



D3.1
Training
Scenarios
and Curriculum
Design

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Lifelong Learning Programme

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LD-skills: Development of learning design skills
for enhancing students' key competencies

D3.1 Training Scenarios and Curriculum Design



Education and Culture DG
Lifelong Learning Programme



EAC
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Education, Audiovisual & Culture
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1. Introduction

1 INTRODUCTION

1.1 Scope

This LD-Skills project Deliverable is D3.1 Training Scenarios and Curriculum Design. This deliverable aims to present the design and specification of training enabling LD-Skills teachers to achieve the levels of technical and pedagogical competence required to use inquiry and problem based approaches to their teaching having a positive impact on developing their students' problem solving competences.

The deliverable builds on WP2 tasks related to teachers needs concerning learning design processes and to a review of the state of the art in learning designs, which provide the threshold for the development of the training scenarios presented in this deliverable. More specifically, the deliverable is based on D2.1 Needs Analysis Report, summarising the results from the workshops in partner countries, the matching between user needs and the desired competencies, as well as the local particularities observed in the specific countries. The Deliverable also takes into account D2.2 European state of the art report, presenting the state-of-the-art in Europe concerning teachers' learning designs and a feasibility analysis concerning the implementation of the project in participating countries in terms of equipment and other constraints.

1.2 Audience

This report is addressed to project partners in the first instance but is relevant to a wider audience of teachers in primary and secondary schools, primary and secondary school ICT support staff, wider educational community and local social organizations and policy makers all around Europe.

1.3 Definitions

Term: **Student**

LD-skills definition: The term student is used for pupils learning at school, either at the primary or secondary levels.

Term: **Pre-service teacher (or teacher trainee)**

LD-skills definition: Pre-service teachers are university students, who attend courses to get a degree in teacher education.

Term: **Learning design skills**

LD-skills definition:

- "The impetus to design for learning comes from a number of directions, taking 'design' to mean the planning and documentation of a learning activity, session or curriculum in advance of delivery." (p. 42)
In: Falconer, I. and Littlejohn, A. (2007). Designing for blended learning, sharing and reuse. Journal of Further and Higher Education, Vol. 31, No. 1, pp. 41-52.
- "We use 'learning design' (without capitals) when the human activity of designing units of learning, learning activities or learning environments is meant."
In: Koper, R. and Tattersall, C. (eds.): Learning Design: A Handbook on Modelling and Delivering Networked Education and Training. Berlin: Springer.
- "A learning designer's basic task is to design a course that meets a set of learning objectives." (p. 4)
In: Koper, R. (2005). An Introduction to Learning Design. In Koper, R., Tattersall, C. (eds.): Learning Design: A Handbook on Modelling and Delivering Networked Education and Training, pp. 3-20. Berlin: Springer.

- "Biggs (1999) describes the task of good pedagogical design as one of ensuring that there are absolutely no inconsistencies between the curriculum we teach, the teaching methods we use, the learning environment we choose and the assessment procedures we adopt. To achieve complete consistency, we need to examine very carefully what assumptions we are making at each stage and to 'align' those." (p. 5)
In: Mayes, T. and de Freitas, S. (2005). JISC e-Learning Models Desk Study. Stage 2: Review of e-learning theories, frameworks and models.
- "Learning Design" in the broadest sense takes place whenever a teacher decides how to deliver a particular session, or devises a task to help learners develop specific knowledge or skills. Quality assurance and professionalisation of teaching have meant an increasingly formal approach to these activities, so that 'designs' in the form of lesson plans, module validation documents, pro-formas etc. are routinely produced as evidence of the teaching process [...]"
In: Beetham, H. (2004). Review: Developing e-Learning Models for the JISC Practitioner Communities. Version 2.1. (p. 5).
- "Accurate, pedagogically informed descriptions of learning designs would support:
 - o More pedagogically-informed decision-making at the design stage;
 - o The inclusion of pedagogically rich information along with learning designs to facilitate their sharing, re-use, adaptation etc.;
 - o Easier management of and searching for relevant learning designs (e.g. through classification according to one or more pedagogic taxonomies);
 - o Reflection on what is pedagogically appropriate and effective in learning designs" (p. 17)
 In: Currier, S., et al., (2005). JISC Pedagogical Vocabularies Project. Report 1: Pedagogical Vocabularies Review.
- Bennett, et al., (2008) point out that the ease with which learning designs can be accessed and shared provides more useful, concrete access to effective pedagogical practice.
In: Bennett, S., et al., (2008). Understanding the potential of learning design to support university teachers' design processes.
- The term LD refers to: a) "The process of planning, structuring and sequencing

learning activities. b) The product of the design process - the documentation, representation(s), plan, or structure created either during the design phase or later.

In: Vrasidas, C., et al., (2010). Usable Representations of Learning Design for Educators and Instructional Designers, <http://www.slideshare.net/pambos/usable-representations-of-learning-design>

- The term “learning design” is used in this paper to refer to the process of designing effective learning experiences for a variety of contexts: in the classroom or laboratory, in the field, online and via standalone packages using a range of media. Learning design involves a wide set of knowledge, skills and competencies, including: learning theory and its applications, course design principles and procedures, use of media, use of different technologies, relevant business processes and so on. This paper briefly introduces a research project that investigated the field of learning design in the UK and elsewhere, and describes the production of a competency framework derived from the results of that research.

In: British Journal of Educational Technology. (2011). Volume 42, Issue 4, pp. 557-572.

- Learning design has been defined as “An application of a pedagogical model for a specific learning objective, target group and a specific context or knowledge”.
- The NSW Institute of Teachers Professional Teaching Standards define part of “professional competence” to be the ability to create, select and use a variety of appropriate teaching strategies and resources including ICT and other technologies to make content meaningful to students

In: NSW Institute of Teachers. (2006). Professional Teaching Standards. p. 9.

Term: **Inquiry-based learning (IBL)**

LD-skills definition: There are many answers to the question: “What is scientific inquiry?” A possible short answer is that it is the systematic and principled process of pursuing and refining explanations for phenomena in the natural or material world.

The following definition of inquiry is used, taken from (Linn, et al., 2004; Internet Environments for Science Education, Lawrence Erlbaum Associates): “Inquiry is the intentional process of diagnosing problems, critiquing experiments, and distinguishing alternatives, planning investigations, researching conjectures, searching for information, constructing models, debating with peers, and forming coherent arguments”.

The term inquiry has figured prominently in science education, yet it refers to at least three distinct categories of activities—what scientists do (e.g., conducting investigations using scientific methods), how students learn (e.g., actively inquiring through thinking and doing into a phenomenon or problem, often mirroring the processes used by scientists), and a pedagogical approach that teachers employ (e.g., designing or using curricula that allow for extended investigations). However, whether it is the scientist, student, or teacher who is doing or supporting inquiry, the act itself has some core components. (Minner et al., 2010).

