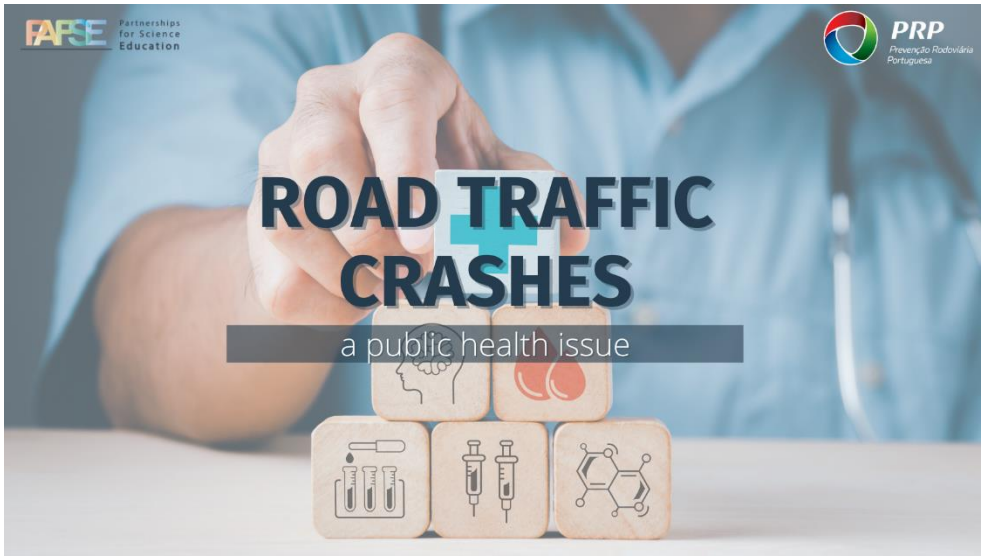
Project Number: 101006468

Project Acronym: PAFSE

Project title: Partnerships for Science Education

EDUCATIONAL SCENARIO



JULY 2023

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101006468.

1. Specifications for an educational scenario on the topic of " Road traffic crashes – a public health issue"

Context

Road traffic crashes cause approximately 1.3 million deaths and 20 to 50 million non-fatal injuries worldwide every year. More than half of all road traffic deaths and injuries involve vulnerable road users, such as pedestrians, cyclists, motorcyclists, and their passengers. Young people are particularly vulnerable in the world roads – road traffic injuries are the leading cause of death for children and young adults aged 5-29 (WHO, 2018). The scenario supports 7th to 9th grade teachers in exploring road traffic crashes as a public health challenge. It is expected that the learning experience leads the young students to understand that road traffic crashes are major public health threats, the influencing variables and how to move to less risky patterns of behaviour in the road, and reach high-level comprehension on how STEM (Science, Technology, Engineering, Mathematics) may contribute to address these issues, contribute to evidence-based personal decision-making, and public policy. The scenario aims to address the Sustainable Development Goals (SDGs), not only by contributing to the quality of education (SDG 4), but also by improving road safety and making the cities safer, especially for vulnerable road users (SDGs 3 and 11, targets 3.6, 11.2, 3.D). The scenario empowers students to adopt safe behaviours in traffic by creating awareness on risky behaviours, social influences, and modifiable risk factors, supports their participation in civic society initiatives and in the design of local responses for the issue, while providing significant interactions with the community (researchers, public health specialists, municipalities, policy makers, enterprises).

Scientific content and its relevance to public health education

To European Commission defined the goal to move to close to zero deaths on the EU roads by 2050 ("Vision Zero") and to halve the number of serious injuries by 2030 from a 2020 baseline. To reach these goals, the European Commission based its road safety policy framework for the decade 2021 to 2030 on the Safe System approach, whose core elements are ensuring safe vehicles, safe infrastructure, safe road use (speed, sober driving, wearing safety belts and helmets) and better post-crash care. The EC also stated that the mindset of "Vision Zero" needs to take hold both among policy makers and in the society (European Commission, 2020). The traffic safety and mobility education play an important role in strengthening and/or changing attitudes and intrinsic motivations towards risk awareness, personal safety and the safety of other road users in order to contribute towards a safety-minded culture. It is considered an essential part of an integrated approach to traffic safety, as education provides the possibility for people to learn how to participate in traffic safely. The aim of traffic safety and mobility education is to positively influence behaviour patterns that result in safer traffic. The transfer of knowledge and gaining an understanding of traffic rules and situations are the basis of traffic safety and mobility education (ETSC, 2020).

The scenario aims to contribute towards a safety-minded culture in traffic. Its content endorses teachers to play a key role in developing knowledge and skills for incorporating road safety as a central topic in their classes and in teaching public health science using high-level methods, high-quality learning objects, and updated evidence. It also challenges them to have a contribution for the community road safety by engaging families in educational activities and reaching the local community with inquiry-based projects and open schooling events leaded by students. The scenario also contributes to increase the interest in STEM (Science, Technology, Engineering, Mathematics) by providing an opportunity to develop a real-world research project in which students will develop and apply knowledge and skills learned in classes. During the scenario, students will design, plan, and carry out a research project that involves concepts as population, sample, sampling, or percentages – learn in Mathematics classes. The project also involves data collection, data manipulation, data analysis and communicating/discussing results based in scientific evidence.

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Subject: Mathematics and Citizenship classes
Grade: 7th to 9th grade (12-15 years old students)
Title of educational scenario: Road traffic crashes – a public health issue
Estimated duration
5 sessions of 40-45 minutes (lesson 1 - lesson 5)
10 sessions of 40-45 minutes for supplementary learning activities and school project (lesson 6 - lesson 15)

Classroom organization requirements

From lesson 1 to lesson 5 students work alone and/or in groups. Classroom with computers with internet access is needed.
From lesson 6 to lesson 15 students work in groups to plan and develop the school project. The use of computer is required.

