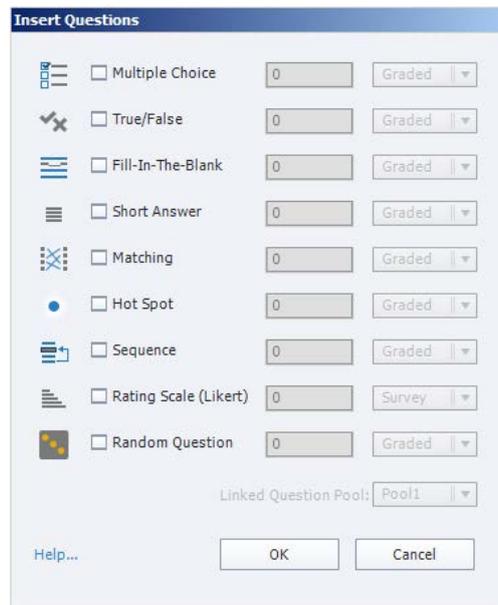


Figure 1 Possible question slide types offered by Captivate

The most frequently used one is the multiple-choice slide (Figure 2, left), where the user can choose between given answers. The correct answer is programmed in Captivate and the order of answers is varied.

Another possibility is the short or free answer option (Figure 2, right), where the questions must be answered freely, without a selection of answers. This is only suitable if the answer is straight forward and well defined, for example for calculation tasks.

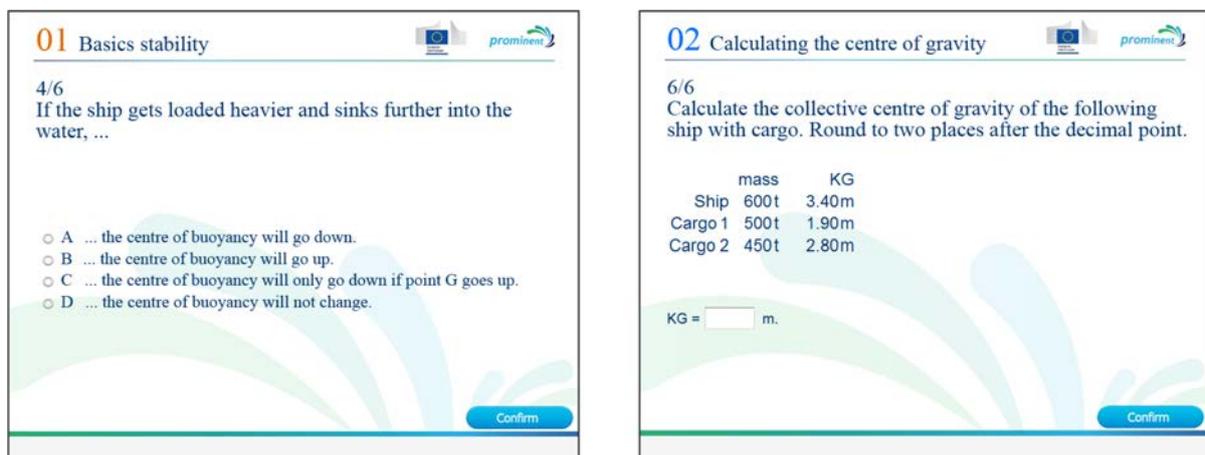


Figure 2 (left) Multiple-Choice question slide; (right) short answer slide

The matching question slide (Figure 3, left) can be used to test the assignment of several items or terms at once. The right matching is defined in Captivate and the order is mixed automatically. Finally, the hot spot question slide (Figure 3, right) can be used to identify certain points or areas in pictures and graphics. Therefore, the right area is marked but not shown in the question. The user must then click to the right point to answer the question correctly.

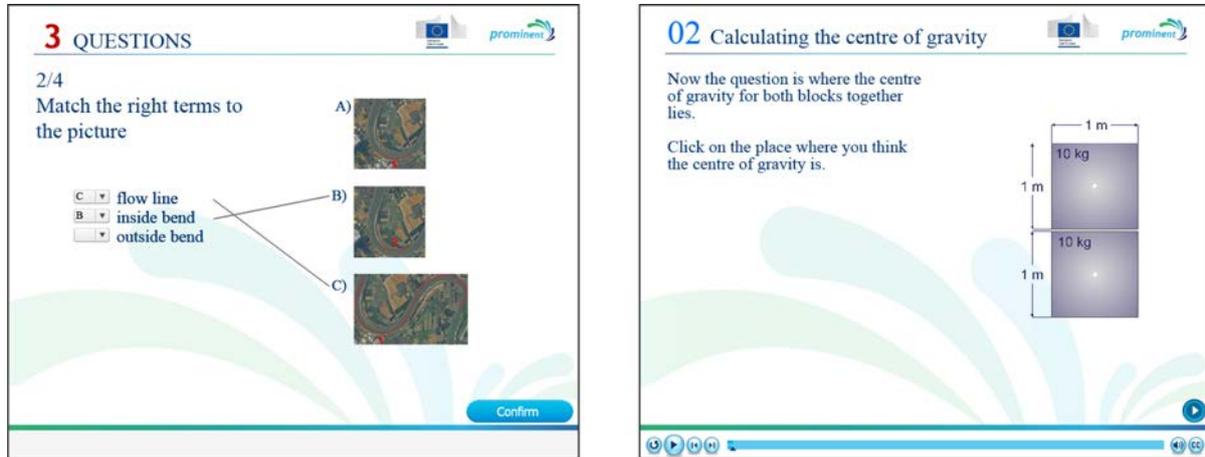


Figure 3 (left) matching question slide; (right) Hot spot question slide

To consolidate the newly learnt knowledge, small quizzes are integrated into the module. They are placed behind each part of the module and only deal with the specific content of this part. The students have to take the quiz to proceed to the next topic. It is not possible to skip a question. When a wrong answer is given, a hint for the right answer appears and the student has another try to answer the question (Figure 4, right). With the right answer, he can proceed to the next questions (Figure 4, left). These quizzes are not rated. They usually consist of a few questions only.

