Ocean Connections State-of-the-Art Review
National report ES

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Content

1. Introduction

The main objective of this state-of-the-art National report is to document current and emerging educational trends, innovative/excellent practice and research in the field relating to the objectives of the Ocean Connections project, namely to develop creative, digital approaches (AR/VR) to teaching/learning ocean literacy in schools and aquaria in each partner country. In this report, we explain the educational context, curriculum and good practice pedagogical approaches relevant to the Ocean Connections project in the Spain, focusing primarily on the curriculum in Spain. We also report on xxx elements of a focused literature review of the international literature across the domains relevant to the Ocean Connections Project, including background to the concept of Ocean Literacy, a review of Creative Pedagogies in science and geography education, and a review of literature drawing on multiple elements of the three domains of interest. The most relevant findings from this national report will contribute to the synthesis State of the Art Report.

1.1 Research questions

RQ1 How and where is Ocean Literacy taught in Science and Geography in Spain
RQ2 What innovative technologies and applications using AR/VR are used to support learning in Science and Geography?
RQ3 What innovative creative pedagogies are used to support learning in Science and Geography?
RQ4 How are these technologies/pedagogies used to support students' ocean literacy?
   i. What positive experiences exist in current practices in schools, aquariums and in cooperation between those?
   ii. What barriers exist?
RQ5 What pedagogical principals for teaching ocean literacy can be identified based on RQ1-RQ4?

2. Methodology

Please refer to the "Handbook for State-of-the-Art review in Ocean Connections" for information about how the UK partners conducted their review of Ocean Literacy within the Spain Curriculum and the identification of good practice examples from which we can learn. CPI O Cruce responded to RQ1, "How and where is Ocean Literacy taught in Science and Geography in Spain?" in the formal context of the school curriculum, and Living Coasts added additional information exploring the teaching of Ocean Literacy in informal learning contexts.

CESGA undertook responsibility for an international literature review with respect to ocean literacy, creative pedagogies in science and geography education (RQ3) and the use of digital technologies and creative pedagogies together, to support the teaching of ocean literacy (RQ4).