Prerequisite knowledge and skills

Knowledge: population, sample, sampling, probabilities, percentages, frequency tables, graphs.
Skills: using a web browser, using spread sheets

Content glossary

Blood alcohol concentration (BAC). Amount of alcohol present in the bloodstream, usually denoted in grams per decilitre (g/L). A legal BAC limit refers to the maximum amount of alcohol allowed in the bloodstream that is legally acceptable for a driver on the road. In some countries, the law stipulates an equivalent quantity of alcohol in the air breathed out, in order to facilitate detection of drink-driving.

Braking distance. Distance taken to stop once the brakes are applied.

Collaboration. A recognized relationship among different sectors or groups, which have been formed to take action on an issue in a way that is more effective or sustainable than might be achieved by the public health sector acting alone.

Community participation. Procedures whereby members of a community participate directly in decision-making about developments that affect the community. It covers a spectrum of activities ranging from passive involvement in community life to intensive action-oriented participation in community development (including political initiatives and strategies).

Countermeasure. An activity or initiative to prevent, neutralize, or correct a specific problem.

Distracted driving. Any activity that could divert a person's attention away from the primary task of driving. Includes activities such as texting or talking on a cell phone while driving.

Driving under the influence (DUI) of alcohol, drugs, or a combination of alcohol and drugs. Operating a vehicle while the alcohol and/or drug concentration in the blood or breath, as determined by chemical or other tests, equals or exceeds the level established by law.

Data. Information collected through research. It can include written information, numbers, sounds and pictures, and can be collected through surveys, interviews, direct observation, focus groups or documents.

Data analysis. Process of transforming raw data into usable information, often presented in the form of a report, article or presentation in order to add value to the statistical output.

Dataset. A collection of data, usually presented in a table where each column represents a particular variable and each row a particular case.

Disability-Adjusted Life-Years (DALYs). A time-based measure that combines years of life lost due to premature mortality (YLLs) and years of life lost due to time lived in states of less than full health, or years of healthy life lost due to disability (YLDs). One DALY represents the loss of the equivalent of one year of full health.

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Enforcement. Actions taken to ensure compliance with legislation; traffic enforcement is usually done by the police.

Evidence. Information such as analyzed data, published research findings, results of evaluations, prior experience, expert opinions, any or all of which may be used to reach conclusions on which decisions are based.

Excessive speed. Driving at a speed higher than the maximum allowed.

Fact-checking. the process of checking that all the facts in a piece of writing, a news article, a speech, etc. are correct.

Fatigued driving. Is a reduction in driving or riding ability as a result of prolonged driving or being tired while driving. It should be noted that prolonged driving/ riding activity is not solely responsible for fatigue. Other factors such as the elapsed time since the person last slept, the time of the day or night, as well as the human circadian rhythm may be involved.

Helmet. A protective device worn on the head to prevent injuries in the event of a crash.

Inappropriate speed. Driving at too high a speed given the traffic situation, infrastructure, weather conditions, and/or other special circumstances

Incidence. The number of cases of disease that have their onset during a prescribed period of time. It is often expressed as a rate. Incidence is a measure of morbidity or other events that occur within a specified period of time.

Mortality. A measure of number of deaths in a given population, location or other grouping of interest.

Mortality rate. A measure of number of deaths in a given population, location or other grouping of interest, scaled to the size of that population, per unit of time (e.g. 9.5 deaths per million population in 2020).

Passive safety/safety equipment. Any device that automatically provides protection for the occupant of a vehicle, such as safety-belts, motorcycle helmets, child restraints, padded dashboard, bumpers, laminated windshield, head restraints, collapsible steering columns and air bags.

Post-crash response. Sequence of time-sensitive actions, beginning with activation of the emergency care system, and continuing with care at the scene, care during transport, and facility-based emergency care.

Population. In research, the population is the entire set of individuals that are of interest to the researcher.

Public health. An organized activity of society to promote, protect, improve, and – when necessary – restore the health of individuals, specified groups, or the entire population. It is a combination of sciences, skills and values that function through collective societal activities and involve programmes, services and institutions aimed at protecting and improving the health of all people.

Quality-Adjusted Life-Years (QALYs). A measure of the state of health of a person or group in which the benefits, in terms of length of life, are adjusted to reflect the quality of life. One quality-adjusted life year (QALY) is equal to 1 year of life in perfect health. QALYs are calculated by estimating the years of life remaining for a patient following a particular treatment or intervention and weighting each year with a quality-of-life score (on a 0 to 1 scale).

Reaction distance. Distance travelled between the presentation of a sensory stimulus and the subsequent behavioural response; the distance travelled from the moment a driver observes a stimulus (e.g. sees a pedestrian or a changing traffic light) until the moment they have decided on their response (but have not yet initiated that response).

Reaction time. The elapsed time between the presentation of a sensory stimulus and the subsequent behavioural response; the time from the moment a driver observes a stimulus (e.g. sees a pedestrian or a changing traffic light) until the moment they have decided on their response (but have not yet initiated that response).

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Research. Activities designed to develop or contribute to knowledge, e.g., theories, principles, relationships, or the information on which these are based. Research may be conducted simply by observation and inference, or by the use of experiment, in which the researcher alters or manipulates conditions in order to observe and study the consequences of doing so.

Risk. The possibility of an unwanted event; usually the possibility will be quantified as a probability and the event will be described in terms of its consequences, resulting in this definition of risk: Risk= Probability x Consequence.

Risky behaviours in traffic. Acts that increase the risk of a road traffic crash and/or the severity of its consequences in the road users. The main risky behaviours in traffic are speeding, driving under the influence of alcohol/drugs, fatigue, distraction, and no using protective devices/systems (helmet, set belt).

Risk factor. A factor that affects the probability of accident occurrence or the severity of the consequences of an accident.

Road infrastructure. Road facilities and equipment, including the network, parking spaces, stopping places, draining system, bridges and footpaths. Roadside furniture: functional objects by the side.

Road safety. Approaches, strategies and measures used to prevent people from being killed or seriously injured in road traffic collisions.

Road safety indicators. Measures that enable to assess and monitor a road traffic system (country, region, …). Includes statistics from road traffic crashes, safety of vehicles and infrastructure, post-crash response, or road users' behaviours.

