



## WP4 – Development of teaching and training resources with the use of remote teaching methodology

### IO.11 Development of resources for roadside safety management

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## 1 INTRODUCTION

The COVID-19 pandemic has forced a departure from the current functioning of society in many aspects of the economy, travel, work and education, not excluding higher education. The necessity of remote education is one of the ways to maintain social distancing and protect our health and life.

A preliminary assessment of the situation at universities in European countries indicates that academic staff were not sufficiently prepared to conduct attractive and practical classes in a remote format.

The necessity to conduct classes remotely involves developing a dedicated didactic and training process project, considering the specific requirements of interdisciplinary engineering knowledge. Transferring this knowledge in remote education, due to its large scope, requires various didactic tools (lectures, fieldwork, design, practicals, laboratories, student assignments and assessment of the progress and knowledge of students and trainees).

The measurable expected final results are:

- Development of a remote learning methodology for Road Infrastructure Management (RIM) as a model solution to provide a basis for extending the methodology to include further aspects of civil engineering and transport.
- Developing an e-handbook for academic staff supporting the remote learning process.
- Development of model digital teaching and training materials dedicated to technical colleges and training for road management staff on RIM:
  - Road safety audit,
  - Roadside safety management,
  - Safety management of vulnerable road users,
  - Road pavement management.
- Developing an e-learning platform with access to project products.
- Appointment of a panel of experts in road infrastructure management.

The InfRO@D project targets the following groups:

- 1) Students, researchers, and academic teachers at universities.
- 2) Road authority staff at national, regional and local levels.
- 3) Experts, specialists, and practitioners involved in RIM activities, including staff who conduct training in various RIM courses.
- 4) All users of road infrastructure, as an indirect target group, for whom the risk of road accidents will ultimately be reduced by increasing the effectiveness and efficiency of RIM activities.

The project is also supported by a group of associates who will cooperate with project partners to consult and evaluate the results. They will implement final products and promote the dissemination and accessibility of the project results.

### ABOUT OUTPUT IO.11

- **Objective:** Development of resources for roadside environment safety management.

- **Work package:** The task falls under WP4 – Development of teaching and training resources with the use of remote teaching methodology.
- Target Groups:
- Research and teaching staff from institutions involved in the project and other European institutions.
- Students of civil and transportation engineering.
- Road authority staff at a national, local and regional level.

## 2 SUBJECT ASSUMPTIONS

### 2.1 Division of Roadside Safety Management Lessons

The planned outcome of the task is the development of modern and innovative digital teaching and training content for remote education in the field of roadside safety management, with the support of RISM tools. As part of the civil and transportation engineering course syllabus in partner universities. The work included a detailed breakdown of the issue into two chapters of 60 hours of lessons each:

- Impact of the environment on road safety.
- Principles of designing road environment.

Following the assumptions made during the development of the methods of remote education (task IO.4 – IO.9), it is assumed learning by doing. Emphasis on practical activities, student collaboration, and knowledge exchange during group work or webinars. The planned division of roadside safety management lessons is shown in Table 1. The potential extension of the programme will be possible when syllabuses have been adapted.

Table 1 The planned division of roadside safety management lessons

Types of classes	Chapter	
	1	2
Lecture	30	30
Field activities	12	12
Practicals (remote)	12	10
Design class	6	8
Number of lessons	60	60

In line with the project's objectives, the work included preparing examples of didactic and training materials. Materials for Chapter 1 - Impact of the environment on Road Safety were prepared.

### 2.2 Type of didactic and training resources

Roadside environment safety management also includes specialist knowledge of the design and use of road safety devices. This knowledge is insufficiently imparted to students and infrastructure management personnel in curricula and various training courses. The materials developed will make it possible to fill this gap in the learning process. The work includes theoretical and practical activities:

- lectures (roadside environment requirements, risk assessment and analysis, rules for identifying and classifying hazards and their source, testing of protective devices – site and numerical tests, rules for the design and location of protective devices, database exploration, etc.),
- fieldwork (recording national, regional, and local road sections and documentation in specific locations, identification and assessment of hazards),
- practical classes (analysis database, risk, analysis and assessment of hazards and their source),
- design classes (of the roadside environment), including the location of protective devices with appropriate parameters,

As part of the project implementation, the following type of data was prepared:

- PowerPoint-teacher – presentation, which should be presented by the teacher (Figure 1),
- PowerPoint-audio – presentation with teacher soundtrack and subtitles if the speaker presented issues in another language than English (Figure 2),
- PowerPoint - without voice – presentation for students/road specialists to self-teaching.
- PowerPoint with YouTube resources (Figure 3).
- Recorded national, regional, and local road sections (Figure 5).
- Shapefile, kml, pdf with prepared localisation of analysed regional and local road sections (Figure 6, Figure 8).
- Papers describing analysed issues.
- Excel files with prepared data (Figure 7).
- Interactive quiz – different quizzes (open questions, multichoice, yes/no).
- Webinar, Q&A, PowerPoint - student presentation (Final discussion with the teacher, all groups together).