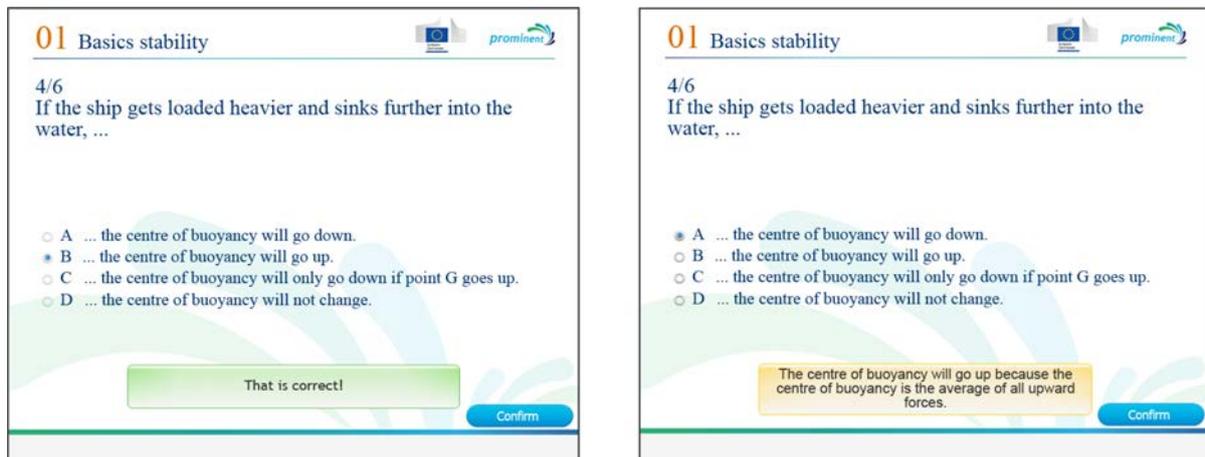


Figure 4 Feedback on right and wrong answer in the quiz between parts of the module

At the end of the whole module the students have to perform a final exam, which covers the content of the whole module. It usually consists of ten questions. The answers are not commented and the student has only one attempt. This exam is rated in the end and the student needs six out of ten questions correct to pass the exam.

e. Workflow

Initially, a workflow for processing the e-learning modules in the most efficient way was created. Therefore, three different groups were created. The first group consists of lecturers and experts on the special topic, who create the concrete content based on the competence plan. The content is passed to the second group by a template (Figure 5).

Module:

Chapter 1				
Slide No.				
1				
	Narration:			
	Graphics, animations, etc:			

Figure 5 Template for the processing of the e-learning modules

The second group consists of e-learning specialists, who implement the content into the e-learning software and who create the e-learning module with all contents, graphics and interactive features. The modules are then passed to the third group, which consists of teachers, experts as well as e-learning specialists reviewing the modules with respect to the correctness of content, the appearance and technical functionality of all features. They give a feedback to lecturers and e-learning specialists for eventual corrections and adaptations or amendments. The third group should not have been involved in the first two steps of the workflow. A scheme of this workflow is given in Figure 6.

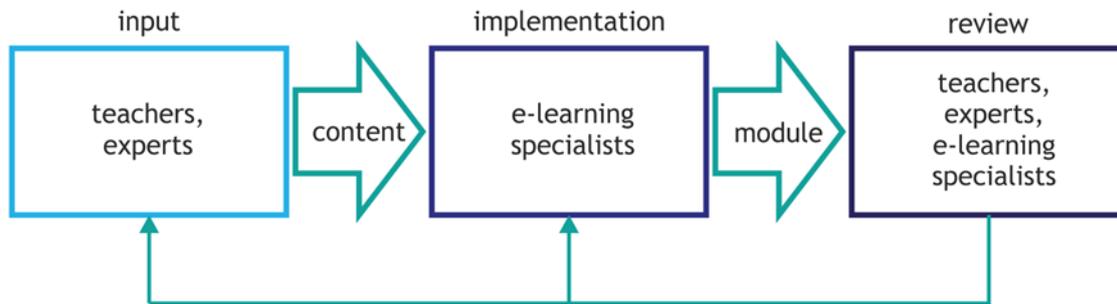


Figure 6 Workflow for processing the e-learning modules

The groups were defined in the beginning for each module, but in practice, input was given from all participants of WP 4.1 at any time and in between the different steps, easing the structure a little.

The modules have been reviewed and revised iteratively by the partners involved in sub work package 4.1 and associated experts. Within the reviews, the content was adapted, extended or removed to create a better consistency. The graphical design and layout have been arranged to match the corporate design of the PROMINENT project and to achieve a well-structured appearance. The last step, before the rollout, was a linguistic revision of the modules.

3. Description of the modules

a. Module 'Energy efficient navigation'

The aim of the 'energy and cost-efficient navigation' module is to provide basic and advanced information on interactions between water depth, current and sailing speed on resulting fuel consumption.

I. Target group

The target group for the module 'Energy efficient navigation' are crew members on a vessel and especially those still in training. Students at inland waterway transport education and training institutes would benefit from the module as well.

II. Competence plan

Table 1 Competence plan for the 'Energy efficient navigation' module

#	Subtitle	Learning competence	Learning outcome	Topic questions
1	Introduction	Introduction, Optimisation potential, Sailing policies	advantages of energy efficient navigation, knowing the purpose and content of the module knowing different possibilities/potentials to save fuel, fuel saving regarding different sailing policies	Why is energy efficient navigation important? What will be covered in the module? How can energy efficient navigation be achieved? What measures can be taken to save fuel? How do sailing policies perform in comparison to each other?
2	Influencing factors	Ship depending factors, waterway depending factors	Knowing ship depending and waterway depending factors which influence the fuel consumption	What are the ship depending factors? What are the waterway depending factors?
3	Physical background	Negative flow, Bernoulli and continuity equation, primary and secondary wave system, depth Froude number, Shallow water effect Resistance and power demand	Knowing how the negative flow develops, Knowing the basic effect of Bernoulli and continuity equation, knowing the primary and secondary wave system, knowing the depth Froude number and the shallow water effect Knowing what the resistance of the vessel is and what it depends on Knowing about the power demand	What is the cause of the negative flow? How does the primary and secondary wave system look like? What is the depth Froude number? What is the shallow water effect What is the resistance of the vessel? What does it depend on? How is the power demand determined?