3. National Practices

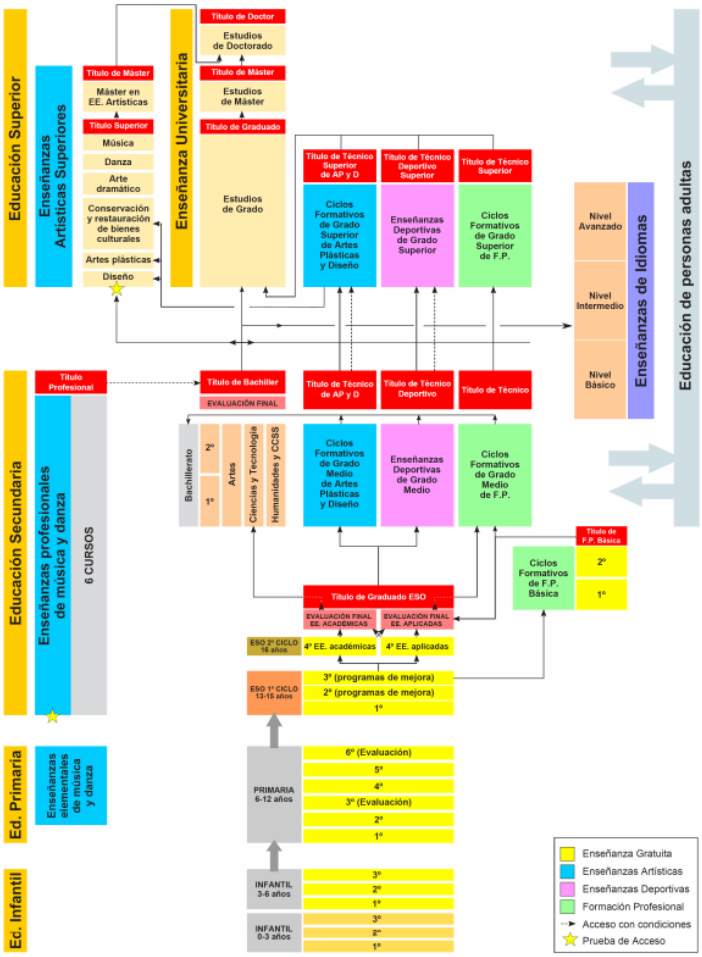
3.1 Curriculum

Educational context

The Spanish Ministry of Education and VET (Ministerio de Educación y Formación Profesional) has the responsibility for education in Spain but the 17 autonomous regions take most of the

decisions regarding their own education systems, with certain degree of personalisation of the core curriculum, regarding, for example co-oficial languages, etc.

Education in Spain is compulsory for all citizens between the ages of 6 to 16 years, after an optional kindergarten (infantil) level. Primary education (primaria) lasts six years followed by four years of compulsory secondary education (Educación Secundaria Obligatoria or ESO), at the end of which a Certificate of Education is received. All students receive basic vocational training at secondary level. After ESO, students choose if continuing their education towards an university degree, in upper secondary education (bachillerato), or follow a VET intermediate level program.[1]



Budget

According to OCDE 2018 report, Spain spends relatively less, as a share of gross domestic product (GDP), at all levels of education (in aggregate, 4%) than the OECD and EU23 averages of 4.5% and 4.2% respectively. Expenditure per student has also fallen between 2010 and 2015, by 11% for non-tertiary education and by 13% for tertiary; this is partly explained by the increase in the number of students at all levels of education for the same period.

[1] To know more: https://eacea.ec.europa.eu/national-policies/eurydice/content/organisation-education-system-and-its-structure-79_en

Gender
As in the majority of OECD countries, fields of study remain gender biased, and only 8% of graduates in upper secondary vocational programmes in engineering, manufacturing and construction are women (OECD average: 11%), while women represent the 77% of secondary graduates in health and welfare in Spain as on average for the OECD. Although most university students are women, its number decreases when it comes to STEM careers.

Results
According to the last PISA report results (2018), Spanish students are excellent when it comes to reproducing learned content, but not so much when it comes to apply this knowledge in a creative way, or have a deep contextualized idea of what they learned. This is due to a learning system that is focused in memorization, reproduction of concepts, but lacks in strategies that focuses in complex learning.

In general, there is no, or very little connection, among teachers from different subjects, and cross-curricular activities are not mainstream in Spanish schools. Most subjects have an extensive curriculum of compulsory concepts to learn, but not so deep.

Initial Teacher Education (ITE)
In Spain, in order to become an elementary or primary school teacher, a 4 years university degree must be obtained. This includes a period of teaching practices in primary schools, under the supervision of both the university and school tutors. In order to work in a public school, future teachers need to pass a national / regional public sector exams. Those who obtain a position, have to spend one school year of supervised teaching. After this, they obtain a permanent position as public teachers in the Spanish system.

Continued professional development (CPD)
Teachers should receive training thorough their professional life. Different courses are offered annually by the competent educational administrations, at no cost for teachers, as well as from universities or other training centers. In-house training is also available, designed and requested by teachers in a school, and paid by the administration. Teachers are not taken time off their duties to attend training, and this many times is organized after classes or during the weekends. The only positive reinforcement for teachers to attend CPD training is they obtain a diploma of their time spent in this activity. Every 6 years they can apply for a specific salary complement if they reach 100 hours of CPD in this period.