## Scope and genesis of the IO - RSIR

In Poland, between 2017 and 2019 there were 15,50 accidents related to the roadside (10% of all accidents), involved 18,700 people injured (16%), including 6,100 seriously injured (16%) and 1,800 people killed (18%).

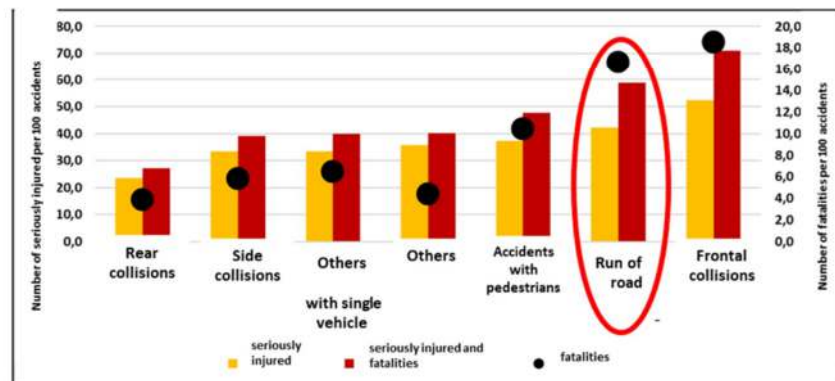


Figure 1. Example of didactic materials - presentation



## CASE STUDY 2



Figure 2. Example of didactic materials – presentation with recorded voice and subtitles