Road traffic crash. A collision involving at least one vehicle in motion on a public or private road that results in at least one person being injured or killed.

Road traffic fatality. A death occurring within 30 days of a road traffic crash.

Road traffic injuries. Fatal or non-fatal injuries incurred as a result of a road traffic crash.

Road user. A person using any part of the road system as a non-motorized or motorized transport user.

Roadside observation survey. Study aiming to estimate indicators (percentages, means, …) that "measure" the road users' behaviours in a given population (city, country, …). Examples of indicators: percentage of car drivers using the mobile phone while driving, mean speed of vehicles by road type.

Sample. A subset of the population that is actually used in research. One common method for selecting a sample is called probability sampling. In probability sampling, each person in the group or community has an equal chance (probability) of being chosen.

Seatbelt. Vehicle occupant restraint, worn to protect an occupant from injury, ejection or forward movement in the event of a crash or sudden deceleration.

Speed limit. The highest speed permitted by legislation; speed limits are often signposted.

Speed. The distance covered per unit of time; speed is often measured in kilometres per hour.

Speeding. Violations of the speed limit.

Stopping distance. Distance travelled between the time when someone decides to stop a vehicle moving, and the time when the vehicle completely stops. The total stopping distance is the sum of the perception-reaction distance and the braking distance.

Sustainable Development Goals (SDGs). Also known as the Global Goals, were adopted by all United Nations Member States in 2015 as a universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity by 2030. The 17 SDGs are integrated—that is, they recognize that action in one area will affect outcomes in others, and that development must balance social, economic, and environmental sustainability.

Visual field (field of view). The size of the area a person can see measured horizontally and vertically.

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Vulnerable road users. Road users most at risk in traffic, such as pedestrians, cyclists and public transport passengers. Children, older people and disabled people may also be included in this category.

Pedagogical glossary

Active Learning. A teaching and learning approach that "engages students in the process of learning through activities and/or discussion in class, as opposed to passively listening to an expert. It emphasizes higher-order thinking and often involves group work".

Brainstorming. Brainstorming is an instructional technique with several variations, that might take place within small group or with the entire class. During brainstorming all students shortly express their ideas or concepts which are relevant to a given guiding question or central term. Criticism on the ideas is absent during brainstorming and its aim is the production of a lot and divergent ideas.

Collaborative Learning. An umbrella term that covers many different methods in which students work together to solve a problem, complete a task, or create a product. Collaborative learning is founded in the concept that learning and knowledge building is social and requires active engagement from students.

Critical Thinking. The mental processes used when evaluating information that has been put forth as true. Consists of reflection, examination, and formation of judgement. Information is gathered through communication, experience, reasoning and observation. While based in values of intellect, critical thinking goes beyond subject/matter division.

Engagement. How a student does or does not feel toward learning and his or her learning environment.

Inclusive Teaching. A mode of teaching that intentionally designs course content and curricula to engage with students of diverse backgrounds, abilities, and lived experiences. The ultimate goal of inclusive teaching is to create a learning environment where all students feel valued and supported to succeed.

Information. Facts, ideas, concepts and data that have been recorded, analyzed, and organized in a way that facilitates interpretation and subsequent action.

Inquiry based learning. By the term inquiry-based learning we refer to the engagement of students in learning activities during which they practice several scientific inquiry skills. Students make use of these skills in order to answer to scientific questions either posed by the students themselves or by the teacher, by the handling of authentic data, either experimentally collected by themselves or given already collected. Some common inquiry skills include constructing and using models, carrying out experiments, data collection and organisation, variable handling, data driven conclusion making and communicating over scientific issues.

Knowledge. A familiarity, awareness or understanding of someone or something, such as facts, information, descriptions, or skills, which is acquired through experience or education by perceiving, discovering, or learning.

Lifelong learning. A broad concept where education that is flexible, diverse and available at different times and places is pursued throughout life. It takes place at all levels—formal, non-formal and informal—utilizing various modalities such as distance learning and conventional learning.

Pedagogical Techniques. Essential resources that the teacher uses to enhance the pedagogical relationship between the students and the teacher in order to ensure learning. Different forms of application to achieve the objectives of a class.

Project based learning. Project based learning is an instructional model of active learning. It has several forms, during which students work in groups on the development of projects, which often refer to authentic problems or situations approaching real life conditions. Project based learning includes the phases of project initiation, project development and project presentation.

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Skill. The ability to carry out a task with pre-determined results often within a given amount of time, energy, or both. Skills can often be divided into domain general and domain-specific skills.

The 5E Model (engage; explore; explain; elaborate; evaluate). developed in 1987 by the Biological Sciences Curriculum Study, promotes collaborative, active learning in which students work together to solve problems and investigate new concepts by asking questions, observing, analyzing, and drawing conclusions.

Work Group. Deepens knowledge, develops research and problem-solving skills; develops attitudes of participation, cooperation, creativity and collaboration; develops teamwork attitudes, social skills and knowledge.

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Competences / Learning Goals

Key Competences
STEM / Personal, social and learning to learn, literacy, citizenship

Knowledge

Science concepts:

- Disease burden measures: Mortality, Mortality rate, Quality-Adjusted Life-Years (QALYs) and Disability-Adjusted Life-Years (DALYs).
- Road safety indicators:
  - road crash statistics (number of crashes, deaths, injuries, rates).
  - roadside observations (observed behaviours).
- Research and scientific method.
- Roadside observation survey.
- Population, sample, and dataset.

Social concepts and global concerns:

- Public health.
- Major public health causes of death and disability.
- Road safety.
- Risk factors in traffic: speeding, driving under the influence of alcohol/drugs, fatigue, distraction, protective devices/systems (helmet, set belt).
- Sustainable Development Goal (SDG).

Knowledge - outcome assessment:

- Recognizes road traffic accidents as a leading cause of death and disability. Defines SDG 3 and target 3.6.
- Identifies disease burden indicators in the context of road safety (road safety indicators).
- Identifies the main risky behaviours in traffic and explains their relationship with risk of crashing and injury.
- Knows the steps of the scientific method applied to a roadside observation survey.
- Defines population, sample, and dataset.