4	Ship depending influencing factors	Influencing factors: Ship depending	Knowing the influence of the dimensions of the vessel, draught, shape and type of vessel, engine, and propulsion system	What are the ship depending factors? How does each factor influence the fuel consumption?
5	Waterway depending influencing factors	Influencing factors: Waterway depending	Knowing the influence of width, depth, current, curves, manoeuvring, and traffic	What are the waterway depending factors? How does each factor influence the fuel consumption?
6	Other influencing factors	Influencing factors: others	Knowing the influence of weather, steering, and sailing time	What are further influencing factors? How do these factors influence the fuel consumption?

III. Content

Energy efficient navigation was a major subject of several work-packages within the PROMINENT project. It is the only greening approach that can be -at least to some extent- applied on all kinds of vessels with little to no additional costs. The awareness of the physical background and the parameters determining energy consumption can help the navigating staff to save fuel with the information already on board. Additional savings can be made accessible with advisory systems and applications making systematic use of sophisticated ship and waterway data. More details can be found in the reports preparing, describing and analysing the pilot application of energy-efficient navigation in sub work-package 5.4 (see deliverables D1.2, D2.3, D2.4, D5.5, D5.6 and D6.2).

The content of the module 'Energy efficient navigation' is structured in the following way:

01. Introduction and motivation
 - Why energy efficient navigation?
 - Influencing factors
02. Physical background
 - negative flow
 - Resistance and power demand
 - Ship waves
03. Influencing factors
04. Final exam

The first part 'Introduction and motivation' shows the reasons why fuel saving is important. Besides the monetary aspects, a reduction of emissions and improvement of the ecological impact, the aspiration to stay competitive with other modes of transport, and the need to meet regulatory requirements are listed. The monetary aspect and the reduction of emissions, as it is one of the main topics within the PROMINENT project, are covered in more detail. Next, general possibilities were presented, how fuel saving can be achieved. Named and shortly explained are the areas: infrastructure, fleet modernisation, hull efficiency, logistics, propulsion systems and operational aspects, called sailing policies. Except for sailing policies, the measures to reduce the fuel consumption are rather time intensive or expensive. They should be kept in mind for long-term improvements, but are unsuitable for immediate changes. Whereas, operational aspects can be

applied instantly, choosing the right sailing policy can strongly improve the fuel consumption and can lead to energy-efficient navigation in an easy way. Therefore, the rest of the module focuses on operational aspects. Besides the benefit of increasing the sailing time, which is the most efficient way, the influences of different sailing policies like constant speed through water, constant speed over ground, constant power, constant RPM, constant depth Froude number and minimised averaged depth Froude number were shown and compared. The first part is completed by listing the vessel depending and waterway depending factors which are important under the operational aspect and which are influencing the fuel consumption.

Before describing each influencing factor in more detail, some of the basic physical aspects that are important to understand the influences of different factors on the behaviour of the vessel and its fuel consumption are displayed in the second part of the module. It starts with the description of the negative flow, which is followed by a short introduction of the Bernoulli equation and the continuity equation. All these aspects are important to understand the flow behaviour of water around a moving vessel and to describe the induced wave system. Further it is important to know, how the resistance of a vessel is composed. Mainly four factors are relevant for the description of the resistance, namely, the wave-making resistance, the frictional resistance, the eddy resistance and the air resistance. All four components are shortly described. The wave making resistance is described in more detail. Next, the formation of the wave system and its characteristics are described. It is divided into the primary wave system and the secondary wave system. Further, the difference of the wave system in deep and shallow water is shown and explained and the depth Froude number is introduced. Finally, the dependency of the fuel consumption on the velocity at a given water depth is demonstrated.

The third module deals with the influencing factors in more detail. It starts with the vessel depending factors, followed by the waterway depending factors and ending with other factors. The vessel depending factors are the dimension of the vessel, mainly the width and length, the draught, the form and type of the vessel, as well as the propulsion system. The waterway depending influences are the water depth, the width of the waterway, the current, curves and manoeuvring, as well as traffic. Further the influences of wind and steering are described. All these influences are mainly demonstrated with exemplary data and calculations.

IV. Structure

The whole module consists of 55 slides, the distribution of slides among the single parts can be seen in Table 2.

Table 2 Number of slides, distribution among the different parts in the module 'Energy Efficient Navigation'

#	Part	Content slides	Quiz slides
1	Introduction and motivation	11	0
2	Physical Background	11	2
3	Influencing factors	15	4
4	Final exam	2	10

V. Highlights

The content is supplemented with appealing graphics, images and videos, as well as interactive elements. Besides the bullet points and small texts on the slide, the content will be read out and explained with more details (voice over). The voice over content is also displayed as closed captions.

Figure 7 shows an example for the usage of rollover captions. The left side of the figure shows the slide, how it is displayed initially. For a further explanation, the user can move the mouse over one of the symbols and the explanation appears as it is shown on the right side of the figure. After moving the mouse out of the defined rollover area, the explanation disappears again.

Figure 8 shows an example for the usage of interactive elements. On this slide, the interconnection of power and velocity is demonstrated. Therefore, the user can click on the plus sign to increase the velocity. This will be shown on the speedometer on the left. Additionally, the increase in power will be displayed on the right. Further, the behaviour of velocity and power is displayed in a diagram, where the curve is extended or reduced for each new velocity. Figure 8 shows two different velocities, a smaller one on the left side and a larger one at the right side. The difference in the speedometer and the diagrams are visible.