## 1. Data for Road Safety Management



Figure 3. Example of didactic materials – presentation with YouTube resources





Figure 4. Example of didactic materials – interview with the specialist



INFRO@D Roadside safety management - Regional Roads - RR211 Section 2

Figure 5. Example of didactic materials – YouTube video

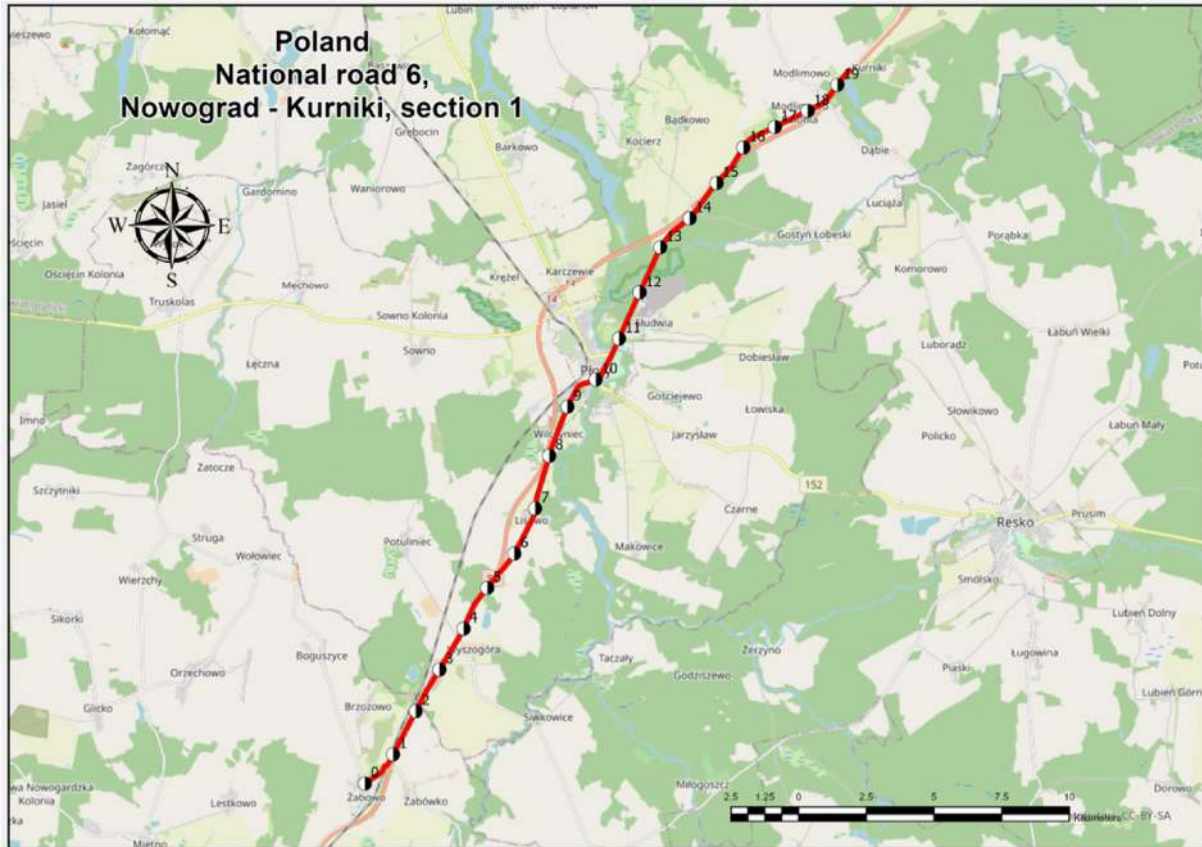


Figure 6. Example of didactic materials – maps of National Road 6, section 1

Table D1.1 - All accidents- density and concentration of accidents in regional roads

Road sector	Voivodeship	Road	Length	VKT	AAFT	Accidents	Injuries	Serious injured	Fatalities	Costs	Density accidents costs			Accidents costs ratio		
			[km]	[min veh-km/3 years]	[Veh/24h]	[number]	[number]	[number]	[number]	[min PLN]	[min PLN/ km/ 3 years]	Risk class	Risk level	[min PLN/ min veh-km/ years]	Risk class	Risk level
2003	Dolnośląskie	R292	14.500	45.310	2854	10	18	10	0	24.668						
2290	Dolnośląskie	R292	1.300	5.632	3957	0	0	0	0	0.000						
2291	Dolnośląskie	R292	3.100	30.036	8848	4	7	4	0	9.712						
2292	Dolnośląskie	R292	3.600	38.703	9818	4	6	6	0	14.375						
2007	Dolnośląskie	R292	14.500	53.556	3373	6	9	3	1	9.668						
2008	Dolnośląskie	R292	4.600	3.160	627	0	0	0	0	0.000						
2309	Dolnośląskie	R292	3.000	2.185	465	0	0	0	0	0.000						
2319	Dolnośląskie	R292	17.000	72.037	3870	2	2	2	0	4.731						
2311	Dolnośląskie	R292	17.000	34.242	1840	4	4	4	0	9.835						
2012	Dolnośląskie	R296	6.621	13.854	1911	0	0	0	0	0.000						
2013	Dolnośląskie	R296	5.200	12.551	2204	1	1	0	0	0.053						
2294	Dolnośląskie	R296	16.600	54.151	2979	8	11	1	2	7.167						
2295	Dolnośląskie	R296	1.200	0.000	0	0	0	0	0	0.000						
2015	Dolnośląskie	R296	9.200	39.708	3942	11	13	3	3	14.221						
2016	Dolnośląskie	R297	10.480	51.583	4495	3	5	0	0	0.233						
2296	Dolnośląskie	R297	4.900	22.418	4378	1	1	0	0	0.055						
2017	Dolnośląskie	R297	1.600	5.738	3275	0	0	0	0	0.000						
2018	Dolnośląskie	R297	2.800	23.374	7624	2	2	0	0	0.106						
2019	Dolnośląskie	R297	2.300	28.079	11149	9	13	5	0	12.690						
2020	Dolnośląskie	R297	18.100	93.397	4712	7	10	2	0	5.174						
2021	Dolnośląskie	R297	5.200	59.738	10491	2	2	1	0	2.418						
2022	Dolnośląskie	R297	15.600	71.107	4163	3	3	2	0	4.859						
2024	Dolnośląskie	R305	6.100	11.122	1665	2	5	4	1	11.905						
2025	Dolnośląskie	R305	4.800	6.137	1168	3	3	0	0	0.164						
2027	Dolnośląskie	R319	9.671	55.847	5274	2	4	1	0	2.559						
2297	Dolnośląskie	R319	1.900	14.424	6933	7	19	8	1	22.096						
2028	Dolnośląskie	R321	13.800	14.850	983	0	0	0	0	0.000						