Skills (abilities/competences)

General: critical thinking; curiosity; problem-based learning; teamwork; collaboration; argumentation; self-awareness; citizenship; public speaking and active debate/ participation.
Specific:

- Understanding the relevance of scientific evidence to explain road safety phenomena.
- Searching, analysing, and interpreting scientific data to understand and characterize road safety deaths and injuries worldwide, in the continent, in the country, at and at the region/city/local level.
- Identifying reliable sources of information, the difference between facts and opinions, and how to find fake claims (fact checking techniques).
- Collecting and organizing data and choosing appropriate instruments to present the results (e.g., tables, graphs, infographics).
- Calculating and understanding road safety indicators at the population level, by gender, by age group, and by road user.
- Planning and executing a data-driven science project and communicating the results.
- Mapping patterns of risky behaviour, the dynamics between risk factors, protective behaviour and outcomes, in terms of road traffic injuries.
- Understanding appropriate strategies to reduce personal and community risk of injury from road traffic accidents.

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Skills – outcome assessment

- Selects appropriate concepts, data, and evidence to characterize performance on road safety indicators at different levels (international/ national/ country/ community).
- Anticipates the consequences of risky behaviour in traffic.
- Can identify problems and challenges in the community in relation to road safety related issues.
- Can adopt safe behaviours in traffic.
- Is able to carry out a roadside observation survey.

Affective /Attitudes/ Behaviour (*beliefs)*

- Adopting safe behaviours in traffic, as a pedestrian, cyclist, motorcyclist, moped rider, and/or as a passenger (car/bus).
- Adopting attitudes towards minimizing risks in traffic.
- Being aware of risks in traffic and contribute to community awareness on those risks.
- Engaging public speaking and debate of measures to remove sources of risk and reduce patterns of risky behaviour in traffic, with a particular focus on public policy.

Affective, Attitudes and behaviour - outcome assessment

- Believes that safe behaviour in traffic reduces the risk of road crashes and the severity of its consequences.
- Reproves patterns of risky behaviour in traffic.
- Adopts safe behaviours in traffic, as a pedestrian, cyclist, motorcyclist, moped rider, and/or as a passenger (car/bus).
- Is committed to communicate and address the problems and challenges of the community in relation to road safety.

Learning goals and outcomes

- Understands why road traffic crashes are a major public health concern.
- Identifies the most important patterns of risky behaviour in traffic (e.g.: speeding, driving under the influence of alcohol/drugs).
- Understands the relationship between risky behaviour and increasing risk of road traffic crashes and the severity of its consequences.
- Extracts statistical information online relative to road safety indicators (e.g., deaths, disability-adjusted life years).
- Plans and executes a roadside observation survey to characterize indicators at the community level based on roadside observations.
- Calculates road safety indicators based on crash statistics and roadside observations.
- Builds a report, presentation, or infographic to communicate the findings.
- Uses evidence to propose actions that improve road safety.

Assessment methods

✓ Outcome assessment
  - Quantitative – questionnaire in paper.
  - Qualitative – students project.

✓ Process assessment – *assessment of the teaching-learning sequence* – observation grid*:* reaching the target audience, and extent; implementation of the scenario as planned; run of the learning scenario as expected/organizational issues to be solved; duration of the teaching-learning sequence; number of people exposed; score for likeability – students ("how fun was it to do"/ how fun would be to do again/ how could it be better).

Assessment of the scenario's impact – questionnaire based on knowledge, skills, attitudes, and behaviour. The questionnaire is answered before and after the scenario by students involved in the scenario and by a control group (students not involved in the scenario).

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Content (relevant to learning goals & research topics)

STEM content

- Road traffic crashes as a major issue in public health.
- Measures of disease burden: mortality, mortality rate, quality-Adjusted Life-Years (QALYs), Disability-Adjusted Life-Years (DALYs).
- Risk factors and patterns of risky behaviour in traffic.
- Road safety indicators (road crash statistics, and roadside observations).
- Probabilities and statistics:
  - percentages, rates, frequency tables, graphs.
  - population and sample.
  - data collection, data, and dataset.

Non-STEM content

- Quality and trustfulness of information sources, facts, opinions, fact-checking techniques.
- Global trends (e.g., agenda for sustainable development) and road traffic accidents.

Digital Learning Objects (DLO) & Digital Educational Resources (DER)

New (*developed by the project team*):

- **DER_1 –** definitions of "public health" and "public health problem". Includes the main public health issues in 2019 and weblinks to updated data on the main causes of death worldwide, distribution by country.
- **DER_2 –** definitions and examples of disease burden measures: mortality, mortality rate, Quality-Adjusted Life-Years (QALYs) and Disability-Adjusted Life-Years (DALYs).
- **DER_10 –**Sustainable Development Goal (SDG) – presentation highlighting the goals related to road safety (SDGs 3 and 11, targets 3.6, 11.2, 3.D).
- **DER_14 –** steps of scientific method – presentation;
- **DLO_1 –** road crash simulators: stopping distance, impact force, field of view, run-over.
- **DLO_2 –** road safety indicators based on roadside observations (to be used in lesson 4 and in the project) – webpage (and/or pdf file) with all the steps (step by step) to collect and calculate the road safety indicators. Includes:
  - Possible indicators for the different road users. *Example – percentage of the cyclists who do not wear the helmet while cycling (number of cyclists without helmet/ number of cyclists observed)*;
  - guidelines for the definition of the observation places;
  - sample size (sample size calculator - interactive);
  - the random process of the observations (interactive);
  - tools for data collection – record sheets/online forms;
  - how to calculate the indicators;
  - how to communicate the results - examples.
- **DLO_5 –** steps of scientific method – quiz;
- **DLO_6 –** risky behaviours in traffic – quiz;