In the National Science Education Standards (NSES), released by the National Research Council in 1996 (The National Academies Press, www.nap.edu), this is stated (p. 23) in the following way: “Scientific inquiry refers to the diverse ways in which scientists study the natural world and propose explanations based on the evidence derived from their work. Inquiry also refers to the activities of students in which they develop knowledge and understanding of scientific ideas, as well as an understanding of how scientists study. Inquiry is a multifaceted activity that involves making observations; posing questions; examining books and other sources of information to see what is already known; planning investigations; reviewing what is already known in light of experimental evidence; using tools to gather, analyse, and interpret data; proposing answers, explanations, and predictions; and communicating the results. Inquiry requires identification of assumptions, use of critical and logical thinking, and consideration of alternative explanations. Students will engage in selected aspects of inquiry as they learn the scientific way of knowing the natural world, but they also should develop the capacity to conduct complete inquiries.”

The NSES (NRC, 1996) actually refers to the way scientists do research and it presents this as an inquiry cycle, which can take many idealised forms such as the ones presented in Figure 1 and Figure 2.

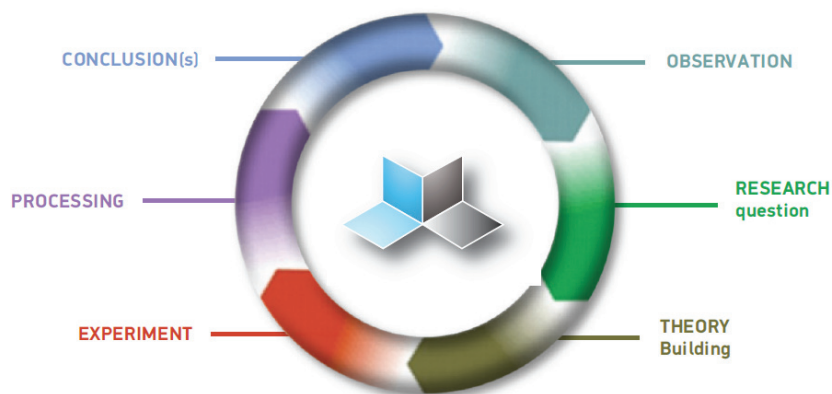


Figure 1. A 6-stage cycle for inquiry investigations and modeling (Betapartners, 2009: *A Learning Route to Inquiry Investigations and Modelling*)

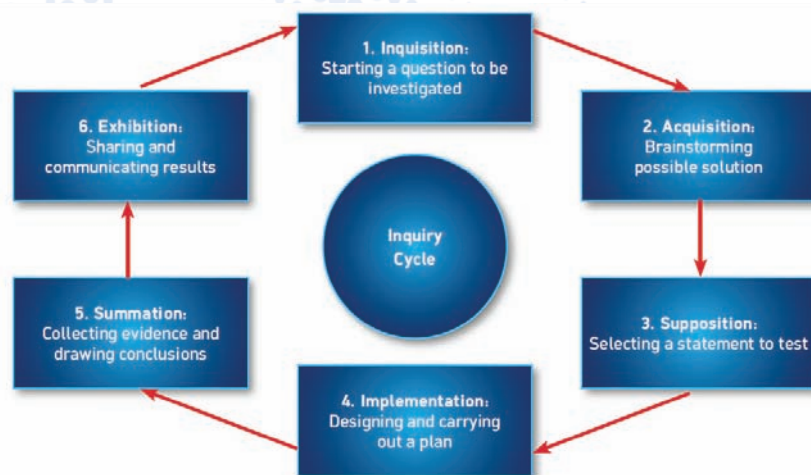


Figure 2. A 6 stage Inquiry Cycle (Llewellyn, 2002, *Inquire Within*)

Figure 2 comes from the book *Inquire Within: Implementing Inquiry-Bases Science Standards* (Corwin Press, 2002), in which the author Douglas Llewellyn defines

inquiry in the following way (p. 16): “To me, inquiry is the science, art, and spirit of imagination. It can be defined as the scientific process of active exploration by which we use critical, logical, and creative thinking skills to raise and engage in questions of personal interests. Driven by our curiosity and wonder of observed phenomena, inquiry investigations usually involve:

- Generating a question or problem to be solved;
- Choosing a course of action and carrying out the procedures of the investigation;
- Gathering and recording the data through observation and instrumentation to draw appropriate conclusions.

As we communicate and share our explanations, inquiry helps us connect our prior understanding to new experiences, modify and accommodate our previously held beliefs and conceptual models, and construct new knowledge. In constructing newly formed knowledge, students are generally cycled back into the processes and pathways of inquiry with new questions and discrepancies to investigate.

Although there are different types and levels of inquiry-based teaching and learning, it is possible to make some general statements about important differences between inquiry-based science education and traditional science education.

Regarding inquiry learning: In the same way that scientific inquiry aims to answer scientists’ questions in an evidence-based method, inquiry-based learning of science aims to answer students’ questions using a similar clear and rigorous scientific methodology. Research (Bransford, et al., 2000; Donovan and Bransford, 2005) indicates that when instruction is designed to engage students in the search of answers to questions that are relevant and interesting to them, their learning improves and they become more motivated. This is also the reason why inquiry learning is quite often positioned in the context of an everyday phenomenon with which students can link up or has personal experience.

Term: **Problem-based learning**

LD-skills definition: Problem solving competencies are individual's capacity to use cognitive processes to confront and resolve real, cross-disciplinary situations where the solution path is not immediately obvious and where the content areas or curricular areas that might be applicable are not within a single subject area of mathematics, science or reading according to the Organisation for Economic Co-operation and Development's (OECD) Programme for International Student Assessment PISA assessments.

“Problem solving competency is an individual's capacity to engage in cognitive processing to understand and resolve problem situations where a method of solution is not immediately obvious. It includes the willingness to engage with such situations in order to achieve one's potential as a constructive and reflective citizen”. This definition extends the PISA 2003 definition as it includes affective factors such as motivation to engage in problem-solving. (Funke et al., 2010)

The proficiency levels in problem solving according to PISA 2003 are presented in Figure 3.