Figure 7. Example of didactic materials – prepared Excel with data

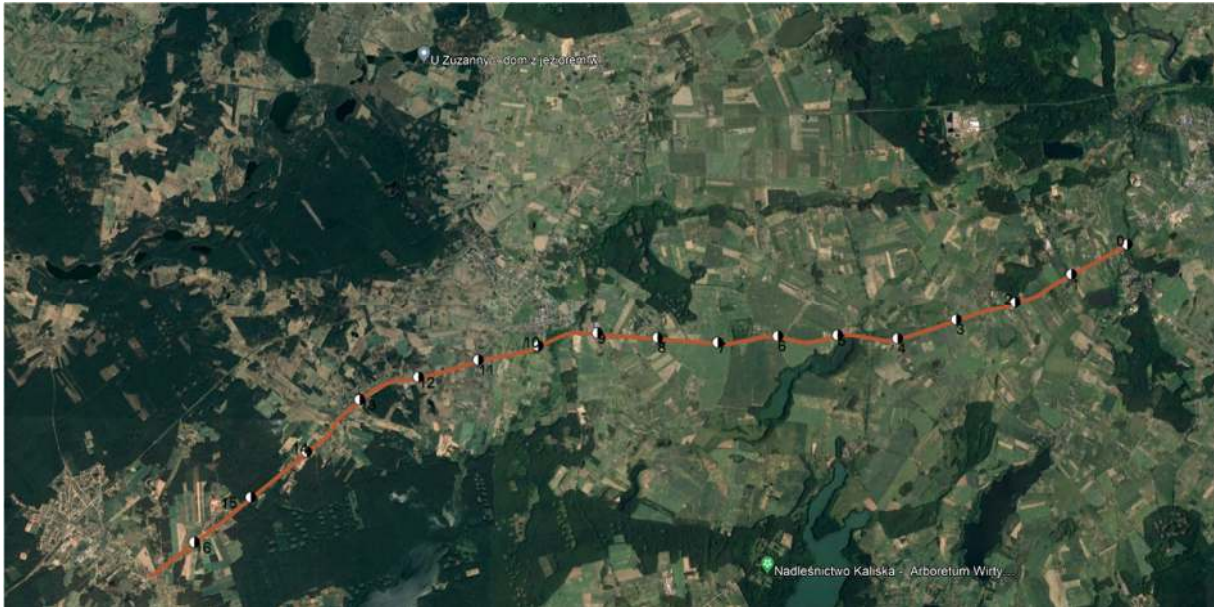


Figure 8. Example of didactic materials – prepared kml files

Example of an interactive quiz

The quiz consists of 9 valid/false questions.

- 1) Is it possible to introduce a new road barrier system to the market solely based on numerical simulations?
- 2) EN1317 standard crash tests represent all traffic accident configurations that may occur on roads.
- 3) The requirements of the EN1317 standard for vehicles have been unchanged for over 20 years.
- 4) Crash tests for road safety barriers analyse real human behaviour in detail.
- 5) Numerical simulations are much cheaper compared to full-scale crash tests.
- 6) Numerical simulations allow for a detailed assessment of damage to road safety equipment.
- 7) The most commonly used software for crash test simulations is LS-DYNA.
- 8) Numerical simulations of crash tests can only be conducted in the LS-DYNA program.
- 9) Developing a numerical model of a road safety barrier and performing numerical calculations of crash tests using LS-DYNA usually takes less than 60 minutes.

### 3 DIDACTIC AND TRAINING MATERIALS FOR ROADSIDE SAFETY MANAGEMENT

Per the adopted assumptions, the material development is available on a publicly accessible e-learning platform.

#### 3.1 Gdansk University of Technology e-learning platform

GUT e-learning is a platform developed by the Gdansk University of Technology to provide remote education, conduct tests to verify knowledge, and access virtual laboratories. E-learning is integral to the university's education and virtualisation, utilising ICT (Information and Communication Technologies). The courses are available in electronic form via web browsers and mobile applications, created using Moodle - a popular software for eLearning.

At Gdansk University of Technology, it covers a fully remote form (e-learning) and a mixed form, in which traditional classes and distance learning complement each other (blended learning).