From other sources/high-quality selected platforms

- **DER_3 –** Top ten causes of death worldwide (WHO): https://ourworldindata.org/causes-of-death
- **DER_4 –** Cause-specific mortality by country (WHO): https://www.who.int/data/gho/data/themes/mortality-and-global-health-estimates/ghe-leading-causes-of-death
- **DLO_3 –** Death on the Roads (WHO): https://extranet.who.int/roadsafety/death-on-the-roads/
- **DER_5 –** Top 10 global causes of disability-adjusted life years (DALYs) in the world: https://www.who.int/data/gho/data/themes/mortality-and-global-health-estimates
- **DER_6 –** Top 10 global causes of disability-adjusted life years (DALYs) by country, sex and age group: https://www.who.int/data/gho/data/themes/mortality-and-global-health-estimates/global-health-estimates-leading-causes-of-dalys

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- **DLO_4 –** Roads kill (Pulitzer center): https://roadskillmap.com
- **DER_7 –** Road safety statistics (European Commission): https://ec.europa.eu/transport/road_safety/specialist/statistics/map-viewer/
- **DER_8 –** Road deaths in the European Union – latest data (ETSC): https://etsc.eu/euroadsafetydata/
- **DER_9 –** Walking and Cycling Data (ETSC): https://etsc.eu/walking-and-cycling-data/
- **DER_11 –** Dashboard – road crash statistics in Portugal (PRP)
- **DER_12 –** Elements of road safety system and contributing factors for road crashes – image
- **DER_13 –** Crash tests videos: helmet motorcyclists, pedestrian run-over, seat belt 1, seat belt 2

Complementary

- Road safety indicators based on roadside observations – Baseline project: https://www.baseline.vias.be
- Guided questions for activities of lessons 1, 2 and 3.

Teaching -learning activities

Principal target

- Citizenship and Mathematics classes + Science clubs. Other teachers may be involved in the enactment of the scenario (e.g, English, Arts, Informatics) as it aims to be interdisciplinary and innovative.
- 7th to 9th grade (12-15 years old students)

Number of sessions/classes

4-6 sessions/classes of 40-45 minutes; classroom with computers with internet access is needed.

Lesson 1- Concept of public health, main public health problems in the world, road traffic crashes as a major issue.

The teacher raises the questions "What is public health about?" and "What are the main public health problems we face nowadays?". Students are challenged to work in groups to answer both questions (3-4 students). Each group writes a definition of public health (and/or attributes of public health) and identifies 3 main public health problems. Each group presents their ideas on the board. After debating the students' answers, the teacher presents definitions of public health, the main causes of death worldwide and in the country (**DER_1 and DER_3**): Top ten causes of death worldwide (WHO) - https://ourworldindata.org/causes-of-death).

Then the groups explore the WHO website "Leading causes of death" (**DER_4**) to find if road injuries are one of the top 10 causes in the country, by age group, and by sex (focus on the age group of the students: 10-14 and 15-19 years old).

After finishing this task, the results are discussed with the class: are road traffic injuries one of the 10 causes of death in our country? In which age groups? In our (students) age group? Guided questions for the activity are provided to the students. **Task 1**

At the end of the class, students should be able to: define Public Health; identify Road Safety as a Public Health problem; identify road crashes as one of the main causes of death in the world and the country; research, analyze, and interpret statistical data to support their conclusions.

Evaluation: informal assessment of the student's contributions.

Lesson 2 - Road safety indicators based on road crash statistics, international and national level

The teacher starts the lesson by recalling road traffic crashes as a major public health issue and connecting it with sustainable development, particularly SDG 3, target 3.6 (**DER_10**). Students capture

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differences between countries by exploring World Bank dashboard (World Bank SDGs Dashboard: Track, Monitor and Report Data on Global Goals). Then the teacher organizes debate and promotes a brainstorming around the questions "What are the major consequences of road traffic crashes?" and "How to measure and monitor the problem?". After the discussion, the definitions and examples of disease burden measures (mortality, mortality rate, number of injuries, QALY and DALY) are presented and explained (**DER_2**). The importance of easy accessibility for people with disabilities is discussed. Following the presentation, the teacher presents examples connected with road safety:

- **DLO_3** - Death on the Roads (WHO): https://extranet.who.int/roadsafety/death-on-the-roads/ (mortality worldwide – overall and by road user; mortality and mortality rates in the country);
- **DER_5** -Top 10 global causes of disability-adjusted life years (DALYs) in the world: https://www.who.int/data/gho/data/themes/mortality-and-global-health-estimates (road injuries are one of the 10 global causes of DALYs in 2019);
- **DER_6** - Top 10 global causes of disability-adjusted life years (DALYs) by country, sex and age group: https://www.who.int/data/gho/data/themes/mortality-and-global-health-estimates/global-health-estimates-leading-causes-of-dalys (show the DALYs in the country. Focus on the DALYs of the age group of the students: 10-14 and 15-19 years).

Students are organized in groups (3-4 students) and are challenged to search online (sources below) the statistics of road crashes in the country to answer the questions: "What is the mortality rate from road traffic accidents in our country (overall, car users, cyclists, motorcyclists, and pedestrians)?", "Is the problem of road traffic crashes in our country getting better or worse?", "How is the performance of our country in comparison with other countries of the world/region?", "What is the distribution of road deaths by road user/transport mode in our country?". Guided questions for the activity are provided to the students. **Task 2**

Each group must write the answers to the questions, regarding the statistics that support their answers.

Sources:

- **DLO_3** - Death on the Roads (WHO): https://extranet.who.int/roadsafety/death-on-the-roads/
- **DLO_4** - Roads kill (Pulitzer center): https://roadskillmap.com
- **DER_7** - Road traffic mortality (WHO): https://www.who.int/data/gho/data/themes/topics/topic-details/GHO/road-traffic-mortality
- **DER_8** - Road safety statistics (European Commission): https://ec.europa.eu/transport/road_safety/specialist/statistics/map-viewer/
- **DER_9** - Road deaths in the European Union – latest data (ETSC): https://etsc.eu/euroadsafetydata/
- **DER_10** - Walking and Cycling Data (ETSC): https://etsc.eu/walking-and-cycling-data/
- **DER_11** – Dashboard – road crash statistics in Portugal (PRP)

After the task is completed, one of the students of each group presents the results to the class. The results are discussed in the class.