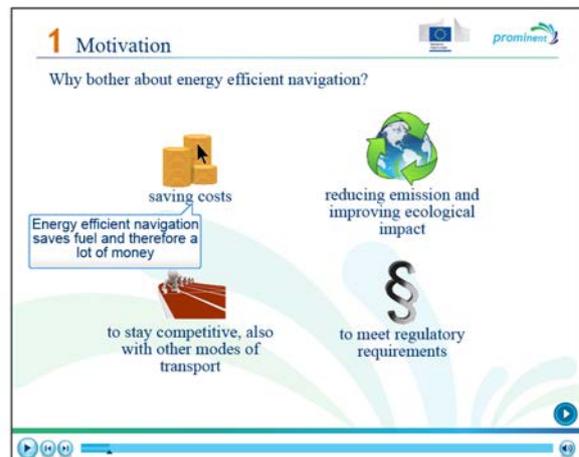
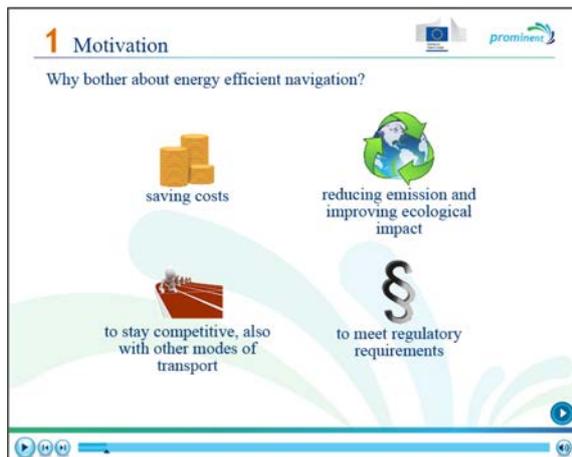


Figure 7 Slide 5 of the 'Energy Efficient Navigation' module. Usage of Rollover captions: Further explanation appears by moving the mouse over the symbols.

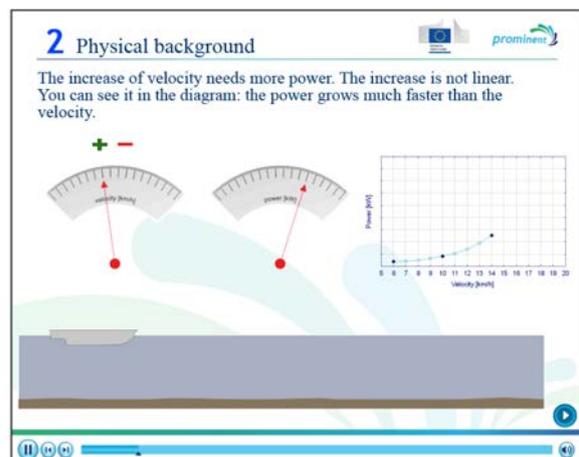
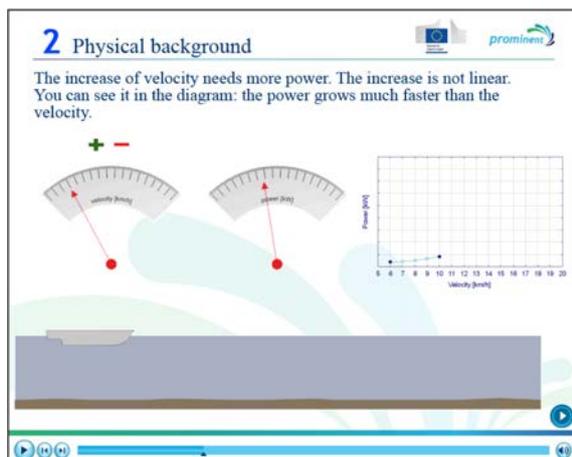


Figure 8 Slide 21 of the 'Energy Efficient Navigation' module. Interactive element to demonstrate the behaviour of power and velocity.

b. Module 'ADN'/Dangerous goods

Since already some e-learning material dealing with ADN regulations and the handling of dangerous goods or LNG exists, this module is further divided into three parts, to cover the gaps in the existing material. The module is divided into:

- A. ADN module for crew not having an ADN certificate and not sailing on an ADN vessel. However, during daily traffic dealing with other ADN vessels, which makes a proper behaviour regarding keeping the right distance, etc. important;
- B. ADN module for crew sailing on board ADN vessels, but not having an ADN certificate (crew not being in the position of skipper/captain);
- C. ADN module for ADN-certified crew, sailing with LNG cargo. This module focuses on cargo handling, loading and discharging LNG, with reference to vessel stability

I. Target group

Due to the division of the module, three different target groups are addressed:

- A. For crew members not having an ADN certificate and not sailing on an ADN vessel;
- B. For crew members sailing on board ADN vessels, but not having an ADN certificate (crew not being in the position of skipper/captain);
- C. For ADN-certified crew, sailing with LNG as cargo.

Besides, the module will be beneficial for students at inland waterway transport educational institutes as well.

II. Competence plan

Table 3 Competence plan for the 'Dangerous goods' module A

#	Subtitle	Learning competence	learning outcome	Topic questions
1	Identification of vessels with dangerous goods	Blue cones and lights	Knowing how to identify vessels with dangerous goods, knowing the meaning of blue cones and lights	How can a vessel with dangerous goods be identified? What does the number of blue cones/lights indicate?
2	General behaviour during encounter with vessels with dangerous goods	Keeping distance to other vessels, Passing locks	Knowing which distance needs to be kept during encounter with vessels with dangerous goods, Knowing how to behave when passing locks together with vessels with dangerous goods	Which distance must be kept during encounter with vessels with dangerous good? What is to do when passing locks together with vessels with dangerous goods?
3	Warning Signal	'Keep clear signal'	Knowing how the 'keep clear signal' sounds, knowing what to do when the 'keep clear signal' sounds	What is the 'Keep Clear Signal'? What measures have to be taken when the 'keep clear signal' sounds?