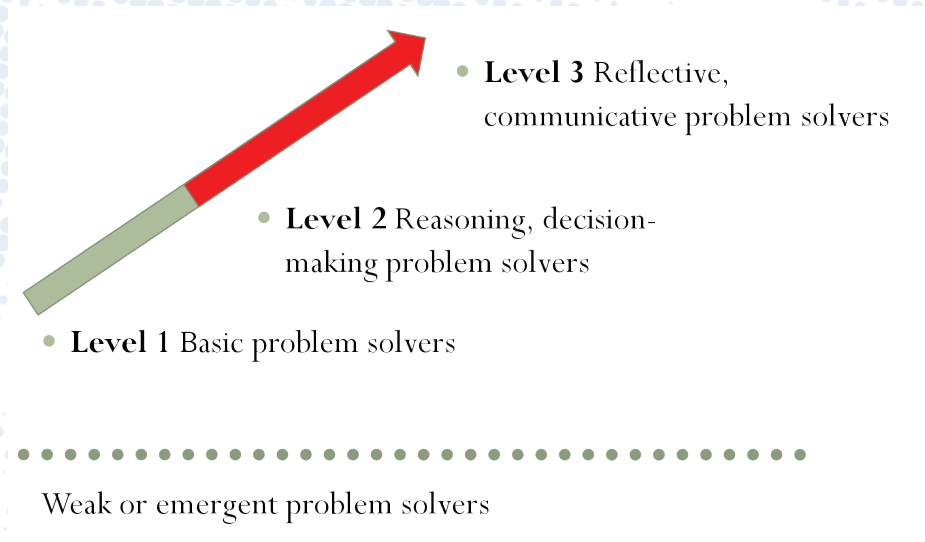


Figure 3. Problem solving proficiency levels

1.4 Structure

- Chapter 1:** contains an overview of this document, providing its Scope, Audience, Structure and relevant Definitions.
- Chapter 2:** describes the initial concepts of the LD-Skills project, the users' training requirements per country derived by the deliverable D2.1 Needs Analysis Report and the way the project corresponds to these needs.
- Chapter 3:** gives an overview of the Training Curriculum Design and the sections of the seminar based training.
- Chapter 4:** provides the Training Curriculum, an overview of the topics and the Curriculum Content that will be available online.
- Chapter 5:** provides the Training Programme its basic principles, the methodological approach on which it is based on, the cycles of implementation as well as its format.
- Chapter 6:** introduces four (4) indicative examples of Training Scenarios as well as the content skeleton developed in order to be deployed during the training (face-to-face and online).
- Chapter 7:** provides the overall training modules and in which cases they can be used based on the competency level of the teacher trainees (beginner, average, expert).
- Chapter 8:** provides the Training Content Requirements (the details of the on-line training material, including the on-line knowledge repository and blogs).
- Chapter 9:** provides a summary and conclusion to the document.
- Appendix A:** Reviews currently applied blended learning approaches.



2. Initial Concepts

2 INITIAL CONCEPTS

According with the European Report “Science Education Now” (Rocard, 2007), many studies have highlighted an alarming decline in young people’s interest towards key science studies and mathematics. This disturbing trend highlights the idea to apply methods that provide science in a more attractive way to students. Following the recommendations of the Rocard report on science education in Europe, the use of problem-based and inquiry-based approaches is important because they provide the means to increase students’ interest and motivation. Today’s teachers need to be prepared to have a positive impact on the development of students’ problem-solving competencies by promoting the use of inquiry and problem-based approaches to teaching.

2.1 Definition and general characteristics-needs

Historically, training for the use of ICTs in education had focused on developing technical mastery (Littlejohn and Peacock, 2003). In contrast to this teachers need support in order to incorporate technology reflectively into their teaching and course design since the effectiveness of technology is dependent on the ways teachers choose to use it. In addition, training for teachers is needed that will enhance the process of creating pedagogically-rich teaching and learning activities hence strengthening students’ acquisition of learning skills.

The range of learning activities that demonstrate specific pedagogic approaches (inquiry-based and problem-based learning) and innovative use of ICT tools is limited, suggesting that teachers are overwhelmed by the plethora of choices and may lack the necessary skills needed to enhance students’ key competences. These are based on the experience of the METASHOOL Project and Training Framework.

Student motivation ought to be increased and learning to be attractive or making students effective and reflective problem-solvers; as well as teachers’ professional development should be enhanced by guiding and enabling teachers to reflect in a deeper and more

creative way about how to design and structure learning activities for students. This will be achieved by introducing the concept of learning as design. Design for learning is characterised as designing, planning, orchestrating and supporting learning activities as part of the learning session or programme. While the benefits of engaging in the process of learning design exist regardless the mode of delivery (face – to face or electronic), they are particularly relevant to the use of ICTs which has tended to focus on content and services while giving less emphasis on creating learning interactions. There are three main ideas in learning design. First, students' competence skills may be strengthened when actively involved in doing something, second, learning activities are carefully structured to promote more effective learning by translating pedagogical theory into templates that can be applied to multiple contexts; and third, it would be useful to record 'learning designs' for sharing and re-use in the future. Overall, teachers do not have the required skills to create such teaching and learning activities that will help students to increase their problem-solving skills.

2.2 The LD-Skills Project

LD-Skills (Development of LD-skills: Development of learning design skills for enhancing students' key competencies) is a collaborative European project funded by the Comenius programme and focused on improving the in-service training of school teachers and school ICT staff on topics related to the development of students' problem-solving competencies by promoting the use of inquiry and problem-based approaches to teaching. It is a multilateral project of 24 months duration, which started in January 2009.

In general, the project aims to improve teachers' practice in all areas of their work, combining ICT skills with innovations in pedagogy, curriculum, and school organisation. It also aims at teachers' use of ICT skills and resources to improve their teaching, to collaborate with colleagues, and perhaps ultimately to become innovation leaders in their institutions.

The main output of the LD-Skills project is an innovative training programme with an aim to have a positive impact on the development of student's problem solving competencies by promoting the use of inquiry and problem-based approaches to learning, thus having a contribution towards the improvement of the quality of science education. The training framework developed is for teachers to learn how to create lesson plans in relation with educational practices that may enhance problem-solving skills. More specifically, the programme is intended to:

- a) train teachers how to change their current teaching practices taking into consideration inquiry-based and problem-based strategies,
- b) introduce learning design processes and methods to motivate teachers to change their practice,
- c) offer access to digital science learning material based on inquiry and problem-based methods and thereby expand the limitations of classroom instruction.

2.3 How LD-Skills Project corresponds to teacher needs

The results of Work Package 2 on user needs and the state of the art provided a solid background to tasks in WP3 related to the LD-Skills training framework. Deliverable D2.1 Needs Analysis Report with teachers identified clear needs, while D2.2, European state of the art, considered implementation prospects, enablers and barriers in partner countries.

The D2.1 Needs Analysis Report included reports from workshops with teachers in Austria, Bulgaria, Germany, Turkey and Greece, revealing that the skills levels of participating teachers was probably higher than those of the average teacher in those countries, and the teachers were positive about ICT and more motivated to learn.

2.3.1 Findings from the needs analysis

The Needs Analysis Report (Deliverable 2.1) provided by our Shumen University “Episkop Konstantin Preslavsky” (SHU) highlights the training needs of the project’s target groups (cf. Table 1). Many of the needs are common to all countries, but indeed there are some differentiations between the partner countries.

Identified needs	Austria	Bulgaria	Germany	Greece	Turkey
Need for web-content: information related to science curriculum, learning scenarios, questions/tests in science, science movies and animation, etc	✓	✓	✓	✓	✓
Need for educational software usage	✓	✓	✓	✓	✓
Need for training with e-learning systems and platforms	✓	✓	✓	✓	✓
Need for examples of good practices that use in science and math educational visits to organisations such as scientific museums, observatories, libraries, etc.	✓	✓	✓	✓	✓
Need for activities related with inquiry-based tools, design of lessons and role-playing games		✓	✓		
Need for small teams of experienced teachers and university students (mixed groups of participants)		✓			✓
Need for practical implementation of curricular materials (development)			✓		
Need for practical training how to use ready web-based courses and how to create their own		✓	✓	✓	✓
Need for training on tagging/ metadata tools & learning activities authoring tools training		✓			✓

Identified needs	Austria	Bulgaria	Germany	Greece	Turkey
Need for practical training on tagging/metadata tools & learning activities authoring tools training	✓	✓	✓	✓	✓
Need for training on problem-based and especially inquiry-based approaches		✓		✓	✓
Need for internal group training, small group discussion and presentations		✓	✓	✓	✓

Table 1. Users' training requirements per country

The needs analysis also outlines the set of specific competencies that LD-Skills users should develop. These are (listed by importance):

- General skills for creating effective lesson plans based on inquiry based approach able to increase the motivation of students;
- General skills for using e-learning systems and platforms (content authoring and metadata tagging);
- General skills for how to use ready web-based courses and how to create their own;
- General skills for enriching their teaching practices including educational visits to organisations such as scientific museums, observatories, libraries;
- General skills for using software related to science.