At the end of the lesson, students should be able to: recognize road accidents as one of the main causes of death and disability; define Sustainable Development Goal 3.6; define and calculate health indicators in the context of road safety; research, analyze and interpret statistical data to characterize road accidents.

Evaluation: informal assessment of the students' contributions in the debates. Written assignment produced during the work group.

Lesson 3 - Risk behaviours in traffic

The teacher starts lesson by promoting a brainstorming with the question "Why so many road crashes happen?". After discussion in the class, the teacher concludes that the main cause of road crashes are risky behaviours in traffic (**DER_12** – Elements of road safety system and contributing factors for road crashes). Students are challenged to identify the main risky patterns of behaviour in traffic for the different road users (car drivers, car passengers, pedestrians, cyclists, and motorcyclists/moped riders).

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After the discussion in the class, students are challenged to explore the crash simulators (**DLO_1:** stopping distance, impact force, field of view, run-over) and to watch the crash test videos (**DER_13:** Crash tests videos: helmet motorcyclists, pedestrian run-over, seat belt 1, seat belt 2). After the exploration of the crash simulators, the students are organized into groups (3-4 students) and are challenged to explain how the velocity, the friction, the distances, and the reaction time are related to the risk of a crash on the road. Guided questions for the activity are provided to the students. One of the students of each group presents the results to the class. The results are discussed in the class. **Task 3**

At the end of the lesson, students should be able to: identify risk behaviors as the main causes of road crashes; identify risky behaviours in traffic and their relationship with the risk of crash and the severity of their consequences.

Evaluation: informal assessment of the student's contributions in the debates. Formal assignment – short quiz with questions related to influence of velocity, friction, distances, and the reaction time on the risk of crash on the road (**DLO_6**).

Lesson 4/5 – **roadside observation survey, statistical concepts, tools for data collection**

The teacher starts the lesson by recalling the previous lesson (risky behaviors in traffic). A brainstorming is promoted based on the questions "How can we "measure" the risky behaviors in traffic?" and "How to estimate the percentage of people that engage in these behaviors?".

After the discussion, the teacher uses the **DLO_2** (road safety indicators based on roadside observations – includes a presentation with the steps of the scientific method – **DER_14** – and a quiz – **DLO_5**) to present the students the School Research Project (described below) and explain what a roadside observation survey is:

- the steps of a roadside observation survey.
- definitions and examples of population, sample, sample size, and associated margin of error.
- examples of instruments for data collection: record sheets or online forms (if possible, online forms should be used – e.g.: Google Forms, Microsoft Forms, …).
- build a dataset for the example of the cyclists (use of the helmet) using a spreadsheet (Microsoft excel, Google sheets, or other) and explains the functions needed for calculating the road safety indicators based on roadside observations (percentage of cyclists who do not wear the helmet while cycling);
- discuss the limitations of scientific evidence obtained with the roadside observation survey.

After exploring the examples and definitions, students are organized in groups (4-5 students). Each group must choose a road safety indicator (for pedestrians, cyclists, car drivers, car passengers, motorcyclists/moped riders) and carry out the following tasks:

- *First task*: define a population, a sample, the sample size, and the associated margin of error. Explain how the margin of error is related to the sample size.
- *Second task*: build a dataset using a spreadsheet (Microsoft excel, Google sheets, or other), enter fictitious data into the dataset, calculate the road safety indicator and the error associated.
- *Third task*: build an app (online form with Microsoft forms, Google forms, or other) for data collection of observed behaviours for the same road safety indicator.

At the end of the classes, students should be able to: identify the steps of the scientific method; define, plan and execute a roadside observation survey; build data collection tools and databases; use a spreadsheet to calculate road safety indicators (counts, percentages) and graphs with the results.

Evaluation: tasks produced by the groups.

Lesson 6 - forward

After these lessons, the students are challenged to build road safety indicators at the community level trough roadside observations (observed behaviours). This is the **School Research Project** described below, in autonomous section. The previous lessons work as the engaging stage for the development of the project.

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Supplementary learning resources and educational activities

During lesson 6 or in the sessions devoted to the development of the research project is desirable to organize:

1. **Meetings** (teleconference) with road safety experts, policy makers, public health authorities, officers of the municipality working on road safety, data scientists, researchers of PAFSE consortium, among others.
2. **Visits to research centers** – examples in Lisbon: Portuguese Road Safety Association (PRP), National Laboratory for Civil Engineering (LNEC).
3. **Competition** and reward of best outcome (poster/infographic).

School Research Project

Topics

- Plan, design, and carry out a roadside observation survey.
- Data collection to calculate road safety indicators in the community based on roadside observations (observed behaviours).
- Recommendations to improve road safety in the community.

Challenge

Plan, design and carry out a roadside observation survey to characterize performance on road safety indicators in the scholar community

Research management, design and administration

Goal: calculate road safety indicators through roadside observations (observed behaviours) for risky behaviours as a pedestrian, cyclist, motorcyclists/moped rider, car passengers, and/or car driver. Build a poster/infographic with the main findings, present the results to the community, aware for risky behaviours in traffic, and propose measures to improve road safety in the community.

NOTE: the teacher is free to decide the topics (pedestrian, cyclist, motorcyclists/moped rider, car passengers, and/or car driver), depending on the dynamics of the community (e.g. if the bicycle it is not a common transport mode in the community, the topic "cyclist" should not be included).

Development process:

The project is based on guided research to aware for risky behaviours in traffic. To address this challenge, students are asked to measure risky behaviors in traffic in the community through roadside observations. Students can draw their first ideas from the topics discussed in the classroom in this scenario and the supplementary educational activities, mainly the **DLO_2** (road safety indicators based on roadside observations), which includes all the information needed for the different phases of the project development.

During the learning process:

- Students will be able to carry out a roadside observation survey in the community.
- Students will be able to aware for risky behaviours in traffic and to propose policy measures to increase the road safety in the community.

Teaching-learning process milestones:

1. Students will be able to incorporate evidence in their poster/infographic coming from a roadside observation survey to support their ideas and show media literacy.
2. Students will be able to identify and communicate evidence-based policy measures to help promoting road safety in the school and community settings.
3. Students will be able to suggest and advocate for actions by different stakeholders, though scientific-based data and information.