Table 4 Competence plan for the 'Dangerous goods' module B

#	Subtitle	Learning competence	learning outcome	Topic questions
1	Basic knowledge ADN legislation	ADN	Knowing what ADN is and what is regulated in the AND documents	What does ADN stand for? What does ADN regulates?
2	Classification of dangerous goods	Classification, labels, risk properties, precautions, measures in case of emergency	Knowing the classification of dangerous goods, Knowing the labels of classes, Knowing what a packing group is, Knowing the risk properties of each class, Knowing the appropriate precautions and measures in case of emergency	How many classifications exist? How are dangerous goods classified? How do the labels for each class look like? What is a packing group? What are the risk properties of each class? Which precautions can be taken? Which measures must be taken in case of emergency?

Table 5 Competence plan for the 'Dangerous goods' module C

#	Subtitle	Learning competence	learning outcome	Topic questions
1	Properties of LNG	LNG	Knowing what LNG is, Knowing the main properties of LNG	What is LNG? What are its properties?
2	Technical requirements	Tank, drip tray, spraying system	Knowing the requirements for the tank and other devices	Which requirements have to be fulfilled? What devices are necessary?
3	Handling LNG	Holding time, boil-off, filling procedure, Pressure changes	Knowing how to fill the tank, Knowing how to determine the holding time, Knowing what boil-off is, Knowing what influences the pressure	How is the tank correctly filled? How is the holding time calculated? What is boil-off? What influences the pressure?

III. Content

A. ADN module for crew not having an ADN certificate and not sailing on an ADN vessel.

For crew not sailing on an ADN vessel it is not an obligation to have an ADN certificate. But all crew on board inland navigation vessels must know how to deal with ADN vessels during daily operations. The newest *Draft of Standards for competences on operational and managerial level* describes which knowledge, understanding and proficiency is necessary for all crew. This includes knowledge with respect to ADN cargo. This means that also crew not having an ADN certificate must be able to show a proper behaviour regarding ADN vessels. This e-learning module contains the most important knowledge a crew member needs to have to deal with other ADN vessels.

- I. Keep clear signal
- II. Sounding signal/keeping distance
- III. Blue cones and lights
- IV. Calculation of the distance to be kept
- V. Final test

B. ADN module for crew sailing on board ADN vessels, but not having an ADN certificate.

Crew not being in the position of a skipper/captain does not need to have an ADN certificate. But as mentioned in the most recent *Draft of Standards for competences on operational and managerial level* all crew on board must be able to at least identify the ADN labelling of dangerous goods. This e-learning module contains:

- I. Basic knowledge about ADN legislation
- II. Classification of dangerous substances
- III. Necessary precautions to be taken
- IV. Final exam

C. ADN module for ADN-certified crew, sailing with LNG cargo.

Although LNG as a gas is covered in the ADN classification structure, this is a gas with such different characteristics, that more knowledge and understanding is necessary for a safe operation on inland navigation vessels. This e-learning module focuses on cargo handling, loading and discharging LNG, with reference to vessel stability, according to the following structure:

- I. Main properties of LNG
- II. Transportation of LNG
- III. Construction and configuration of LNG tanks
- IV. Holding time calculations
- V. Final exam

IV. Structure

Table 6 Number of slides, distribution among the different parts in the 'Dangerous goods' module A

#	Part	Content slides	Quiz slides
1	Start & Content	3	0
2	Keep clear signal	4	0
3	Sounding signal	14	0
4	Final exam	1	10

Table 7 Number of slides, distribution among the different parts in the 'Dangerous goods' module B

#	Part	Content slides	Quiz slides
1	Start & Content	3	0
2	Basic knowledge	4	0
3	Classification...	21	0
4	Final exam	1	10

Table 8 Number of slides, distribution among the different parts in the 'Dangerous goods' module C

#	Part	Content slides	Quiz slides
1	Start & Content	2	0
2	LNG	3	0
3	Technical requirements	10	0
4	Operational requirements	5	0
5	Final exam	1	10

V. Highlight

The content is supplemented with appealing graphics, images and videos, as well as interactive elements. The content will be read out to support the text and bullet points on the slides.

Figure 9 shows how videos are used to support the transfer of knowledge with respect to the dangers.

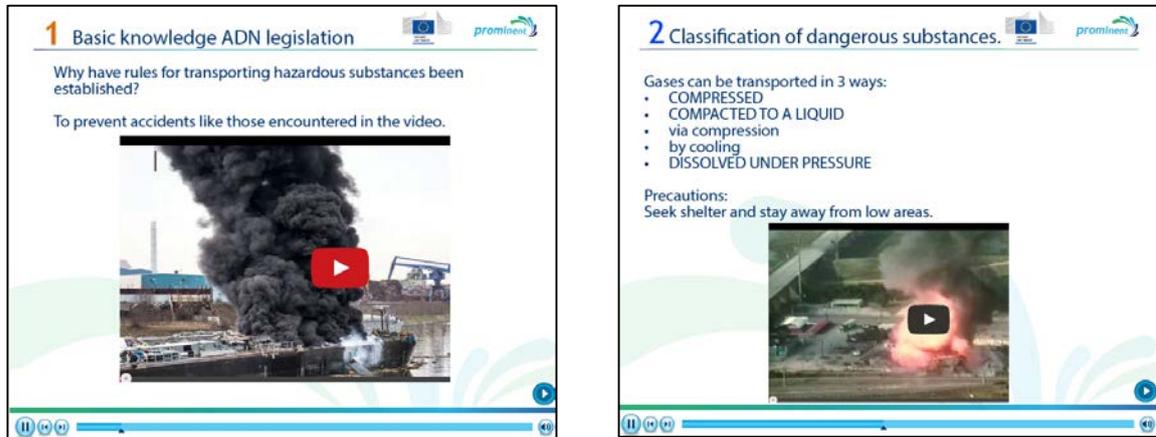


Figure 9 Videos used to support the explanation of dangers

Further, roll over captions are used to provide additional information on demand, without disturbing the flow of reading as shown in Figure 10.