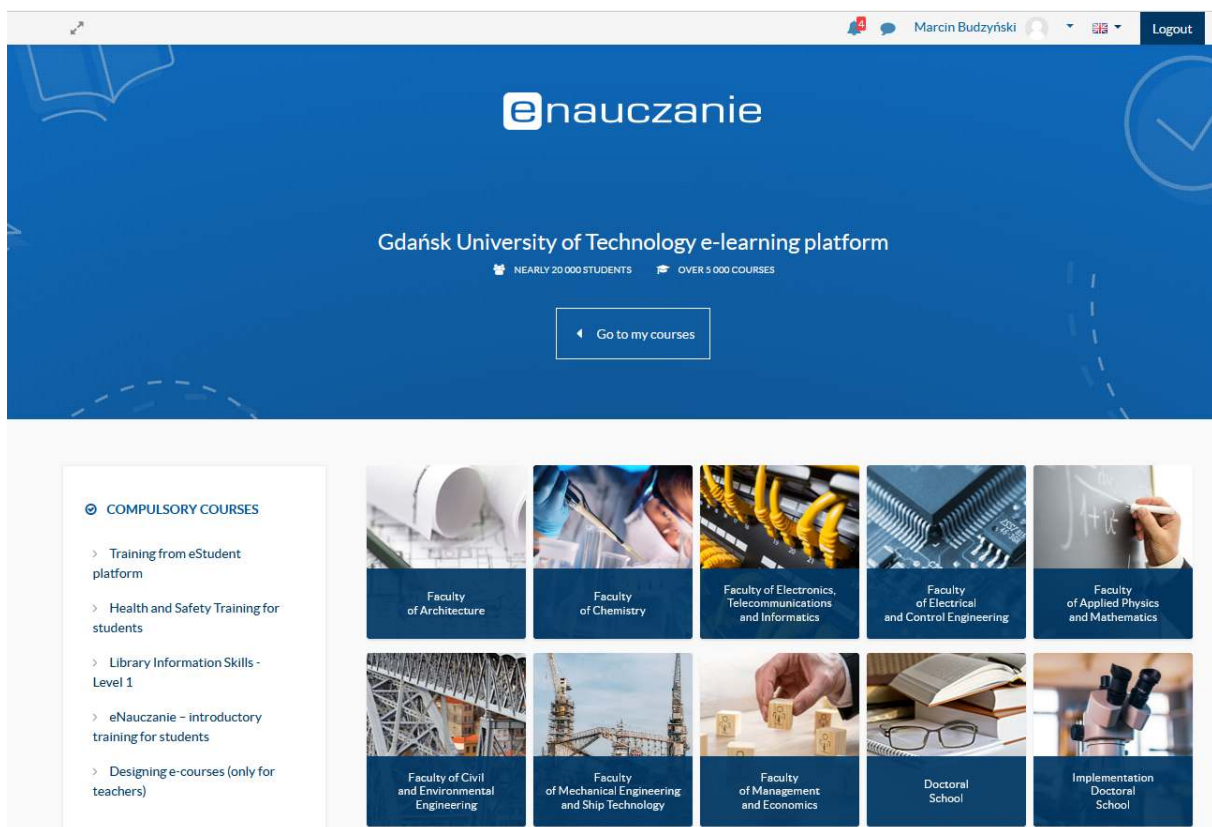


Figure 9 Start menu of e-learning

### 3.2 Introduction and purpose of the e-learning platform

The Moodle-based e-learning platform, developed under the project InfRo@d, is a comprehensive digital tool to enhance road safety education.

The e-learning platform is available on the Internet, which enables its use by research centres and road authorities throughout Europe. The e-learning platform contains road safety courses, all available to be applied to existing university course curricula. Through the e-learning platform, the project is committed to creating a one-stop solution for online learning on Road Safety by offering training on all aspects of the subject that cater to all levels.

The platform's content is a synthesis of extensive research on the impact of infrastructure on road safety, combined with established road safety methodologies. Users of the platform can:

- Observe Road Safety Audit (RSA) - Erasmus+ European Digital Education in Road Infrastructure Management INFRO@d.
- **Observe Roadside safety management - Erasmus+ European Digital Education in Road Infrastructure Management INFRO@d.**
- Observe Safety management of vulnerable road users - Erasmus+ European Digital Education in Road Infrastructure Management INFRO@d.
- Observe Road pavement management - Erasmus+ European Digital Education in Road Infrastructure Management INFRO@d

The platform with InfRo@d courses is accessible at: <https://enauczanie.pg.edu.pl/moodle/my/>

The didactic and training materials will be available after logging into the e-learning platform. Detailed information describing the process of registration is available at <https://support.pg.edu.pl/archive/display/HPPG/Access+to+eLearning+platform>.

A Chrome browser on a PC or Laptop is recommended for optimal performance. A user registration process is mandatory for full access. Post-registration, certain features may require administrative approval.

