OpenScienceResources: Towards the development of a Shared Digital Repository for Formal and Informal Science Education

Summary – Aim:

"Open Science Resources" (OSR) is a practice that aims to promote effective science education, by connecting in-class teaching with museum visits and field trips by harvesting the potential of digital science education materials. To succeed in connecting formal and informal learning, a large pool of educational digital content has been created that offers to teachers access to the finest science museum collections of Europe as well as numerous respective educational activities that follow the Inquiry-Based Science Education (IBSE) approach. All the educational content and the educational activities are gathered and organized in an easy-to-use open repository. In this repository, a set of tools and respective manuals are also available to users in order to facilitate them in designing their own educational activities.

Main activities:

The main activities included are the following:

- Introduce to teachers the use of digital educational resources and help them integrate their use in their everyday teaching so as to make their lessons more effective and interesting for their students.
- Promotion of the IBSE approach and student-centred practices through training workshops and presentation of respective good practices.
- Design of Inquiry-Based educational activities that are connected to the school curriculum and combine in-class teaching with science museum visits and hands-on activities for students through training workshops, related supporting materials and demonstrations.
- Implementation of the produced educational activities in different learning contexts so as to demonstrate their multicultural aspect and their effectiveness on different levels of students.

Narrative:

The content of the OSR repository consists of high quality educational activities that follow the IBSE approach and focus on modifying current teaching practices in order to make science teaching more effective and interesting for students. By connecting the teaching in-class with museum visits and hands-on activities, teachers are given the opportunity to transform their lesson into an exciting for students activity that will help them learn through a student-

OpenScienceResources: Towards the development of a Shared Digital Repository for Formal and Informal Science Education

centered procedure that allows them to be actively involved in the learning process instead of being simple spectators. This educational approach is in accordance with the recommendations of the High Level Group on Science Education (Rocard report: "Science Education Now: A New Pedagogy for the Future of Europe", 2007).
The proposed activities offer unique experiences to the users, by expanding a simple presentation of artifacts to an interactive presentation of facts. Students' may interact with exhibits and through their inquiries they learn about the subject at hand and the interconnection between different principles and phenomena.
Additionally the proposed approach aims to raise the wider public's interest and awareness on science. The aim is to demonstrate an innovative methodology that involves visitors in extended episodes of playful learning. As the content of the OSR repository is expected to be used from a quite heterogeneous group of people (youngsters, adults, professionals, educators, school groups, families), the educational activities proposed vary significantly in order to cover the different users' needs and their objectives. These scenarios are one of the basic vehicles for the promotion and the dissemination of the proposed approach to the user communities.
The content of the OSR best practice covers all subjects of natural science from the most fundamental principles of physics, like for example Newton's laws to advanced subjects like quantum mechanics and genetics. The activities involved cover all stages of education, from kinder garden to higher education.

Example activities:
Foucault's pendulum
(www.osrportal.eu/en/node/93935)
This educational activity targets students of primary and secondary education. Primary school students may find out about Earth's rotation and how a pendulum works whereas secondary education students may also practice adding and analyzing vector and forced oscillations.
History of flight
(www.osrportal.eu/en/node/94455)
Students may found interesting information about the history of flight and learn how airplanes fly, the gravitational force and Newton's laws.
The Double Slit experiment – Wave-Particle Duality
(www.osrportal.eu/en/node/94689)
This activity allows students to interact with an augmented reality exhibit and learn about the concept of wave - particle duality, the cornerstone principle of quantum mechanics.

Methods of learning supported:
Inquiry Based Science Education model, hands-on activities and field trips/

End user:
teachers and students of primary and secondary education, museum curators, lifelong learners

Involved actors:
Students, teachers, researchers, museum visitors, informal learning web visitors, museum curators, stakeholders in education

Location:
schools, science museums, science centers and on the web
Connection with the curriculum: Natural Sciences

Languages available:
English – Greek – German – French – Italian – Portuguese– Finnish – Hungarian
Where to find the application:
www.osrportal.eu/

Evaluation parameters:
The educational content and the educational activities of the OSR repository is evaluated by the users in three ways:
1. Rating system (from 1 to 5 stars)
2. Add comments to the content
3. Add social tags. Social tags are either free terms or educational objectives based on a predefined list. Users may evaluate the content by inserting the educational objectives which they believe its activity serves.
4. Realization of educational activities in different learning contexts. The implementation of the activities is recorded and analyzed in order to identify its cognitive impact on students.