RQ1: How and where is Ocean Literacy taught in Science and Geography in Spain

Ocean literacy in primary school (Grades 2nd to 6th) – Natural science (RQ1)

In Natural Science and Living creatures (see annex XX), the science subject in primary school (grades 2 to 6), the curriculum is formulated in general. The general purpose with Natural science and Technology is: The pupil must in Natural sciences/Living creatures develop competences of science and thereby understand how science contribute to our understanding of the world. The pupils must acquire skills and central knowledge about important phenomena's and connection, as well as they must improve their thoughts, language and terms about science, that has value in everyday life. Also, observing, caring, identifying and studying living creatures in marine

environments, using different strategies and tools to learn about their life, relationships, impact of our actions in this environment.

Central concepts in Natural Science and Living Creatures connected to Ocean Literacy are:

- Observation and identification of animals and plants in local environment. (1st year)
- Classify and register living creatures following different criteria and media. (1st year)
- Consider personal responsibility in taking care of plants and animals of local environment. (1st year)
- Living creatures adaptation to environment (2nd year)
- Use of guides of animals and plants in local environment to identify and classify them. (3rd year)
- Observe changes in living creatures in local environment (3rd year)
- Relations among living creatures. Food chain (5th year)
- Learn the characteristics and components of an ecosystem. (5th year)
- Use of technology to study living creatures (6th year)
- Interest in rigorous study of living creatures (6th year)

Ocean literacy is not directly addressed in Spanish primary school curriculum, only as part of the knowledge expected in natural sciences curriculum, dealing with physical description of water environments, and living creatures in it. It is highly dependent on how teachers reinforce this knowledge within the general framework of Natural Sciences subject.

Ocean literacy in upper secondary (Grades 1st to 4th) – Biology and Geology

In lower secondary, 1st and 3rd he focus is placed on biodiversity in the Earth: animals, plants and their interaction with our planet. Students are also asked be curious, show initiative and reflect on real life and environment around them, in order to improve their local environment.
The 1st and 3rd year have a common goal to work on scientific methodology and research projects and the
4th year is aimed to understanding the big theories behind this science and study ecosystems and their interactions:

- Biodiversity in planet Earth (general objective)
- 1st year. Biodiversity, ecosystems, at a closer, more visible level. Biodiversity in our local environment.
- Aquatic ecosystems
- 4th year: more abstract analysis of living creatures, cells, health, etc.
- Design of small research projects on animals/plants of local ecosystems (related or not with human food).

Ocean literacy is not directly addressed in Spanish secondary school curriculum, only as part of the knowledge expected in biology curriculum. It is highly dependent on how teachers reinforce this knowledge within the general framework of Natural Sciences subject.

The most adequate age to work in this project will be 1st course ESO, as in 2nd year they don't have biology subject and in 3rd year they only have 2 hours a week.

3.2 Pedagogical Approaches in schools

Ocean literacy as a term in and of itself was not well known amongst teachers. We could only derive from the Spanish curricula, similar concepts by linking the Ocean Literacy framework with the Learning objectives.

RQ2: What innovative technologies and applications using AR/VR are used to support learning in Science?

There aren no specific examples of the development of ocean literacy within the classroom include practical investigations and general awareness of the biodiversity in our coasts which are part of many of the schemes of work being directed by the curricula.

Only there is an example of the use of digital technologies that did use AR/VR but as a pilot experience:

AR-Sci (age 10-12)

The 2014 EU Funded project AR-Sci main aim is to Spark children's interest in science with Augmented Reality and make teaching and learning sciences more engaging and less complex with freely available or self-made AR resources. More info at https://ar-sci.cesga.es/about-ar

RQ3: What innovative creative pedagogies are used to support learning in Science?

The examples of creative or innovative pedagogies used to support learning science in Spanish schools, focus on learning about the ocean and are drawn from web searches and projects.

Climántica (Age 13-14)

The Educational Research group of the University of Santiago and the Secondary School Virxe do Mar, promoted an European Project with the main aims of developing students appreciation of marine reality, species, and climate changes, understanding of scientific methodology and the promotion of development of artistic products (movies, music, etc) related to marine issues and awareness of climate change effects.