As an outcome of the needs analysis workshops and surveys, the following guidelines and recommendations were provided in the needs analysis report:

Pedagogical approaches

Through the training services that exist in the institutions, it is possible to state that pedagogical scenarios should be oriented to learning by doing and exploratory learning.

Modalities of training

Most of respondents highly value face-to-face training, as users prefer to have

direct contact with trainers. The respondents voted that the trainings should be delivered in a blended learning context including face-to-face (internal group training, small group discussion and presentations) and online learning. Thus, LD-Skills should provide methods for implementation of blended learning. Additionally, online training materials could offer complementary learning spaces based also on the particular competences of the trainees as well as their interest and motivation.

The training framework should include some main components, presented in Figure 4.

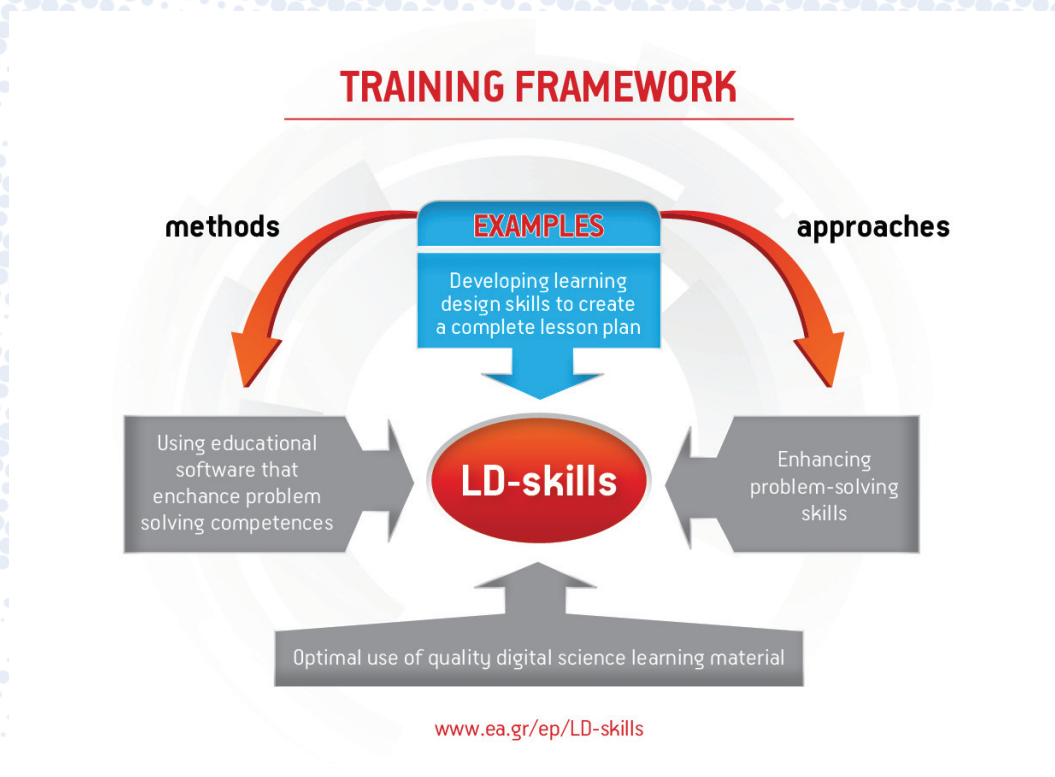


Figure 4. Training Framework

In Bulgaria a network has been built of schools and organisations, whose teachers will be participating in training and at this stage includes:

- Teachers from Shumen and Varna and other towns in Bulgaria.
- Teachers from Children's Centre.
- Researchers from Shumen University.
- Researchers from Center for Creative and Personal Development - National Astronomical Observatory and Planetarium in Varna.
- Policy makers.

In Greece the network of participating teachers consists of:

- Teachers from EA.
- Teachers' communities of METASCHOOL, COSMOS, Organic. Edunet, OSR, and Natural Europe projects (from Greece and around Europe).

In Germany the network of participating teachers consists of:

- Pre-service teachers/University students from HUB.
- Science teachers from schools in Germany.

In Austria the network of participating teachers consists of:

- Pre-service teachers/University students from University of Vienna.
- Science teachers from schools in Germany.

In Turkey the network of participating teachers consists of:

- Pre-service teachers/University students from DEU.
- Science teachers from schools in Turkey.

2.3.1 Findings from the state of the art report

According to the European state of the art report provided as deliverable 2.2 within the LD-Skills project the following issues have to be taken care of:

Training offer / ICT services

Training resources related to the users' needs

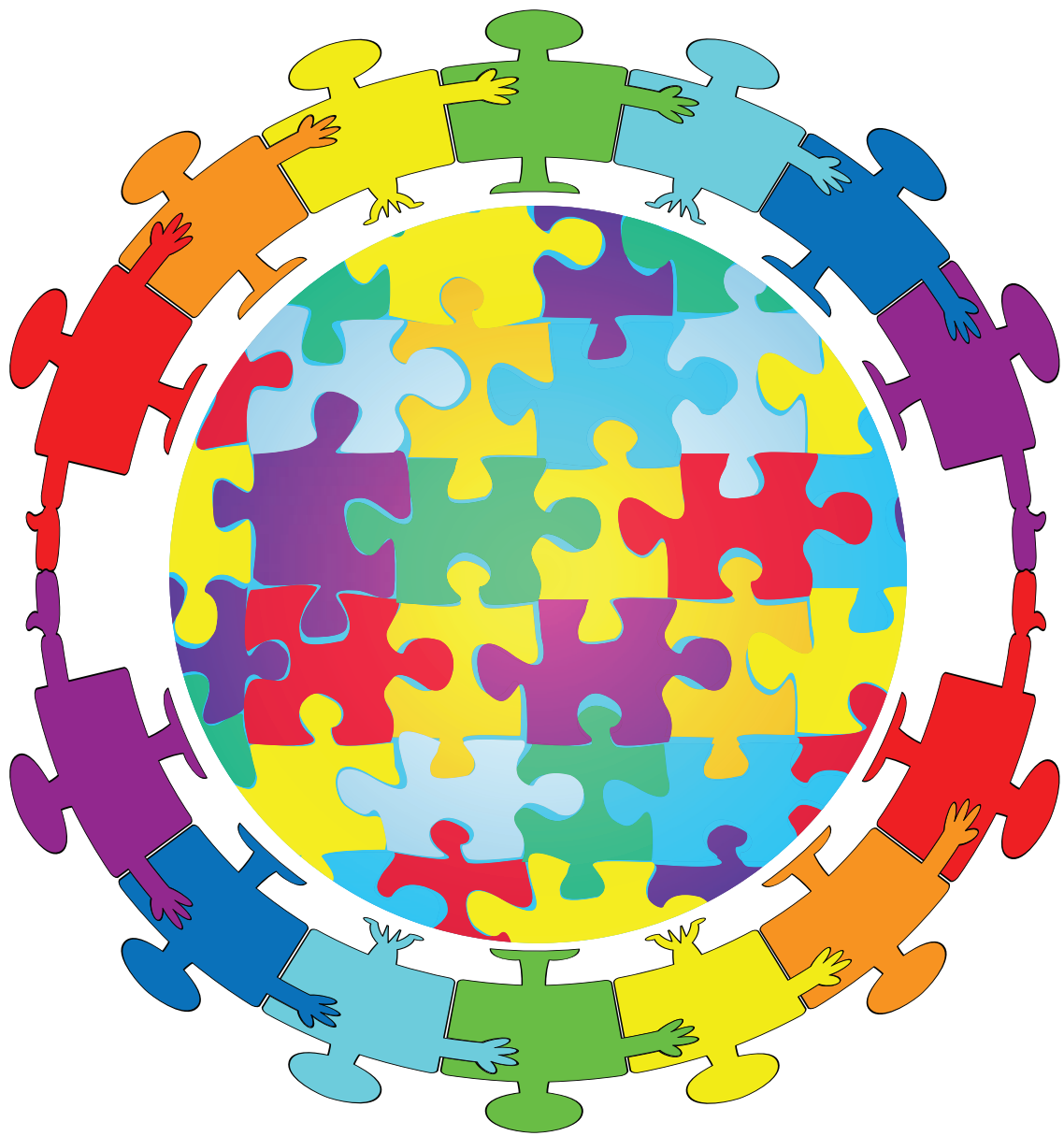
The training resources provided by the project should be related to topics of interest for the teacher communities (in-service and pre-service), as identified in the needs analysis report. They should aim at presenting to teachers the benefits of applying inquiry and problem-based approaches to teaching.

National policies and programmes

Many Governmental and non-Governmental initiatives aim at enhancing teachers' competences. The project should take them into account, inform the related policy makers in order to use the relevant channels to disseminate the project objectives, reach the relevant target users in an adequate way, and use the resources that these programs offer.

Technical aspect

In order to avoid possible problems the portal and related training materials provided by the project should be compatible with low quality ICT and weak internet connections.



3. Training Curriculum Design

3 TRAINING CURRICULUM DESIGN

3.1 The Design of the Training Curriculum

The Training Curriculum was finalised during the 3rd project meeting held in Athens in October 2011. An initial proposal was made by EA based on the experience it had from previous training activities (METASCHOOL Training Framework). The discussion has closed with a plenary session in which partners from each country have presented their scenarios and their required training resources. Also, the contribution of all partners was asked by completing a form delivered to them regarding the material that they would like to be included in the training.

After all it was decided that the training material should comprise of both generic content, providing high level information relevant to all partner countries, and local content and examples that are only of interest to particular countries. The training material will therefore comprise of theoretical material to introduce topics and concepts and practical material to bring the theory to life – with a particular weighting on the latter.

The above training requirements were then further divided into six (6) distinct areas of commonality that would each form key parts of the three (3) hours of seminar based training. The duration of the training was adapted according to the findings of the Needs Analysis Report. The training sessions are the following ones:

- I. **Introduction and overview of the Course and the LD-Skills Project (30 minutes):** This would comprise an introductory section to the training objectives, means, and the philosophy of the LD-Skills Project.
- II. **Approaches to teaching: IBSE principles, skills, ideas (20 minutes):** This section will try to promote the inquiry based approach to teachers by demonstrating the increase of student interest and motivation, as well as the enhancement of students' problem solving skills and competences.

- III. **Learning Design Use Cases (30 minutes):** This would comprise an introductory section to Searching, Retrieving, Authoring, Uploading and Annotating Content with the presentation of the concepts of Learning Resources, Repositories and Metadata, Learning Activities, Learning Courses/ Lesson Plans/ Programmes and relevant Web 2.0 Technologies.
- IV. **PISA Assessment Framework (30 minutes):** This would outline how the PISA assessment framework can be used for evaluating students' acquired inquiry-based skills/ problem-solving competences.
- V. **Practical training on creating an IBSE scenario (50 minutes):** A detailed demonstration would be provided on searching and using learning objects in the classroom following a constructivist learning approach. Furthermore, the annotation process using social tags in order to assess the scenario and in order it to be reused will be demonstrated. An indicative example is "The Faucult Pendulum" by the OSR Project or other indicative examples proposed by each training organisation.
- VI. **Closing Session (20 minutes):** This would provide an opportunity to remind attendees of the more important aspects of the training and the benefits, of applying inquiry based approaches to teaching.



4. The Training Curriculum

4 THE TRAINING CURRICULUM

The tables that follow provide a more detailed description of the outline of the training curriculum, as well as the correspondent content available online. The mapping between the curriculum topics available online and the sections of the seminar based training is depicted in the following table.

Seminar based training	Curriculum topics (online)
Introduction and overview of the Course and the LD-Skills Project	• Introduction to Learning Design
Approaches to teaching: IBSE principles, skills, ideas	• IBSE principles, skills, ideas
Learning Design Use Cases: Searching, Retrieving, Authoring, Uploading and Annotating Content	• Content Authoring: Learning Resources, Repositories and Metadata • Learning Activities • Learning Courses/Lesson Plans/ Programme
PISA Assessment Framework	• PISA assessment framework for assessing students' acquired problem-solving competences
Practical training on creating an IBSE scenario	• Hands-on modules • Educational software related to science education • Technical Session/Learning Design Tools [Optional]

4.1 Overview of Topics and Curriculum Content

4.1.1 Introduction to Learning Design

Topic Area	Curriculum Content
Introduction to Learning Design	• Introduction to Technology Enhanced Learning (TeL) ◦ Types of Learning ◦ Types of Education • Conceptual Model of eLearning ◦ Levels of eLearning Model: Resource, Activity, Course/Lesson Plan, Programme/Educational Pathway • An introduction to Learning Design • Learning Design and the script of a theatrical play as a metaphor ◦ Understanding the LD Specification • Issues related to Copyright and Intellectual Property Rights

4.1.2 Approaches to teaching: IBSE principles, skills, ideas

Topic Area	Curriculum Content
IBSE principles, skills, ideas, approaches	• The inquiry-based approach ◦ Important principles of the inquiry-based approach ◦ Inquiry-based skills • Types of Inquiry Activities: interactive demonstration, guided discovery, guided inquiry, bounded inquiry, open inquiry • The other instructional models