The Open Science Resources project has is the recipient of the
- 2010 EDEN/IMS award for Leading Practice in Learning
- 2011 silver award of the IMS Global Learning Consortium
- 2011 OPAL (Open educational Quality Initiative) award for learning contexts
- Time frame*: One complete educational activity requires approximately 3 didactic hours.

Number of participants*:
not limited number of students using the material at a time

Additional information or resources:
www.openscienceresources.eu/

Teachers' Competencies

1	subject matter/content knowledge	x
2	nature of science	x
3	Multidisciplinary	
4	knowledge of contemporary science	x
5	variety of (especially student-centred) instructional strategies	x
6	lifelong learning	x
7	self-reflection	x
8	teaching/ learning processes within the domain	
9	using laboratories, experiments, projects	x
10	common sense knowledge and learning difficulties	x
11	use of ICTs	x
12	knowledge, planning and use of curricular materials	x
13	Information and Communication Technologies with Technological Pedagogical Content Knowledge	x

Mapping best practices with main principles

PATHWAY

x

1. Building interest in natural science phenomena and explanations:

OSR practices connect in-class teaching with respective field trips that are supported by the content of the repository and the use of experimental devices and documentation, as well as innovative interactive applications. The activities are student-centred; they focus on having students become little scientists themselves and carry out their own guided inquiries and experiments so as to come up with their own explanations.

2. Building up informed citizens:
Students understanding the nature of Science & Science in society:

The OSR approach aims to meet the challenge of 'science for all', by providing activities designed for families and general museum visitors that follow a more open format. Moreover in the framework of OSR several 'science days' are also organized in different European countries in order to improve the citizens' attitude towards science.

3. Develop multiple goals:

- **understanding big ideas in science including ideas of science, and ideas about science**
- **Scientific capabilities concerned with gathering and using evidence**
- **Scientific attitudes**

The OSR learning approach is based in the idea that problems drive the learning. Within the context of a field trip, children try to interpret the problem, gather needed information on site, identify possible solutions, experiment, and evaluate options and present conclusions. The interconnection between different activities allows students to see the bigger picture; how different phenomena and principles are connected to each other and how ultimately how the world around us works.

4. Understanding students' concepts and learning style about of science phenomena:

The Open Science Resources learning approach suggests that learning contexts and learning methods should be mixed, in order to provide an effective blend of learning experiences. Students are trained to be self-responsible learners who decide over their individual learning paths, actively search relevant information, and simultaneously develop problem-solving as well as critical thinking skills.

5. Relevance of the content to daily life of students:

The OSR best practice is in line with the modern pedagogy, according to which teaching should be guided by a holistic planning process. Thus, students learn science in meaningful ways that allows them to see connections to familiar problems which are relevant and important in their daily lives.

6. Understanding science as a process not as stable facts. Using up to date information of science and education:

Museum trips and relative activities allow students to learn on site using exhibits and acquire complete apprehension not only of the stable facts but also the connection between different facts and phenomena, how science works and its connection to everyday life.

7. Activities for gaining knowledge, not for entertainment, nor for simple imitating of results:

Learners use their background knowledge along with their science process skills to construct new explanations which allow them to understand the natural world. Thus, learning is confronted as the result of on-going changes in our mental frameworks as we attempt to make meaning out of our experiences.

8. Doing science: experimenting, analyzing, interpreting, redefining explanations:

The heart of every activity is a hands-on task that allows students to learn by doing. Learners are expected to work directly with exhibits that concern natural phenomena. They use their senses in order to observe and the use instruments to extend the power of their senses. Thus, students begin to form a better understanding of the natural world through all the parts of the activity that include problem-solving approaches and 'minds-on' experiments that involve "real" experiments in the "user-friendly" and engaging environment of the science museum.

9. Assessment

By comparing students' knowledge before the realization of the activity to the results they produce, the teacher may assess the cognitive impact of the activity on students. Several game-based on-line applications help teachers understand the impact of the activity through relative quizzes. Furthermore, student's behavior and performance over a series of activities allows teachers to record and assess the summative progress of their students.

10. Cooperation among teachers and with experts:

Teachers may cooperate with the stuff of science museum and science centres that will guide them and give them detailed information about the exhibits they plan to use. Thus teachers have the opportunity to prepare their visits fully and refine their activities and make them as effective as possible.