

OPEN EDUCATIONAL RESOURCES FOR ENVIRONMENTAL QUALITY MONITORING

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Abstract: *This article will present the Massive Open Online Courses (MOOCs) and Open Education Resources (OERs) created in partnership under the TOX-OER project, especially the OERs created for learning environmental quality monitoring, for the development of which the team from Transilvania University of Brasov was responsible.*

Key words: *environmental quality monitoring, massive open online courses, open educational resources.*

1. Introduction

The literature presents a limited number of MOOCs developed in the last years for environmental education in Europe, as they are included in journal publications or conference papers: “Greening the Economy: Lessons from Scandinavia” at Lund University, Sweden (Leire et al., 2016); “Sustainable Energy in Education” at University of Helsinki, Finland (Kaul et al., 2018); “Marine Litter” at University of Madrid, Spain (Tabuenca et al., 2019); “Environmental Sustainability of Organizations in the Circular Economy” at Universidad San Jorge, Zaragoza, Spain (Loste et al., 2020).

Taking into consideration the lack of Massive Open Online Courses MOOCs and OERs for toxicology learning, including environmental education, the European project “Learning Toxicology through Open Educational Resources (TOX-OER)” was implemented. The TOX-OER project was coordinated by University of Salamanca (Spain – USAL), and the partnership was completed by: Space Research and Technology Institute (Bulgaria – SRTI-BAS), Charles University, Prague (Czech Republic – CUNI), South-Eastern Finland University of Applied Sciences (Finland – XAMK), University of Bologna (Italy – UniBo), University of Porto (Portugal – Uporto) and Transilvania University of Brasov (Romania – UNITBV).

The aim of this study is to present the development of OERs for environmental quality monitoring.

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2. Methodology

The following methodology was used during the TOX-OER project: (i) design of a new syllabus and MOOC platform, for toxicology and related items learning (<https://toxoeer.com/>); (ii) development of OERs, accessible on the new MOOC platform (<http://moodle.toxoeer.com/>).

3. Syllabus and OERs for Environmental Toxicology

The design of the new syllabus for toxicology learning was previous presented (Draghici and Salca Rotaru, 2024). The syllabus comprised in seven teaching modules (M1-M7) developed by the project partners, each one with different number of topics and ECTS to be implemented.

3.1. Development of OERs for Environmental Quality Monitoring

For each module, OERs were produced and uploaded on the TOX-OER platform, as: video lessons and commented slides, text-based learning resources, tests (Guerra et al., 2018). Module M6 was developed for Environmental Toxicology, with four topics (T), of which M.6.3 and M.6.4 are dedicated to environmental quality monitoring. The description of the topics (T) and learning units (U) of M63 and M64 related OERs is given in Table 1. The OERs were produced in English and further translated in all native languages of the project partners (Bulgarian, Czech, Finish, Italian, Portuguese, Romanian and Spanish), being thus available in eight languages.

Table 1

Description of the topics (T) 6.3, 6.4 by learning units (U) and by types and numbers of produced OERs

Topics and units	Types of OERs		
	Video (a)	Text (b)	Test (c)
T6.3. Introduction to the Environmental Quality Monitoring System	1+4	3	3+1
U1. Environmental monitoring scheme and related activities	1	1	1
U2. Environmental sampling and analytical measurements	2	1	1
U3. Environmental data processing and reporting	1	1	1
T6.4. Monitoring the Environmental Quality – Air, Water, Soil	1+4	4+1	4+1
U1. Air quality monitoring	1	1	1
U2. Waters quality monitoring	1	1	1
U3. Soils quality monitoring	1	1	1
U4. Environmental quality – European Environment Agency	1	1	1

Legend: ^(a) introduction video for the topic + video presentations/ learning unit; ^(b) text-based learning resources + additional reading; ^(c) self-evaluation tests + evaluation tests (final).

3.2. Monitoring the environmental quality

Environmental monitoring (EM) can be conducted for a number of purposes (Weston, 2011), of which of interest to our study are: to ensure compliance with environmental regulations (with reference to the OERs for Topic 6.1) and to educate the public about environmental status (with reference to OERs for Topic 6.3 and Topic 6.4). Starting from the description (definition) of the EM as a systematic sampling of air, water, soil, and biota aiming to observe and study the environment, and to produce knowledge from this process (Weston, 2011), OERs were developed for the two topics related to environmental monitoring: Introduction to the Environmental Quality Monitoring System (Topic 6.3) and Monitoring the Environmental Quality – Air, Water, Soil (Topic 6.4).