4.1.3 Learning Resources, Repositories and Metadata

Topic Area	Curriculum Content
Learning Resources, Repositories and Metadata	• Practical demonstration of learning resources and their classroom use, Introduction to Resource-based learning • Introduction to learning repositories and learning communities (ratings, comments) • Review and demonstration of popular learning design repositories • Introduction to educational metadata, metadata-based searching, metadata schemas (IEEE LOM, DC-ed) • Social metadata and Web 2.0 tools (folksonomies and social tagging)

4.1.4 Learning Activities

Topic Area	Curriculum Content
Learning Activities	• Learning activities definition • Approach for Developing Technology Enhanced Educational Scenarios Templates • Description of the Educational Scenario Template in a narrative format: ◦ Graphical representation, Analysis of the complex Learning Activities in simple, Indicative example of describing learning activities using the DialogPlus Taxonomy • IBSE Activity Scenario Templates and the concept of the Educational Pathway ◦ Inquiry Based, Guided Research, Learning Cycle, The 5E Instructional Model and Problem Based Learning

4.1.5 Learning Courses/Lesson Plans/Programmes

Topic Area	Curriculum Content
Learning Courses/ Lesson Plans/ Programmes	- Designing an eLearning Course - Description of objectives, educational problem, assessment - Demonstration of Learning Courses based on the IBSE templates (use of COSMOS, OSR, Natural Europe)
Learning Programmes	Popular tools for electronic classroom/content management systems (locally or online hosting solutions)

4.1.6 Assessment

Topic Area	Curriculum Content
Assessment	- Inquiry-based Skills/Competences - PISA assessment framework for assessing students' acquired problem-solving competence

4.1.7 Hands-on modules

Topic Area	Curriculum Content
Hands-on modules	• Pedagogical strategies and best practices for using digital teaching and learning resources in the classroom ◦ Practical demonstration of learning objects and their classroom use: “The electromagnetic spectrum” (OSR Project) and “Renewable, Green, Clean? Wind Energy and Solar Energy” (Natural Europe Educational Pathway) • Practical examples of learning resource descriptions with metadata ◦ Introduction to tools to describe resources with educational metadata according to the IEE LOM Standard (COSMOS, OSR, Pathway, Natural Europe, Merlot, LOMPad) • Searching and retrieving learning resources through dedicated portals (such as COSMOS, OSR, Natural Europe) • Hands-on session working on resources related to science education (use of COSMOS, OSR, Natural Europe) • Supporting teachers to share resources through social tagging in the OSR, Natural Europe portals • Scenarios with the use of educational software related to science education (e.g. online flash applications, java applets, Geogebra, Modellus, Mathematica, Matlab, Table curve, Chemmath, Virtual Chemistry Laboratory, Virtual Lab)

4.1.8 Technical Session/LD-Tools [Optional]

Topic Area	Curriculum Content
Technical Session	• Introduction to Web 2.0 tools (blogs, wikis) for encouraging the sharing and use of developed inquiry-based activities and the support of teachers' communities of practice/ personal portfolios of digital resources • Introduction for teachers to set up and use metadata authoring tools (LOMPad, Naturnet Redime URM or Confolio) in order to describe their resources with metadata • Introduction for teachers to set up and use learning design authoring tools (Graphical Learning Modeller, LAMS or Compendium LD) in order to describe the scenario they developed • Introduction for teachers to upload their content at dedicated repositories such as COSMOS, OSR, Natural Europe or Content Management Systems (e.g. Moodle, Open eClass)



5. Training Programme

5 TRAINING PROGRAMME

5.1 Basic principles of the training programme

The training programme is designed to provide support to the teachers in finding educational resources on the web, Classroom management and curriculum organisation, Differentiated instruction, Collaboration – Community building and Professional development and PISA assessment framework for assessing students' acquired problem-solving competences. The LD-Skills intended audience is teachers pre-service (university students) and in-service and ICT support staff both at primary and secondary schools.

The school staff taking part in the training programme, will profit in several different ways:

- They will participate in the development of the specialised courses and the course material and thus acquire skills in conceptualising, planning and evaluating their didactical approaches and methodology.
- They will gain knowledge, skills and experiences in organising resources, tagging them with metadata, uploading them in some repository, and facilitate their sharing and exchange with other people.
- In this way, they will also gain experience on the use of educational technology in the classroom, and provide interesting classroom experiences for their students.
- They will gain intercultural awareness through cooperation with partners from different European countries, adding a new dimension to their teaching.
- They also will have an opportunity to look beyond their everyday practical problems get fresh input of ideas by getting in touch with what current educational research suggests.

By the end of the training programme, it is expected that teachers' digital competence will have increased. More specifically, twenty nine (29) optional modules available online are proposed – twenty five (25) aiming at subject teachers and four (4) aiming at teachers at the expert level or IT support staff.

The target group of the project consists of in-service and pre-service teachers. Basic trainings can be incorporated with policy makers and researchers.

5.2 Methodological Approach

More specifically, LD-Skills will mainly carry out the following activities:

- Adapt, develop, test, implement and disseminate a new training framework that supports the training of teachers in-service and pre-service and additionally other stakeholders such as policy makers, ICT personnel of school staff on topics related to inquiry-based approaches and learning designs.
- Suggest a variety of pedagogical strategies based on an inquiry-based approach, for science education.
- Organise pilot training and validation activities of trainees from schools all over Europe, exploring the benefits of inquiry-based teaching in science education, testing the content developed for training as well as the students' acquired problem-solving competence with use of the PISA assessment framework.

The development of the proposed training program is based on the adoption of a user-centred approach.

5.3 Cycles of implementation-Timetable

LD-Skills training programme is spanned into two implementation phases. The first training cycle is scheduled for the period February 2012 – April 2012 and the second training cycle for the period May 2012 – July 2012. Additionally, at least two summer

courses are planned to take place in July 2012 which are open for participations from teachers all around Europe.

The implementation of the training program includes extended cycles of school centred work. Teachers will continuously give feedback to the academic team about their experiences gained in the classroom. This will not only increase the motivation of the teachers, and give weight to their practical experiences, but also provide the necessary cross-links between theory and practice. Upon suggestions of the teachers, the academic team performed the necessary adjustments to the training approach. Finally, the LD-Skills consortium will deliver a structured and reusable set of guidelines and recommendations which will further support the development and assessment of teacher training programs on the use of inquiry-based approaches to teaching.