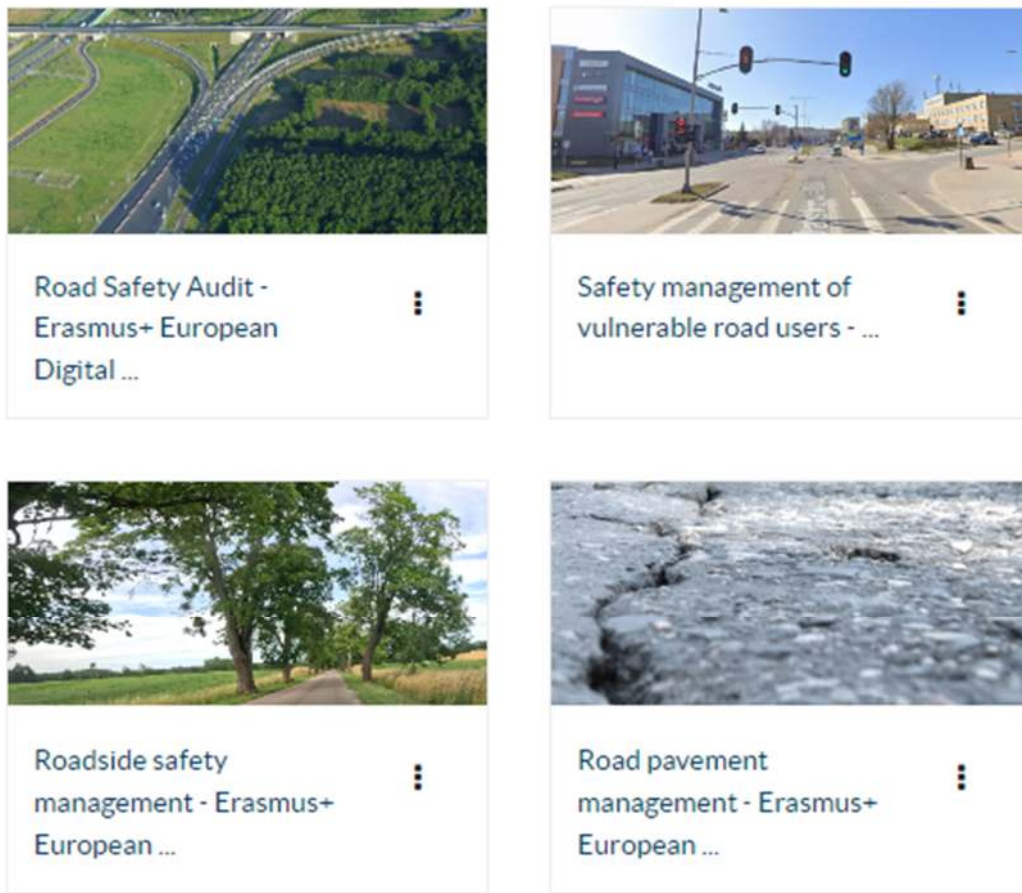


Figure 10 Overview of InfRo@d didactic materials and certification programme available on <https://enauczanie.pg.edu.pl/moodle/my/>

### 3.3 YouTube InfRo@d canal

A dedicated channel on the YouTube platform will complement the course on the platform. The platform with InfRo@d canal is accessible at: [youtube.com/@Infrod-EuropeanDigitalEducation](https://www.youtube.com/@Infrod-EuropeanDigitalEducation)

The platform's content is video, which is used in didactic materials divided into playlists:

- INFRO@d Road Safety Audit - Rural highways,
- INFRO@d Road Safety Audit - Motorways, Expressways
- INFRO@d Road Safety Audit - Rural Interchanges
- INFRO@d Road Safety Audit - Urban Interchanges (additional materials)
- INFRO@d Roadside safety management - National Roads
- INFRO@d Roadside safety management - Regional Roads
- INFRO@d Roadside safety management - Local Roads
- INFRO@d Interview.