Students take part in a field study led by scientists from University in the beach where they analysed different parameters and measured one bivalves species along a time period, taking into account different parameters such as water temperature, tides, sea weeds, etc. Finally they developed products to explain their research and presented to the public in multimedia products.

Climantica started as a project financed by EU funds, but has developed into a more ambitious initiative, being recognized and funded by UNESCO, National and regional governments in Spain. Their activities include an international virtual campus and collaborative activities and training in 9 countries in Europe and Latin America.

Ocean is the one of the main issues of Climantica products, from a scientific / educational point of view. One of the main products of this initiative is a digital magazine with training units to be applied in EU schools, which focuses on ocean: EduCO2cean: http://www.educo2cean.org/ .

RQ4: How are these technologies/pedagogies used to support students' ocean literacy?

Collaborative approach, learners as producers, virtual campuses, school-university shared scientific projects.

1. International virtual conferences. Students participate by sending works to them, which are assessed by a scientific committee and also public voting through social networks.
2. Students who are finalist in this 1st stage are invited to participate in an International Campus to learn about multimedia production for awareness on climate change. s
3. Teacher training seminars are linked to the activity at the campus to reflect on better methodologies to present ocean literacy and climate change.
4. Different collaborative projects are set between participant schools and universities regarding science education, biology and marine environments where school students contribute in data gathering.

RQ5: What pedagogical principals for teaching ocean literacy can be identified based on RQ1-RQ4?

The topic lends itself well to the use of many different sources thus ensuring that learning will be varied and engaging. Teaching ocean literacy provides opportunities for practitioners to be creative and approach the curriculum from a broad, topical perspective.

3.2 Pedagogical Approaches in out-of-school contexts

By contrast the pedagogical approaches in out-of-school contexts were more visible We summarise here a range of practices observed on site visits or identified through desk research online.

RQ1-4: How and where is Ocean Literacy taught in Science and Geography in out-of-school contexts?

Sea in feminine (Primary and secondary)

A programme developed by the Faculty of Pedagogy from the University of Vigo in order to present and empower the value of the feminine work in the fishing sector, with talks, workshops, didactic materials, exhibits as the ocean literacy. This programme is aimed at children from second stage of primary schools and first stage of secondary schools, although some materials / proposals are better suited for each of these levels. There are also didactic materials for teachers to download and work in class. The main aim is to provide resources in different formats for students to have a better and closer understanding of the role of women in all works related with sea life in Galicia region, and the importance of preserving nature to assure the sustainability of employments related to sea life.

Inland sea (Primary and secondary)

The goal of Mar Interior is to improve knowledge about marine environment and species among primary school students in Inland Spain. The project visited rural schools in several inland Spanish regions, carried out some activities to learn about species and marine protected areas. Ocean literacy is also promoted, so children can understand how sea and humankind influence each other.

The initiative was formed of several face to face workshops in schools. Marine materials (dead species -shells, starfish…-, artefacts, scuba diving gear, etc.), as well as multimedia presentations, posters and panels were brought. There was also an educational resources package, both for students and teachers to support and complement the face to face activities with the initiative. Some of them were artistic: face painting, drawing, mimics…
This project is very interesting because it is focused to rural schools which are far from the coast, so their children have less chances of learning about marine environments.

School Camp: Sea school (Primary and secondary)

This project is sponsored by a private company but very close to the educational sector. Many schools use their services to schedule summer activities for their pupils.

The camp is a 5 days proposal to schools that includes many types of activities:

- Outdoor visits to museums, aquariums, harbours, sea shore
- Physical games: gymkhana, Circuit following tree-top walkways, Burma bridges, etc.
- Indoor games based on virtual reality, to learn about sea predators, food chain, life of some marine species, where children take the role of different fish, which need not to "be fished".