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Teaching-learning process for school project (summary):

1. Planning: define the topics to include in the project (pedestrian, cyclist, motorcyclists/moped rider, car passengers, and/or car drivers); build the instruments for data collection with the selected indicators; define the observation places, the sample size, and other details of the data collection process.
2. Data collection: carrying out the roadside observations.
3. Data analysis: organizing the data and calculating the road safety indicators.
4. Produce the posters/infographics with the main findings.
5. Present the poster/infographic in open schooling event.

Organization of the open schooling event:

1. Each project output (poster/infographic) is presented by the students in a community setting (e.g., exposition center, municipality, garden, museum, science fair).
2. Students will communicate policy measures using science-based argumentation. Students appeal to the action of all in health and safety of the community, providing great understanding that road safety promotion is a responsibility of all.
3. Students, families, school community and relevant local stakeholders attend the event and understand how important is to change behaviours in traffic. They also get high-level understanding on strategies to improve road safety - and how they may have an influence on the relevant settings (e.g., home, school, workplace, public space at the community level).

Data Analysis and Reporting

Poster or infographic with the most important findings of a research project (roadside observation survey) and possible measures to implement in the community to help improving the road safety.

Target Audience for Recommendations

School community and local stakeholders: students, parents, municipalities, healthcare providers, local enterprises.

Public Debate and Recommendations (based on research results)

Public presentation of the results by students in a community setting and dissemination of evidence-based recommendations via social, community and conventional media.

Parents assessment of the scenario (*research purpose*) - attitudes/beliefs concerned with PAFSE project and scenario enactment:

1. If the scenario is relevant for students learning and for school community.
2. If the scenario positively influenced the behaviours in traffic in family environment.
3. If the scenario was well balanced for the youth and for the adult to help and engage.

Main partner responsible:

Portuguese Road Safety Association – PRP

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Assessment Questionnaire- Knowledge, Skills, Beliefs, attitudes and behavior

Scenario topic: Road traffic crashes – a public health issue

Knowledge	
1. Recognizes road traffic accidents as a leading cause of death and disability. Defines SDG 3 and target 3.6.	**Question 1.1.** According to the World Health Organization, what is the leading cause of death for children and young adults aged 5-29 years worldwide? A) road traffic injuries. B) cancer. C) cardiovascular diseases. **Question 1.2.** How many people died in car crashes each year around the world? A) Approximately 1.3 million people. B) Approximately 3 million people die. C) Approximately 13 thousand people. **Question 1.3**. What is the goal of the Sustainable Develop Goal (SDG) – target 3.6 – defined by the United Nations? A) by 2030, halve the number of global deaths and injuries from road traffic accidents. B) Strengthen the capacity of all countries, in particular developing countries, for early warning, risk reduction and management of national and global health risks. C) By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities.
2. Identifies disease burden indicators in the context of road safety (road safety indicators).	**Question 2.1.** Which of the following indicator should be used to compare the road safety situation between two countries in a given year? A) number of deaths per million people. B) number of accidents. C) number of injured people. **Question 2.2.** In a country with 8,094,807 people, in a given year, 565 people have died in road traffic crashes. What was the mortality rate? A) 69.8 deaths per million people. B) 56.5 deaths per million people. C) 565 deaths per million people. **Question 2.3.** In a roadside observational study, 876 of the 2455 cyclists observed were using the helmet. What was the percentage of cyclists who were using the helmet while cycling? A) 35.7%. B) 87.6%. C) 75.3%.
3. Identifies the main risky behaviours in traffic and explains their relationship with	**Question 3.1.** Which of the following conditions increases most the risk of a road crash? A) risky behaviour of the road users (drivers, pedestrians). B) unsafe roads. C) unsafe vehicles (cars, motorcycles, bicycles, …).

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risk of crashing and injury.	**Question 3.2.** What is the effect of speeding, driving after drinking alcohol, driving when tired, and using the mobile phone while driving, in the reaction time? A) increases the reaction time. B) reduces the reaction time. C) does not affect the reaction time. **Question 3.3.** As a pedestrian, crossing the road when the traffic light is red, crossing the road outside the crosswalk, or using the mobile phone while crossing the road: A) Increases the risk of being run over by a vehicle. B) Decreases the risk of being run over by a vehicle. C) Does not affect the risk of being run over by a vehicle.
4. Knows the steps of the scientific method applied to a roadside observation survey.	**Question 4.1.** Which of the following options shows the steps of the scientific method in a correct order? A) 1º - define the research goal, 2º - collect data, 3º - analyse the data, 4º - draw conclusions. B) 1º - collect data, 2º - analyse the data, 3º - draw conclusions, 4º - define the research goal. C) 1º - define the research goal, 2º - draw conclusions, 3º - collect data, 4º - analyse the data. **Question 4.2.** In a roadside observation survey, the researcher: A) collects data on road users' behaviours. B) collects data on road crashes. C) collects data on road users' opinions. **Question 4.3.** In a roadside observational survey that aims to estimate the percentage of drivers using the mobile phone while driving, the process of data collection must be: A) observe the first driver, record the data, observe the next driver on the road, record the data of second driver, …. B) observe and record the data only of drivers who are using the mobile phone. C) observe the first driver, record the data, observe the next driver who is using the mobile phone, record the data of second driver, ….
5. Defines population, sample, and dataset.	**Question 5.1.** Which of the following sentences is correct in the context of a statistical study? A) a population is the entire group that a researcher wants to study and a sample is a subset of the population from which the data are collected. B) a sample is the entire group that a researcher wants to study and a population is a subset of the sample from which the data are collected. C) none of the above. **Question 5.2.** What is a dataset? A) A collection of data, usually presented in a table where each column represents a particular variable and each row a particular case. B) A collection of data, usually presented in a table where each row represents a particular variable and each column a particular case. C) A collection of data, usually presented in several unrelated tables.