A great number of reports, books, publications and reviews are available on environmental monitoring, of which we only suggest several (Mihaiescu, 2014; Ni et al., 2011; Sousa et al., 2018; Tenga et al., 2014), a schematic presentation of an EM process being only identified in a book, in Romanian language (Mihaiescu, R., 2014). Therefore, our new approach was to create the OERs for T6.3 in an easy to understand manner, where the EM system is shown as a complex process, presented as cycle-based schemes, following well-defined stages.

After completing the OERs contents related to the three learning units of the Topic 6.3 (Table 1), students should be able to understand: the importance of the environmental monitoring activity; the structure of the monitoring systems – cycle scheme and related activities; the necessary steps to take in order to measure the pollutants in environmental samples.

In the first learning unit (U1), the video presentations and the related text resources were organized to give a general description of an environmental monitoring system, an EM scheme presenting its stages (planning, execution and evaluation), and their related activities (Figure 1).

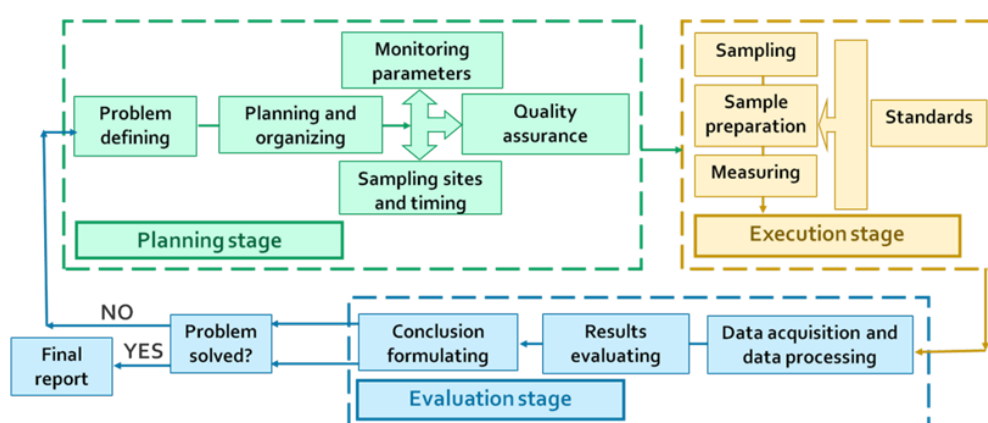


Fig. 1. *Environmental monitoring activities – scheme included in the T6.3 OERs (video presentations and text-based learning resources)*

The main EM stages are explained in the video presentations as well as in the texts, through a cycle-based scheme, where the different stages are color coded, in order to be more easily followed. Depending on the monitoring conclusions, the decision can be that the defined problem was solved, thus moving on to issuing the EM report or that the problem has not been solved, and therefore, the EM cycle should be resumed.

In the following two learning units (U2 and U3, see Table 1), the OERs offer a detailed presentation of the execution and evaluation stages: sampling and sample preparation, measuring (analytical methods), environmental data processing and results reporting. All these EM related activities are presented from a process standpoint, explaining the principles, methods and techniques available for a laboratory approach of the EM measurements. The requirements for high quality results reporting were detailed, thus for each execution and evaluation activity the need for accurate and valid information acquisition was presented.

The OERs developed for T6.3 were further completed and exemplified with those for the last topic (T6.4), presenting information about requirements for EM at the European Union level. Examples of available standards for sampling, sample pre-treatment and for analytical measurements, from International Organization for Standardization (ISO) or European Norms (EN) series are given. The last unit presents the European Environment Agency (EEA) and examples of the environmental monitoring results, on air, water and soil quality registered at EU level, evaluated and uploaded on the EEA website. At the end of the unit, the Environmental Protection Agencies (EPA) network is also presented, comprising the national agencies from each EU member country, responsible for reporting data from their national EM system to EEA.