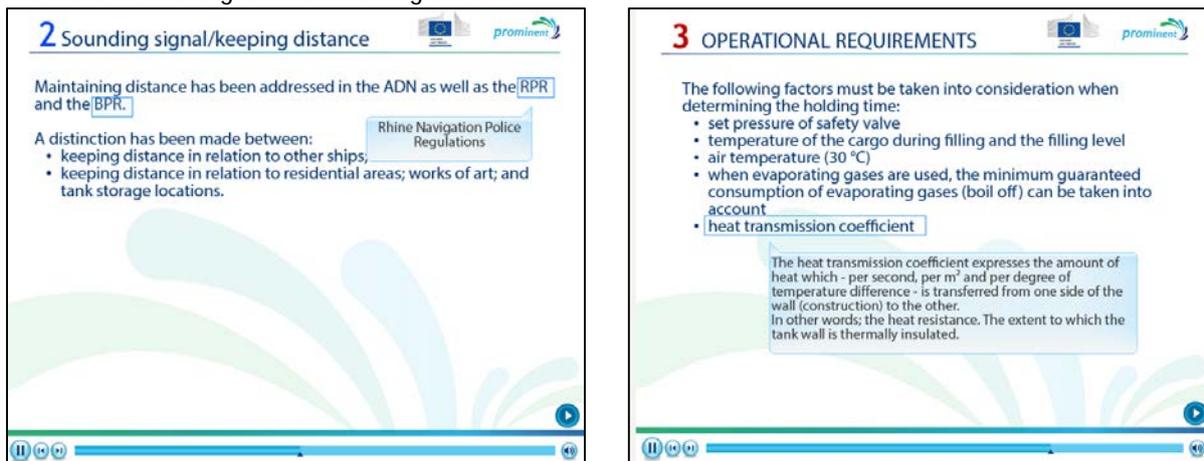


Figure 10 Use of roll over captions: By moving the mouse over the word, further explanation appears

c. Module 'Vessel Stability'

The aim of the 'Vessel stability' module is to provide basic and advanced calculation schemes for the stability of inland vessels with focus on container and liquid bulk cargo vessels. The module shall help to create awareness and sensitivity for vessel stability.

I. Target group

The target group for the module 'Vessel stability' are crew members on a vessel and especially those still in training.

II. Competence plan

Table 9 Competence plan for the 'Vessel Stability' module

#	Subtitle	Learning competence	learning outcome	Topic questions
1	Introduction	Introduction	Knowing why the topic is important. Knowing the purpose and content of the module.	Why is stability an important topic? What will be covered in the module?
2	Fundamentals Stability	stability, metacentre, centre of mass, centre of buoyance,	Knowing the fundamental vocabulary of stability (metacentre, centre of mass, centre of buoyance) Knowing the condition of stability.	When is an object stable? What is the metacentre? What is the centre of mass? What is the centre of buoyancy?
3	Description of stability	Initial stability, Righting and heeling arm, Righting arm curve, Static and dynamic stability	Knowing what the righting and heeling arm is. Knowing what the righting arm curve is.	What is a lever arm? How can the stability be illustrated?
4	Influencing factors	influencing factors	Knowing the factors that influence the stability of a ship. Knowing the strength of the influencing factors.	What influences the stability of a ship?
5	Calculation of stability	Sheets and curves for the determination of stability, Calculation procedure for stability	Knowing what documents are needed to calculate stability. Being able to calculate stability.	What data sheets are necessary to calculate stability? What do they describe? How are they used? How to calculate stability?

6	Special aspects for container cargo vessels	special aspects for container cargo vessels, Loading and unloading, Storage plan	Knowing the special factors for the stability of container cargo vessels. Knowing what to consider during loading and unloading. Being able to use a storage plan.	How does the displacement of cargo influences the stability? How does manoeuvring influence the stability? What needs to be considered during loading and unloading?
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III. Content

The content of the module 'Vessel Stability' is structured in the following way:

01. Basic Stability
 - Terms and definitions
 - What is stability?
02. Calculating the centre of gravity
 - What is a momentum?
 - Righting arm curve
 - How to calculate the centre of gravity
03. Applying stability practically
 - Determine stability
04. External factors
05. Final exam

The first part of the module is quite extensive and starts with some general terms and definitions that are used within the module. The term stability is defined and destabilising factors are named. Afterwards, special terms used for the description of stability, are explained and dependencies are displayed. This includes the description of the centre of gravity, the centre of buoyancy, the metacentre and the metacentric height. Based on that, it is described what happens, when a vessel heels or how the stability is influenced by additional cargo. Finally, the special case for tankers or vessels with liquid cargo is shown.

In the second part, it is explained how the centre of gravity can be calculated. Therefore, the momentum, lever principle and the righting arm curve are introduced. In this part, a link to a 'balancing game' is integrated. Here the understanding of momentum and the lever principle can be intensified. After this short excursion, the calculation of the centre of gravity is shown very detailed with the help of a simple example.

The third part is dedicated to the practical use of the calculation of the centre of gravity for the determination of the stability. The example, on which the calculation is performed, is more specific, dealing with standard container on a vessel. The stability book and the information given in this book are explained and an exemplary stability book is shown.

In the fourth part 'external factors', which were already mentioned in the beginning, are described explicitly, for example, influence of wind, influence of cargo movement, influence of damage, influence of current, and the influence of steering.

IV. Structure

The module 'Vessel stability' is the most extensive module with 104 slides in total. The distribution among the different parts is listed in Table 10.

Table 10 Number of slides, distribution among the different parts in the module 'Vessel stability'

#	Part	Content slides	Quiz slides
1	Start and Content	2	0
2	Basic Stability	24	6
3	Calculating the centre of gravity	24	6
4	Applying stability practically	16	6
5	External factors	6	0
6	Final exam	2	12

V. Highlights

The content is supplemented with appealing graphics, images and videos, as well as interactive elements. Besides the bullet points and small texts on the slide, the content will be read out and explained more detailed (voice over). The voice over content will be displayed as closed captions.