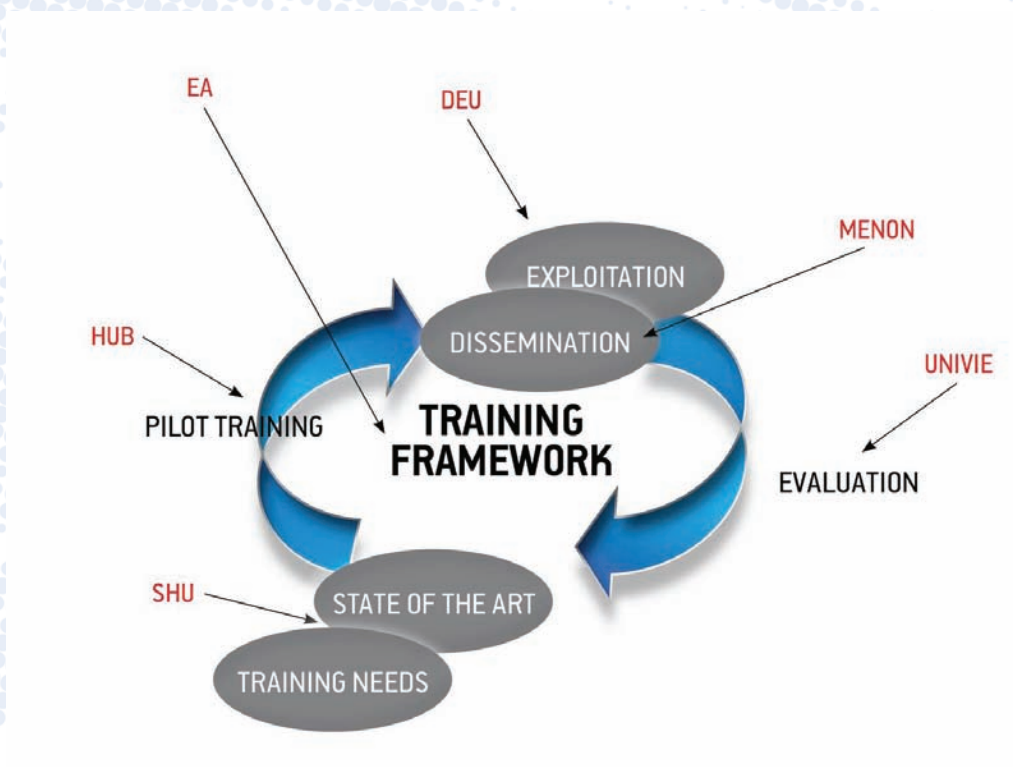


Figure 5. Cycles of implementation

5.4 Modular Format of the Training Programme

Modularity in the design of the training programme is one of the most important parameters of it. The realisation of a project like LD-Skills is indeed a difficult task to accomplish. This is mainly due to the reason that the project deals with the provision of training to teachers in different European countries, with different professional training backgrounds and with numerous differences in the national educational systems in general.

In addition there is a need for uniformity in training programmes for facilitating the purposes of the evaluation. The LD-Skills project took the previous aspects into account by introducing modularity in the development and the implementation of the training programme, as well as giving the trainees the right to optionally study the more technical sections of the developed training curriculum.

The modules are in English and are self-contained for flexibility and offer individual learning paths, to take into account different levels of ICT competence and experience with learning designs. In response to needs for training on specific applications and tools, there are modules covering the most frequently mentioned products. One or two modules aim to showcase good examples of practice to ensure that the pedagogical value of the training is to the forefront and to motivate teachers to apply their training in sustained and effective day to day practice.

5.5 Training module format

The training modules are going to have the structure referred to in Table 2. But some of the modules might not strictly follow this rule due to the modular design of the training programme.

Details

The module starts with a small paragraph presenting the subject and the main aim of the training activity. The purpose of the module is revealed while the main aims of the activity are presented in this section.

Pedagogical objectives

The theoretical background is illustrated here by clearly presenting the pedagogical objectives of the module. The objective is typically a course of study, lesson plan, or a practical skill.

Process

Each module is going to include a section presenting the tasks that must be done by the trainees, the certain reflection needed by the trainees and the time framework of this reflection.

Evaluation

Suggestions for evaluating the training procedure that teachers will follow.

Follow Up

Suggestion for further personal and “user centered” study are given here with specific focus in section of interest within books, training material documents, etc.

Links

Suggestion for websites that can be used for this module.

Table 2. Structure of Training Modules



6. Training Modules

6 TRAINING MODULES

6.1 The Training Modules

A detailed description of modules is presented on Chapter 5.

6.2 Training Scenarios

Training Scenarios have been developed in order to be deployed during the seminar based training, as well as be available online for the interested trainee to work at their own pace. An educational scenario is a complete description of an educational activity including class topic and objectives, learning activities, resources and participating actors as well as their roles.

The scenarios are provided as examples of learning strategies and material content that could be adapted to educational situations and regional particularities. In order for the training to take place successfully it is important to appreciate the context in which it will take place and the enablers and inhibitors that exist. The factors are common to all countries but there is always local variation. There are references provided with each of the scenarios so that an instructor can go more in depth into the background and theory of each one, so that more detail can be included and presented if needed.

In this chapter, indicative examples of Training Modules are introduced with the content skeleton, each under the same headings: details, pedagogical objectives, process, evaluation, follow up and links.

6.2.1 Module example 1: Learning Design Use Cases: Demonstration of Searching, Retrieving, Authoring, Uploading and Annotating Content with use of the OSR Repository

Details

In this learning module you will get familiar with a complete approach of Learning Design, thus Searching, Retrieving, Authoring, Uploading and Annotating Content searching online educational resources by using the Open Sciences Resources (OSR). The OSR is a service for schools to find educational content from many different countries and providers. Anyone is free to search and browse content in the OSR. The users, who can be teachers, trainers, lecturers, instructors, tutors or learners can also register to use the OSR authoring and social tagging tools. Social tagging makes sharing of resources easy. OSR is a service developed in the context of the homonym project.

Pedagogical objectives

1. Teacher preparation for the science lesson.
2. Enhancement of lesson with content from the OSR Repository using the Inquiry Based Approach to teaching.

Process

In the samples below we are looking at a complete scenario of use of the OSR Repository in a step-by-step fashion. The steps are:

1. Accessing the OSR Portal;
2. Understanding the OSR Repository;
3. Exploring in the OSR Repository;
4. Contributing learning objects;
5. Contributing user-authored educational pathways.



Figure 6. The OSR Portal main page

The OSR Repository

The main purpose of the OSR Portal is to provide access to the OSR Repository, an online collection of digital learning content contributed by the OSR user community.

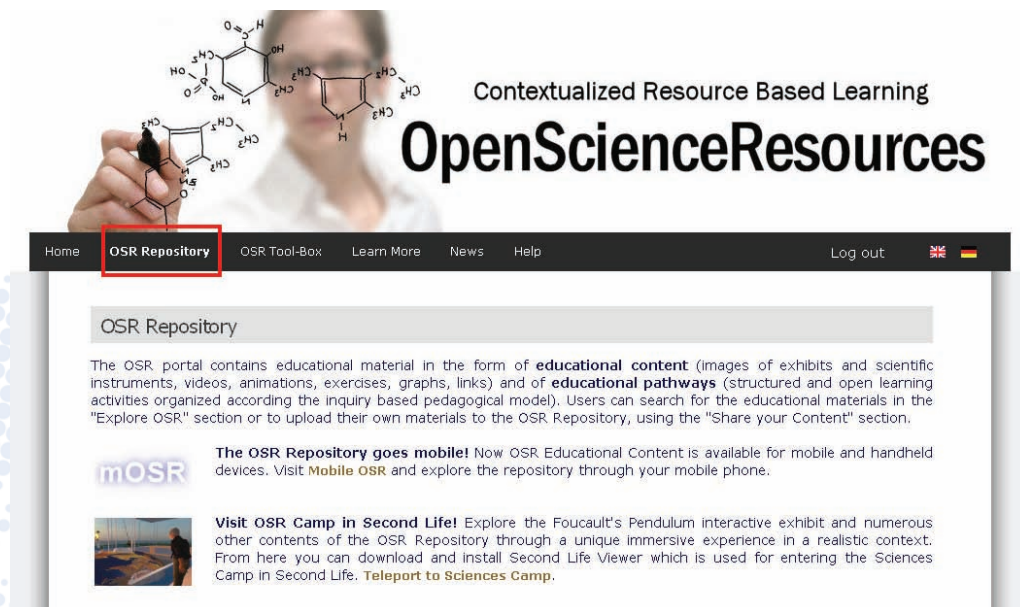


Figure 7. Through the OSR Portal users can gain access to the OSR Repository, the online collection of digital learning content contributed by the OSR user community