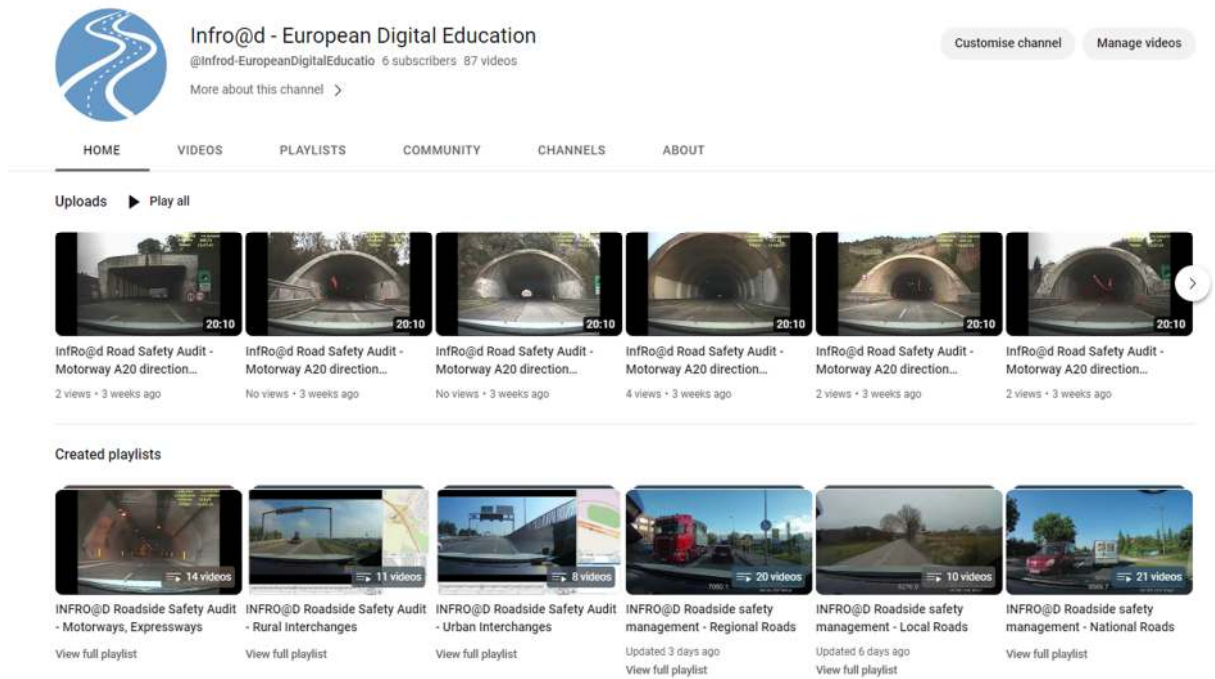


Figure 11 Overview of InfRO@d video didactic materials available on [youtube.com/@Infrod-EuropeanDigitalEducatio](https://youtube.com/@Infrod-EuropeanDigitalEducatio)

### 3.4 Detailed division of didactic and training materials

Table 2 provides a detailed description of the planned didactic and training materials under the roadside environment safety management issues.

Table 2 The planned detailed division of roadside safety management lessons

Exampled materials were prepared for chapter 1 (white colour of table).

No.	Types of classes	Hour	Short Name	Detailed description	Resource Type
<b>Chapter 1 - Roadside - Impact of the environment on road safety</b>					
1	Lecture	4	Elements of roadside, safety zone	Introducing what the roadside is and what elements it contains	PowerPoint-teacher Interview Interactive quiz PowerPoint-audio PowerPoint-audio Interactive quiz
2	Lecture	4	Road safety analysis	Database, statistics, Poland, Italy, Hungary, Slovakia, Austria	Interactive quiz PowerPoint-YouTube resources 1-6 PowerPoint-audio 1-2 Interactive quiz
3	Lecture	4	Hazard identification and classification	Why does the roadside have such a negative effect on road safety?	PowerPoint-teacher Interview Interactive quiz PowerPoint audio Interactive quiz



No.	Types of classes	Hour	Short Name	Detailed description	Resource Type
4	Lecture	2	Introducing barriers	Parameters of barrier, crash tests,	Interactive quiz PowerPoint-YouTube resources PowerPoint-audio PowerPoint-teacher Interview PowerPoint-audio Interactive quiz
5	Lecture	4	Field crash tests	Introduction (norm 1317 about tests, polygons) Field crash test generally and in detail Numerical crash tests generally and in detail	PowerPoint-teacher Interactive quiz Interview PowerPoint-audio (numerical crashes) Interactive quiz
6	Lecture	4	Numerical crash tests	Numerical simulation of crash tests	Interactive quiz PowerPoint-YouTube resources Interview PowerPoint-YouTube resources Interactive quiz PowerPoint -teacher PowerPoint-audio Research paper Interactive quiz
7	Lecture	2	Roadside studies (general)	Guidelines different countries, norm 1317, Mash	PowerPoint-teacher Interactive quiz PowerPoint-audio Interactive quiz

No.	Types of classes	Hour	Short Name	Detailed description	Resource Type
8	Field activities	4	Roadside - national roads	Determination of the level of hazard on national roads using a predefined sheet. Students' own work in the field.	PowerPoint-teacher (project details) Maps/video Collect data about the source of hazards Group working (by themselves)
9	Field activities	4	Roadside - regional roads	Determination of the level of hazard on regional roads using a predefined sheet. Students' own work in the field.	PowerPoint-teacher (project details) Maps/video Collect data about the source of hazards Group working (by themselves)
10	Field activities	4	Roadside - local roads	Determination of the level of hazard on local roads using a predefined sheet. Students' own work in the field.	PowerPoint-teacher (project details) Maps/video Collect data about the source of hazards Group working (by themselves)
11	Lecture	2	Road safety and hazard analysis	The teacher will manage the webinar, fixing the time slots and online tools (like Teams and Zoom).	Webinar, Q&A, PowerPoint - student presentation (Final discussion with the teacher all groups together)
12	Practicals (remote)	6	Road safety analysis	Database, statistics, Poland, Italy, Hungary, Slovakia, Austria	PowerPoint-teacher (project details) Statistic data from the country (roadside accidents) Group working (by themselves) Student PDF report, presentation
13	Design class	6	Containment level of the road safety barriers	Assesses one road section based on national standards and guidelines for the selection of road safety barriers	PowerPoint-teacher (project details) Maps Group working (by themselves) Student PDF report, presentation