Figure 10 shows an example, where the rollover image is used to explain a sequence of actions. On the left side, the slide as initially displayed, is shown. The user can now move the mouse over each graphic to display the explanation for the current graphic. Thus, the whole process can easily be explained on one slide, without overloading it with text. On the right side of Figure 10 the mouse is over the third graphic and displays the according explanation. The user can work through the slide at individual pace and can repeat single explanations on purpose.

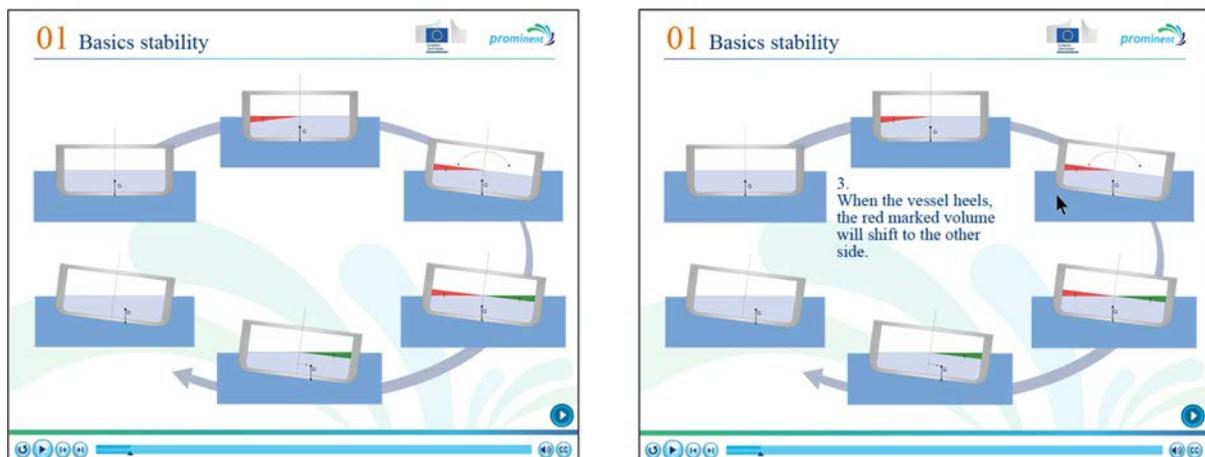


Figure 10 Rollover images used in the 'Vessel Stability' module to explain the movement of liquid cargo during heeling

Figure 11 shows an example for the usage of state changes, where graphics or pictures change their state depending on external conditions. In the shown example, cargo can be added to the empty vessel by clicking on the button 'Add cargo', with each click, a new mass is added atop. Together with adding the mass, the centre of gravity moves up. Thus the user can directly see the influence of additional mass.

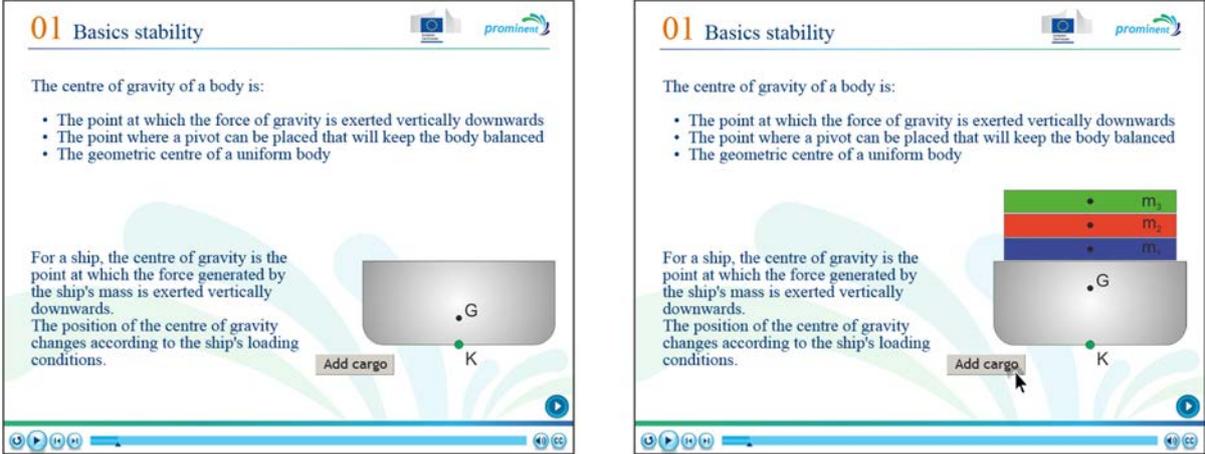


Figure 11 Slide 9 shows the state change option

4. Pilot tests

The pilot tests are crucial to assess the performance of the e-learning modules. Based on the results last adjustments can be carried out before making them available for the public. The prototypes of the e-learning modules will be made available with open access on the INes-Danube (ILIAS) platform (Figure 12) within the web/based community of practice established in SWP 4.3. The technical requirements are already established and a test module has been uploaded and is working properly.