After completing the OERs contents related to the four learning units from Topic 6.4 (Table 1), students should be able to understand: sampling and sample pre-treatment requirements for air, water and soil samples; standard analytical methods available for measuring pollutant concentrations in air, water and soil; reporting the results obtained from air, water and soil monitoring; European institutions involved in environmental monitoring.

3.3. Evaluation of the impact of the developed OERs at students' level

The impact of the OERs developed for the environmental legislation and monitoring courses is of great interest not only for the general evaluation of project outcomes, but also for future developments. Therefore, we wanted to find out (i) the students' ability to use and capitalize on the OERs contents; (ii) the students' perception of the TOX-OER MOOC and the OERs developed for learning environmental legislation and monitoring.

A survey on the TOX-OER MOOC platform was used for the evaluation of the final results of our learners, students in Environmental Engineering study program, thus giving an overview of their capacity to acquire knowledge and capitalize on the learning resources. The survey showed that an average of 25 students/ year were enrolled on the platform for each topic (6.3 and 6.4) and most of them completed the OERs (videos and texts, as well as the evaluation tests), Figure 2. The grades registered on the MOOC platform, as final evaluation test, for the environmental related topics show that most of them received very good grades (9-10), quite a few received good grades (7-8), a limited number of students got satisfactory grades (5-6).

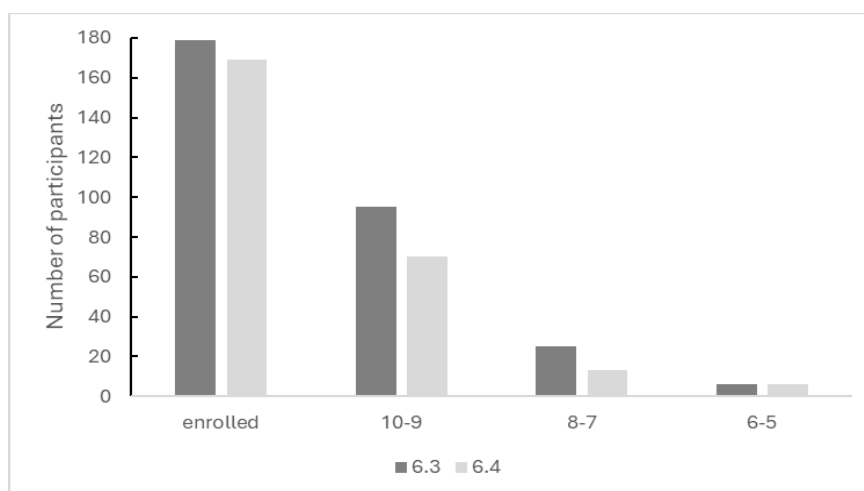


Fig. 2. Evaluation of the number of students enrolled on the TOX-OER MOOC platform and the grades they received after completing the OERs related to Topics 6.3 and 6.4.

4. Future Developments and Conclusions

The lessons learned from the TOX-OER project and the experience in developing project-based OERs allowed us to implement a new project, Environmental Education – OERs for Rural Citizens (EnvEdu – OERs). EnvEdu – OERs project developed new OERs for environmental education (https://envedu.unitbv.ro/en_US/). The new consortium was formed by specialists in environmental engineering and experience in environmental education: UNITBV (as coordinator), and three more partners, Reykjavik University (RU, Iceland), Bucharest University of Economic Studies (BUES, Romania) and Gheorghe Asachi Technical University of Iasi (TUIASI, Romania) (Draghici and Salca Rotaru, 2024; Salca Rotaru et al., 2023). The new OERs (teaching modules – TM1-6) produced during this project, in English and Romanian languages, as well as the partners responsible for their development, are:

- TM1. Sustainable Communities and Social Communication (UNITBV);
- TM2. Environment Quality (UNITBV);
- TM3. Environmental Management, Impact and Risk Assessment (TUIASI);
- TM4. Waste Management in Rural Communities (TUIASI);
- TM5. Water Resources and Water Balance for Sustainable Community (RU);
- TM6. Environmental Projects Management (BUES).

In conclusion, this study presents part of the OERs development for the TOX-OER MOOC platform, in the framework of the TOX-OER project. Developing OERs during the project was an innovative initiative. The video lessons, the text based resources as well as the tests were produced in English and further translated into the native languages of the seven project partners, being thus available in eight languages.

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