One of its key elements is to know about the seabed, by using a combination of visits, games and outdoor activities, and use of virtual Reality technologies. A Virtual Reality application is used to provide children with an immersive experience of the sea bed

El Mar a fondo: The Sea in-depth (Primary and secondary)

The sea in depth is a very extensive project that includes about 50 different activities, grouped in explanatory videos with didactical references, flash card games, outdoor contests, research activities proposal. Their Marine Sciences Institute (ICM) in collaboration with National Research Council of Spain (CSIC). http://elmarafons.icm.csic.es are the institutions in charge of the programme.
This project brings knowledge about seas and oceans to the area of education through various teaching proposals. Schools and individuals can access the educational contents through the virtual platform and participate actively on the project.
In general terms, the study of natural sciences on the formal education curriculum is designed so that students learn about and understand the natural world. Often it is difficult to grasp the complexity of nature from inside a classroom. One way of doing so is by generating questions that the students can resolve through the results obtained by applying scientific methodology and theories. It is precisely this scientific competence that students need to acquire. The search for simplicity in the approach and its place in a local context can help develop this scientific competence, creating a teaching-learning process that actively involves the students. The sea is the ideal scenario for this type of activity. In addition, direct contact with nature can motivate and encourage a learning spirit among the students.

ReeducaMar / AZTERKOSTA (Adaptation of EU Programme COASTWATCH,Primary and secondary)

This project brings knowledge about seas and oceans to the area of education by providing learning resources that are adapted to the school subjects (natural sciences and biology). These reference theoretical material is complemented with small outdoor research activities in the coastline, where students analyse the characteristics and conditions of a limited area (fauna, flora, water, marine

pollution...). The main actors of this programme are the Regional Government of Basque Country and the Spanish Environment Ministry.
This initiative counts on reference class material both for teachers and students in primary and secondary school education. Besides, this is complemented with outdoor activities that bring students to local coastline to observe, analyse and gather data for further study and compilation. This initiative is active every school year, with about 3000 students participating in it.

4. National and International literature review/perspectives

In this section we searched for literature about VR/AR technologies focused on an educational context.

4.1 Peer-reviewed literature

The following is based on searches in the national peer reviewed literature in Spain. The systematic searches for Spanish peer-reviewed research was conducted in March and May 2019 in the two database: bugalicia.org Network of Spanish Biblioteques and The Spanish National Biblioteque. The first one is a portal for all Galician libraries (public libraries, specialized libraries and academic libraries) and gives broad access to what is published in spain and abroad, having acces to many R&D databases. The Spanish National Biblioteque (bne.es) is an institution which stores and catalogs all the data collected from the local research databases of spanish universities and research institutions and covers published literature (e.g. journal articles, PhD theses and conference presentations).

The identified literature was manually rated based on the inclusion criteria and relevance for the specific research questions. The criteria for inclusion/exclusion was discussed both internally. In the following findings will be presented under headlines of VR/AR technologies. The main work is done in the template for literature review:

Virtual and augmented reality digital technologies

The literature from the search for virtual or augmented reality include 4 main articles. The first one is a study named “Virtual Reality in Education”, Hu-Au, E., & Lee, J. (2017), with presentation of examples of how the affordances of virtual reality lead to new opportunities that support learners, recommendations and next steps.

The second study, “Interactive Virtual Reality Educational Application” from the Technology and Engineering journal, explores the possibilities of VR Educational Applications for different subjects. The study validates the uses of a designed VR lab environment in chemistry, electricity, also as framework for recorded classes, and the uses of 360º videos to provide immersive tours to educational facilities.

The third study, “The benefits of virtual reality in education-A comparison Study” describes the results of a qualitative study that examines the benefits of VR educational applications in comparison to the same.

We also included the results from the part Erasmus+-project AR-sci (B. Nielsen, Brandt, Radner, Surland, & Swensen, 2017; B. L. Nielsen, Brandt, & Swensen, 2016, 2018) focus on how students’ inquiries and exploratory talk are scaffolded, both the pre-planned sequencing of the lessons (macro scaffolding) and the micro scaffolding in the form of teacher-student dialogue.

5. Annexes

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