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EDUCOAST – NATURE-BASED EDUCATION IN COASTAL GEOSCIENCES: A FIELD STATION IN SOUTHERN PORTUGAL

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Abstract

Project EDUCOAST is funded by the EEA grants "Blue Growth Programme", and aims to promote nature-based education in the area of coastal and marine geosciences at the Portuguese Institute for Sea and Atmosphere (IPMA, I.P.) field Station in Tavira, in southern Portugal. This station is located in a unique coastal environment, which includes natural features such as saltmarshes, lagoons, barrier islands, dunes and beaches. Moreover, IPMA, I.P. station is equipped with a new research laboratory, "Centre Tavira EMSO-PT", dedicated to the study and characterization of marine and coastal sediments. Partnering with the University of Lisbon, the local *Tavira Ciência Viva* Science Centre and the Portuguese Environmental Agency, the project offers diversified training, including activities and short courses to various educational levels, local social associations, and maritime-tourism companies, lifelong learning for basic and secondary school teachers, summer schools for higher education students, academic field trips and internships, and communication and outreach for the public in general. The trainees have the opportunity to experience a hands-on approach to learning, by observing processes in the field, collecting data and analyzing it in the laboratory/office, and interpreting the results, all in one place. Besides providing a unique learning experience, the set of activities offered by EDUCOAST project falls within the priority theme of preserving and protecting the environment with special reference to the importance and sustainability of coastal systems using the Ria Formosa as a case study example.

Keywords: *"Hands-on", field station, geosciences, Ria Formosa.*

1. Introduction

Experimental learning and field trips provide a variety of experiences that cannot be acquired in the typical classroom setting, especially in the scope of natural sciences. Field-based nature education promotes critical thinking and problem solving, which aids in the understanding of new concepts. According to Kuo et al. (2019), several studies exist on this topic, suggesting that experiences of nature-based education improve academic learning, personal development, and environmental stewardship. For this reason, off-campus facilities have existed for a long time, preferably established in natural and pristine settings, and instructors often resort to field trips to provide authenticity to the experience of data collection and interpretation. However, despite the awareness of the importance of field-based education, there has been a general decline of field programmes in the schools' curriculum, from basic to higher education level.

The Portuguese Institute for Sea and Atmosphere, I.P. (IPMA, I.P.) has an experimental station in Tavira, southern Portugal, located in "Ria Formosa", a unique coastal environmental setting that includes sand barriers (beaches and dunes) saltmarsh and a lagoon, (Figure 1). The marine geology branch of the station is dedicated to coastal and ocean geological studies, including the analysis of present and recent past sedimentary environments, and morphodynamics of coastal, estuarine, and marine environments.

Figure 1. Location of IPMA, I.P. field station adjacent to Ria Formosa.

The geo labs were much improved in 2019-2020 through the acquisition of several state-of-the-art equipment in the scope of EMSO-PT project (FCT-Portuguese Roadmap of Research Infrastructures). The partnership with the Faculty of Sciences of University of Lisbon (FCUL), Tavira Ciência Viva Science Centre and the Portuguese Environment Agency provided the opportunity to extend this infrastructure to act as a field station to receive students and trainees in the scope of the EEA Grants funded project: "EDUCOAST - Nature-Based Education in Coastal GeoSciences: a field station in southern Portugal" (PT-INNOVATION-0067), providing "hands-on" field-based learning and using Ria Formosa as an "open sky lab".

2. Objectives

Under the blue growth strategy, the primary goal of the EDUCOAST project is to improve and foster hands-on teaching and learning in the marine and coastal geosciences education. Additionally, the project aims to stimulate natured-based education, to provide solid training in the field/lab of coastal and marine geosciences and to raise awareness on the importance of scientific knowledge.

The opportunities for carrying out nature-based programmes of formal, as well as informal, education are plentiful, including higher education and postgraduate levels studies, undergraduate or even professional lifelong training.

EDUCOAST innovates by promoting the first field station dedicated to marine and coastal geosciences in Portugal, focused on nature-based learning. Besides the outdoor learning experience and access to the specialised laboratories, it also provides trainees with the opportunity to learn from guest experts, an experience that is not commonly available to students nor to the general public. Students also acquire and develop generic competences such as teamwork, autonomous learning, critical thinking, and communication skills.

The team project is strongly committed to improve STEAM (science, technology, engineering, and math) literacy, hands-on pedagogical practices, diversity and collaboration, converging towards the objectives of the United Nations Sustainable Development Goal #4 that aims to "ensure inclusive and equitable quality education and promote lifelong learning opportunities for all" as well as to prepare the next generations to meet the challenges that threatens the sustainability of coastal and marine systems.

3. The activities

All programme activities outlines are defined in close collaboration with the project partners in order to create fit-for-purpose contents depending on the target audience. The main activities include: 1) school visits on demand; 2) academic training for graduate and postgraduate students; 3) high school teachers life training course; 4) summer schools and 5) communication and outreach.

1)School visits on demand

School visits target primary and high schools, as well as local associations and usually correspond to half-day activities. The pedagogical offer typically includes a visit to the station surroundings, for observation and sample collection, followed by a lab analysis component. Thematic sessions include: "What are the differences between beaches and saltmarsh sediments?" (Figure 2);

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"The importance of saltmarshes"; "Is the water in the Ria and sea the same?"; "The sand of the world in your phone", among others. Until present, in one year project, 438 students have participated in these activities that contribute to the ongoing *IPMA Escolas* programme (https://escolas.ipma.pt/).