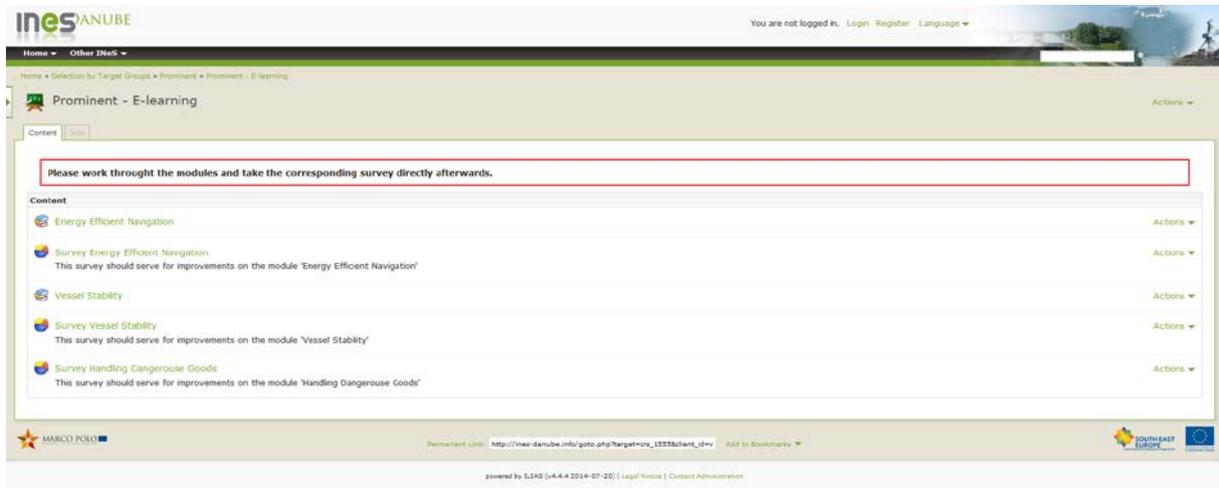


Figure 12 Screenshot of the INes Danube platform on which the module are published

a. Test group

The prototypes should be tested during courses under the supervision of experienced lecturers to assess the performance of the tools. Testing can be performed by students at the STC and the 'Schiffer-Berufskolleg RHEIN'. Also crew members already working on board of inland vessels can evaluate the e-learning modules.

b. Evaluation form

The evaluation of the e-learning modules will be performed in SWP5.5. Some preparations have already been done in advance. The evaluation will be done also on the platform in form of questionnaires (Figure 13). These questionnaires are divided into different categories:

1. General
2. Content
3. Quiz
4. Appeal and Attractiveness
5. Summary

How long does it take to complete the whole module? *

- < 20 min
- 20-30 min
- 30-40 min
- 50-60 min
- > 60 min

How do you rate the duration of the module? *

- It was too short
- It was a good length
- It was too long

Do you agree or disagree to the following statements? *

	strongly agree	agree	neutral	disagree	strongly disagree
The course met my expectations.	<input type="radio"/>				
The language is understandable.	<input type="radio"/>				
The voice over was helpful.	<input type="radio"/>				
The closed captions were helpful.	<input type="radio"/>				
The navigation through the slides was good.	<input type="radio"/>				
The interactive elements worked properly.	<input type="radio"/>				
Animations and videos worked properly.	<input type="radio"/>				
The amount of interactivity was good. If not, was it too much or too little?	<input type="radio"/>				
The animations and interactive tools were helpful.	<input type="radio"/>				

Do you have any comments? (eg. What was not working properly? What can be improved?)

Answer:

Do you agree or disagree to the following statements? *

	strongly agree	agree	neutral	disagree	strongly disagree
The content is compatible to the content in a conventional class.	<input type="radio"/>				
The content is understandable.	<input type="radio"/>				
The content was relevant for me.	<input type="radio"/>				
The content was too easy.	<input type="radio"/>				
The content was too difficult.	<input type="radio"/>				

Do you have any comments? (eg. Should topics be added or omitted?)

Answer:

Do you agree or disagree to the following statements? *

	strongly agree	agree	neutral	disagree	strongly disagree
The questions are compatible to the content.	<input type="radio"/>				
The quiz was too difficult.	<input type="radio"/>				
The quiz was too easy.	<input type="radio"/>				

The quiz contributed to the learning process.	<input type="radio"/>				
The quizzes prepared me for the final exam.	<input type="radio"/>				
Do you have any comments?					
Answer: <input type="text"/>					

Do you agree or disagree to the following statements? *					
	strongly agree	agree	neutral	disagree	strongly disagree
The design was appealing.	<input type="radio"/>				
The quality of images and videos was sufficient.	<input type="radio"/>				
The slides were well structured.	<input type="radio"/>				
The slides were overcrowded.	<input type="radio"/>				
Do you have comments? (eg. What was good? What might be improved?)					
Answer: <input type="text"/>					

Please answer the following questions. *		
	yes	no
Did the module helped you to a better understand the topics?	<input type="radio"/>	<input type="radio"/>
Do you prefer e-learning over conventional learning?	<input type="radio"/>	<input type="radio"/>
Did you like the module?	<input type="radio"/>	<input type="radio"/>
Would you like to have modules an other topics? If so, which topic? <input type="text"/>	<input type="radio"/>	<input type="radio"/>
Which mark would you give the module? (1 is good, 6 is bad) *		
Answer: <input type="text"/> (1 to 6)		
Do you have any comments?		
Answer: <input type="text"/>		

Figure 13 Questionnaire for the evaluation of the e-learning modules

I. Analysis

The analysis of the questionnaires will be done in SWP5.5 and the results will be presented in the deliverable D5.14 in October 2017.

5. Summary and Outlook

a. Summary

To deal with the conflict of practical training on board of a vessel versus the attendance in conventional classes, SWP 4.1 aimed to develop three e-learning modules, dealing with 'Energy Efficient Navigation', 'Vessel Stability' and 'Dangerous goods'. This task was successfully managed.

The three modules have been developed based on current learning material in conventional classes; graphics, videos and interactive elements were used to take advantage of the e-learning benefits. Quizzes and small exams make sure that the content will be repeated and consolidated.

b. Outlook

The final pilot tests and evaluation of the modules will take place in the following two months. After possible adjustments the module can be made available for public on the Ines Danube platform. The report on the evaluation is due in November 2017 in deliverable D5.14.

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c. Abbreviations

DST	Development Centre for Ship Technology and Transport Systems
EICB	Expertise and Innovation Centre Barging
EU	European Union
H2020	Horizon 2020
IMST	Department of Systems Engineering and Management Technology, University of Craiova
LMS	learning management system
PROMINENT	Promoting Innovation in the Inland Waterways Transport Sector
SBKR	Schiffer-Berufskolleg Rhein
SCORM	Sharable Content Object Reference Model
SI	International System of Units
SWP	Sub-Work Package
WP	Work Package