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SKILLS	
1. Selects appropriate concepts, data, and evidence to characterize performance on road safety indicators	**Question 1.1.** Which data sources may we use to proper characterize the road safety situation? A) International Institutions such as World Health Organization, European Commission, Word Bank. B) Social media publications from multiple sources. C) Data retrieved by google searches. **Question 1.2.** To find scientific information about road safety I should consult the following sources. A) researchers, scientific publications and national and international experts' institutions. B) friends, journalists, social media. C) google, radio, newspapers.
2. Anticipates the consequences of risky behaviour in traffic.	**Question 2. What level of risk do you perceive in…** 1) low risk... 5) high risk. **2.1.** travel as a car passenger without wearing the seatbelt. **2.2.** as a pedestrian, use the mobile phone while crossing the road. **2.3.** as a pedestrian, cross the road when the pedestrian light is red. **2.4.** as a pedestrian, cross the road outside a crosswalk. **2.5** cycle without a helmet. **2.6.** not respecting the traffic rules while cycling (e.g. don't stop when the traffic light is red or before the "STOP" sign). **2.7.** use the mobile phone while cycling.
3. Can identify problems and challenges of the community in relation to road safety related issues.	**Question 3.1.** I feel able to identify the main problems my community faces in relation to road safety. 1) definitely false… 5) definitely true. **Question 3.2.** I feel capable of proposing actions that address road safety challenges in my community. 1) definitely true... 5) definitively false.
4. Can adopt safe behaviours in traffic	**Question 4. Choose the option that applies:** 1) definitely true... 5) definitively false. **4.1.** I never use the mobile phone while crossing the road. **4.2.** I never cross the road when the pedestrian light is red. **4.3.** I always use the seat belt while travelling as a passenger in a car. **4.4.** I always use the helmet while cycling. **4.5.** I never use the mobile phone while cycling.
Beliefs, attitudes and behavior	*Include: There are no correct or incorrect answers; we are only interested in knowing your perspective.*
1. Believes that safe behaviour in traffic reduces the risk of road crashes and the severity of its consequences.	**Question 1. Choose the option that applies:** 1) strongly disagree… 5) strongly agree **1.1.** As a pedestrian, using the mobile phone while crossing the road increases the risk of being run over by a vehicle and severe injury. **1.2.** As a pedestrian, crossing the road when the pedestrian light is red increases the risk of being run over by a vehicle and severe injury. **1.3.** As a pedestrian, crossing the road outside a crosswalk increases the risk of being run over by a vehicle and severe injury.

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	1.4. Using the seat belt while travelling in a car may save my life in case of a crash. **1.5.** Cycle with a helmet decreases the risk of severe injury in case of a crash. **1.6.** Driving after drinking alcohol increases de risk of a road traffic crash and severe injury. **1.7.** Not respecting the traffic rules while cycling (e.g. don't stop when the traffic light is red or before the "STOP" sign) is dangerous. **1.8.** Speeding on the road with a car or moped/motorcycle is dangerous.
2. Reproves patterns of risky behaviour in traffic.	**Question 2.1.** The adoption of safe behaviours in traffic will ruin my image 1) strongly disagree… 5) strongly agree **Question 2.2.** For me, the adoption of safe behaviours in traffic (e.g.: always use the seat belt, not use the mobile phone while crossing the road, always cross the road in the crosswalk, always wear the helmet while cycling) in the next 3 months, would be: 1) bad... 5) good **Question 2.3.** For me, the adoption of safe behaviours in traffic (e.g.: always use the seat belt, not use the mobile phone while crossing the road, always cross the road in the crosswalk, always wear the helmet while cycling), in the next three months, would be: 1) useless... 5) useful **Question 2.4.** I don't accept patterns of risky behaviours in traffic even when I am with my family and friends. 1) definitely true... 5) definitively false.
3. Adopts safe behaviours in traffic	**Question 3. During the last 30 days, how often have you…?** 1) never… 5) (almost) always **3.1.** travelled as a car passenger without wearing the seatbelt. **3.2.** as a pedestrian, used the mobile phone while crossing the road. **3.3.** as a pedestrian, crossed the road when the pedestrian light was red. **3.4.** as a pedestrian, crossed the road outside a crosswalk, when there was a crosswalk nearby. **3.5** cycled without a helmet. **3.6.** ignored the traffic rules while cycling (e.g. did not stop when the traffic light was red or before the "STOP" sign). **3.7.** used the mobile phone while cycling.
4. Is committed to communicate and address the problems and challenges of the community in relation to road safety.	**Question 4.1.** I intend to identify the problems of the community in relation to road safety in the next three months. 1) extremely unlikely... 5) extremely likely **Question 4.2.** I intend to address the challenges of the community in relation to road safety in the next three months. 1) extremely unlikely... 5) extremely likely **Question 4.3.** Among the following statements, choose the one that best describes what you currently think. 1) I am not contributing to the road safety of my community, and I also have no intention of doing so.

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	2) I am not contributing to the road safety of my community, but I have been thinking about the possibility of starting to do so. 3) I am never or rarely have been contributing to the road safety of my community, but soon I will start doing it on a regular basis. 4) I am contributing to the road safety of my community regularly. 5) For more than six months I have always or almost always been contributing to the road safety of my community. 6) For several years now, I have been contributing to the road safety of my community, and I will continue to do so.
5. Attitude towards safe behaviours in traffic	**Question 5.** For me to adopt safe behaviours in traffic is: **5.1**. harmful :_____:_____:_____:_____:_____: beneficial **5.2**. pleasant :_____:_____:_____:_____:_____: unpleasant **5.3**. good :_____:_____:_____:_____:_____: bad **5.4**. worthless :_____:_____:_____:_____:_____: valuable

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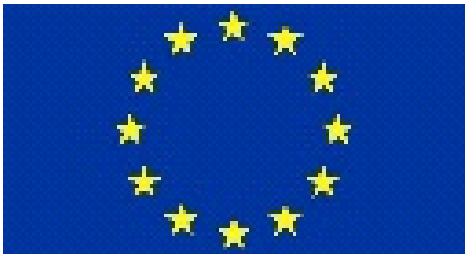
Partnerships for Science Education



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