Figure 2. "What are the differences between beaches and saltmarsh sediments?" activity for basic school students.

2)Academic training courses

This activity targets graduate and postgraduate students from marine-related courses of higher education institutions. It includes internships, related with final degree Dissertation/Project, master degree courses field work, and "field trips" for class groups. For example, two groups of students from the Faculty of Sciences of Lisbon University performed field and lab work between the 18th and 21st March, 2022 and collected sediment samples aiming to the characterization of sediment populations or performed intertidal cartography using video-monitoring, both in an area of the Ria Formosa adjacent to IPMA, I.P. field station (Figure 3). Also, two undergraduate students from the University of Algarve did their final degree work (April-July 2022) in the framework of EDUCOAST, on studying microplastics in the sediment record of the saltmarsh and by analysing the recent evolution of the coastline of the barrier island of Cabanas.

Figure 3. Field work by FCUL students (18-21th March 2022).

More recently, between the 22nd and 25th of February, 2023, a training activity entitled "Geodynamics and Ecology of the Coast - "Hands on" in Ria Formosa", was attended by 25 undergraduate and master/postgraduate students from the School of Technology of the Polytechnic Institute of Setúbal and the Faculty of Science of the University of Lisbon.

A half-day lecture at the *Tavira Ciência Viva Science Centre* was followed by three days of field and laboratory activities where students had the opportunity to get hands-on with the natural environment of the Ria Formosa. Field activities included observation, and sediment, benthic organisms and plants sampling in the salt marsh environment, and morphodynamic characterization of the beach and dune environment along the barrier island, resorting to topography and sediment transport measurements (Figure 4). This training course counted with the collaboration of professors from the Polytechnic Institute of Setúbal (IPS), Faculty of Sciences of the University of Lisbon (FCUL) and researchers and technicians of IPMA, I.P. In total, these academic training courses has already involved 38 students.

Figure 4. Some aspects of the field and lab work of the training action "Geodynamics and Ecology of the Coast - "Hands on" in Ria Formosa", performed between 22-25 Feb 2023.

3)Teachers training courses

High school teachers training must have, at least, 25 contact hours aiming to provide lifelong qualifications in coastal and marine related subjects, contributing to their curricular knowledge updating and providing them with field-based teaching skills that, overall will contribute to improve the quality of teaching. Besides the STEAM, multidisciplinary approach is highly promoted, namely in the production of their final report, submitted to final evaluation and grading.

The first edition of the training course entitled "Coastal zones: a changing world" took place from the 13th to 16th of July 2022 and had 17 participants. The main objective was to update and deepen the Biology, Geology and Geography teachers' knowledge, about i) the morphodynamic characteristics of the coastal zone since the Last Glacial Maximum and ii) its future evolution, estimated according to the scientifically established scenarios. The course was fundamentally based on the acquisition of technical skills of observation and characterisation of the coastal zone ecosystems. The theoretical sessions are enriched by several sessions of field and laboratory work, which include methods adequate to be applied and executed by primary and secondary school students, within a scope of know-how to do what they have learned (Figure 5).

Figure 5. Some aspects of the field and lab work of the first edition of "High school teachers training course".

4)Summer school

The first edition of the summer school was held from the 11th and the 17th of September of 2022, in collaboration with the Institute Dom Luiz, an associated laboratory of FCUL, in the scope of the doctoral programme "Earthsystems". The general theme was "Land-Atmosphere-Ocean interactions in a changing planet - A hands-on approach to Earth System observation and modelling". It had the participation of 25 students from 7 universities, both national and international. The training sessions were delivered by 26 researchers from 5 universities (ULisboa, UAveiro, UCoimbra, UÉvora and UCádiz), 1 State Laboratory (IPMA, I.P.) and 3 associated laboratories (IDL, CESAM, ARDITI) (Figure 6).

Figure 6. Field work, lab processing data and 2" pitch presentations during the first edition of the summer school.

The students were divided in 3 groups according to their different research areas, and all had hands on experience in Coastal Environment and Processes, Estuarine and Coastal Dynamics and Atmospheric Processes, including both field and lab components. Field activities included trips to the barrier islands, field measurements onboard a boat, and experiencing air-borne sensor deployment in balloon and drone. At the end of the course, the students presented a 2 minutes pitch with a theme of their choice followed by a 5 minutes discussion each (Figure 6).

5)Communication and outreach

Communication and outreach are important to divulge the objectives of the project and to reach a wider public that might take advantage of the current project's educational offer. Content was created for institutional websites and social networks, namely news, photos, and videos of the activities. Branding

products were created and shared with the participants (pads, pencils, pens, t-shirts, caps, bags and pen drives) and a website dedicated to the project was created with the main information.

Whenever the opportunity exists, project members take part in science related events, such as the Summer Live Science (August and September 2022) and the European Researchers' Night in September 2022, where at least 75 persons were involved.

4. Conclusions

After one year of activities, the expectations and goals of the EDUCOAST project have been widely met, by creating an educational offer that provides hands-on experience in coastal and marine geosciences, bridging the formal and in-class training. At the end of each activity, a questionary is provided to the participants and the feedback given by the school/university's population so far has been "good" to "very good".

The several activities' outcomes and final evaluations, such as the reports of the teachers training course, the 2-minute pitch that culminate the summer school of September 2022 and the internships of February of 2023 final work, have been evaluated with high marks, which allows us to foresee the continuation of this effort and the development of more initiatives among the school population, technically and scientifically consolidated by the training acquired in these activities.

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