No.	Types of classes	Hour	Short Name	Detailed description	Resource Type
14	Practicals (remote)	2	Roadside - national roads	Students' own work: - preparation of presentation materials - presentation with discussion	Student PDF report, presentation
15	Practicals (remote)	2	Roadside - regional roads	Students' own work: - preparation of presentation materials - presentation with discussion	Student PDF report, presentation
16	Practicals (remote)	2	Roadside - local roads	Students' own work: - preparation of presentation materials - presentation with discussion	Student PDF report, presentation
17	Lecture	4	Webinar	The teacher will manage the webinar, fixing the time slots and online tools (like Teams and Zoom).	Webinar, Q&A, PowerPoint - student presentation (Final discussion with the teacher all groups together)
<b>Chapter 2 - Roadside - Principles of Designing Road Environment</b>					
1	Lecture	8	Design fixed road barriers	Types of road barriers, characteristics of barrier parameters, and location rules. Divided into permanent and temporary barriers.	Interactive quiz PowerPoint-teacher Interview/podcast with a safety expert and/or YouTube videos PowerPoint-teacher PowerPoint (Drawing/photo/video gallery without comments) PowerPoint-audio (Drawing/photo/video gallery with comments) Interactive quiz

No.	Types of classes	Hour	Short Name	Detailed description	Resource Type
2	Lecture	4	Identification of design errors (Fixed RB)	Principles of selection of barrier parameters. Determining the length of the barrier. Principles of shaping endings and transition sections. Examples of incorrect solutions with their discussion.	Interactive quiz PowerPoint-teacher Interview/podcast with a safety expert and/or YouTube videos PowerPoint (Drawing/photo/video gallery without comments) PowerPoint-audio (Drawing/photo/video gallery with comments) Interactive quiz
3	Practicals (remote)	10	Design fixed road barriers	Selection of barrier parameters, their location and detailed solutions. The teacher prepares sets of tasks containing a road infrastructure plan, traffic volume, heavy vehicles, and various areas and objects on the roadside. The task for students to design and select parameters of barriers adjusted to given conditions.	PowerPoint-teacher (project details) Data for the student project Group working (by themselves) PowerPoint - student presentation (Final discussion with teachers all groups together)
4	Field activities	6	Identification of design errors (Fixed RB)	The teacher prepares road sections where there are no barriers or the barriers do not meet the required standards. The teacher performs field research (measurements, photos, videos), the effect of which he presents to students along with a commentary. On this basis, students carry out fieldwork.	PowerPoint-teacher (project details) PowerPoint (Drawing/photo/video gallery without comments) Group working (by themselves) PowerPoint - student presentation (Final discussion with teachers all groups together)

No.	Types of classes	Hour	Short Name	Detailed description	Resource Type
5	Lecture	4	Identification of design errors (Fixed RB)	The teacher will manage the webinar, fixing the time slots and online tools (like Teams and Zoom).	Webinar, Q&A, PowerPoint - student presentation (Final discussion with teachers all groups together)
6	Lecture	4	Design temporary road barriers	Specificity of temporary traffic organisation. Principles of designing temporary traffic organisation (sections, equipment, markings, barriers). Types of temporary road barriers, characteristics of barrier parameters, and location rules.	Interactive quiz PowerPoint-teacher Interview/podcast with a safety expert and/or YouTube videos PowerPoint-teacher PowerPoint (Drawing/photo/video gallery without comments) PowerPoint-audio (Drawing/photo/video gallery with comments) Interactive quiz
7	Lecture	4	Identification of design errors (Temporary RB)	Safety rules for different groups: drivers, employees, and people on the roadside of the building site. Examples of incorrect solutions with discussion.	Interactive quiz PowerPoint-teacher Interview/podcast with a safety expert and/or YouTube videos PowerPoint (Drawing/photo/video gallery without comments) PowerPoint-audio (Drawing/photo/video gallery with comments) Interactive quiz

No.	Types of classes	Hour	Short Name	Detailed description	Resource Type
8	Design class	8	Design temporary road barriers	Selection of barrier parameters, their location and detailed solutions. The teacher prepares sets of tasks containing a road infrastructure plan with work section, speed limits, traffic volume, including heavy vehicles, and various areas and objects on the roadside. The task for students to design and select parameters of barriers adjusted to given conditions.	PowerPoint-teacher (project details) Data for the student project Group working (by themselves) Student PDF report, presentation
9	Field activities	6	Identification of design errors (Temporary RB)	The teacher prepares road sections with work areas. The teacher performs field research (measurements, photos, videos), the effect of which he presents to students along with a commentary. On this basis, students carry out fieldwork.	PowerPoint-teacher (project details) PowerPoint (Drawing/photo/video gallery without comments) Group working (by themselves) Student PDF report, presentation
10	Lecture	6	Identification of design errors (Temporary RB)	The teacher will manage the webinar, fixing the time slots and online tools (like Teams and Zoom).	Webinar, Q&A, PowerPoint - student presentation (Final discussion with teachers all groups together)