Learning Objects and Educational Pathways

The content of the OSR Repository is organised into two distinct categories: Learning Objects and Educational Pathways.

The OSR Learning Objects are digital resources that users have chosen to contribute to the Repository as stand-alone learning materials. These are the main basic elements that constitute the majority of the content of the OSR Repository. They may be anything, from a single digital image to a link to a whole web portal. Their shared common characteristic is that users have considered them as objects with a potential value for learning (hence, they have contributed them to the OSR Repository).

The OSR Educational Pathways, on the other hand, are original learning designs created by members of the OSR user community with the aim to show how digital learning resources (either OSR Learning objects or other) can be combined and integrated

into a series of activities that constitute a meaningful learning experience for school students and/or science museum/centre visitors.

Searching and contributing

The user of the OSR Portal can interact with the OSR Repository through two major types of activity:

- Exploring the OSR Repository for content meeting their needs or interests. To this end, the OSR Portal provides the user with different searching tools and options.
- Contributing their content into the OSR Repository. To this end, the OSR Portal provides the user with mechanisms for uploading files and links, and for authoring and uploading Educational Pathways.

Thus the four options available to the user accessing the Repository are:

- Search for Learning Objects
- Search for Educational Pathways
- Upload Learning Objects
- Upload Educational Pathways.



Figure 8. The four options available to the user for interacting with the OSR Repository

Searching for content through a search form

The user who wishes to explore the content available in the OSR Repository has various options available. The main function is that of searching for content meeting criteria that the user can specify in a search form. In this case, the user needs to perform distinct

searches for Learning Objects and Educational Pathways. To access the corresponding search tools the user selects the relevant links appearing in the first page of the OSR Repository (Figure 9).



Figure 9. Searching for Learning Objects or Educational Pathways meeting criteria that the user specifies in a form

A very characteristic case of searching by clicking on keywords is that of using the OSR Tag Cloud in the first page of the portal. It shows the most common keywords, while letter size visually represents the relevant frequency of each keyword in the OSR Repository. By clicking on a keyword, the user will ask the portal to return all the items (Learning Objects and Educational Pathways) in the OSR Repository which share this specific keyword

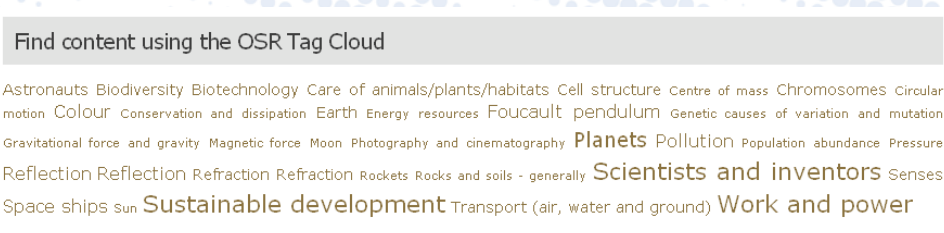


Figure 10. The OSR Tag Cloud

Further, the user may browse the ‘top’ entries in the OSR Repository, by clicking on the titles of the items appearing in the lists of top-rated, most popular, and most recent Learning Objects or Pathways (Figure 11).

Top Rated Learning Objects

- Ampulheta dos milhões
- 7 3D animations of Leonardo da Vinci's machines
- Deinotherium
- A fruta também tem ADN?

Most popular Learning Objects

- Foucault's Pendulum
- Foucault pendulum made from Lego blocks
- Biochips
- Diaporama d'images exposition Changer d'ère

Most Recent Learning Objects

- Bearded Vulture
- Monk Seal

Figure 11. Overview table of the ‘top’ entries in the OSR Repository

Annotating the content of the OSR Repository

A priority for the OSR Portal is to foster dynamic interactions of the user with the content, and of users with each other. In other words, the OSR Portal is far more than a display for ‘exhibiting’ the content of the OSR Repository. Rather, it is lively place where users are facilitated to leave their marks after their visit, in the form of tags attached to the viewed Learning Objects and Pathways, or rating of these items reflecting the user’s appreciation of their ‘value’. In this way the community of the

OSR users can grow and develop not just *within* the portal, but actually *around* Learning Objects and Educational Pathways. The user can find other users with who he may agree (or disagree), and may choose to contact them using the message mechanisms and/or user information available in the portal.

Users' average evaluation of an item is reflected in the five-point-scale ranking signified with stars in the 'ID' page of each item. Five stars denotes top ranking by the users ('awesome'). The user can also see how many people have voted, and use this place to add their own evaluation by clicking on the appropriate star.

7 3D animations of Leonardo da Vinci's machines



Average: 5 (2 votes)

Figure 12. Average evaluation of resources as reflected in the five-point-scale ranking

Social tagging is the other option available to the user for adding their comment or characterisation remark on a Learning Object or Educational Pathways. This refers to adding words or short phrases as 'tags' attached on the item, or making your own selections in relation to categories which have already be defined by the contributor of the resource. Such categories are the context in which the user can envisage the use of this resource, and the type of educational objectives it can serve. Information about social tags, users who have provided them, and the resource, is interlinked, so that the user of the OSR Portal can see, for example, who has tagged a resource, what other resources have been tagged with the same term, or which other resources a user has tagged and with which terms. To do all this, the user will click on the relevant links on the 'ID' page of the Learning Object or Educational Pathway (Figure 13). They will be lead to a dedicated page to insert their own tags (Figure 14).

Social Tags: Leonardo da Vinci, 3D, (see all)

Social Taggers: 2 people

Add your tags

Figure 13. Social tags of resources

Your Tags:

Educational Objectives

Cognitive domain (processes):

Cognitive domain (knowledge):

Affective domain:

Psychomotor domain:

Context:

Contributor's Keywords

Users' Tags

Figure 14. The form in which the user will add their own social tags

Uploading Learning Objects

The OSR Repository is dynamically built by its users, who are provided with functions for uploading their resources after having annotated them with metadata that will make these resources better searchable, identifiable, and usable. To upload a Learning Object, the user gets access to the relevant mechanism of the OSR Portal by following the relevant link in the first page of the OSR Repository (Figure 15).



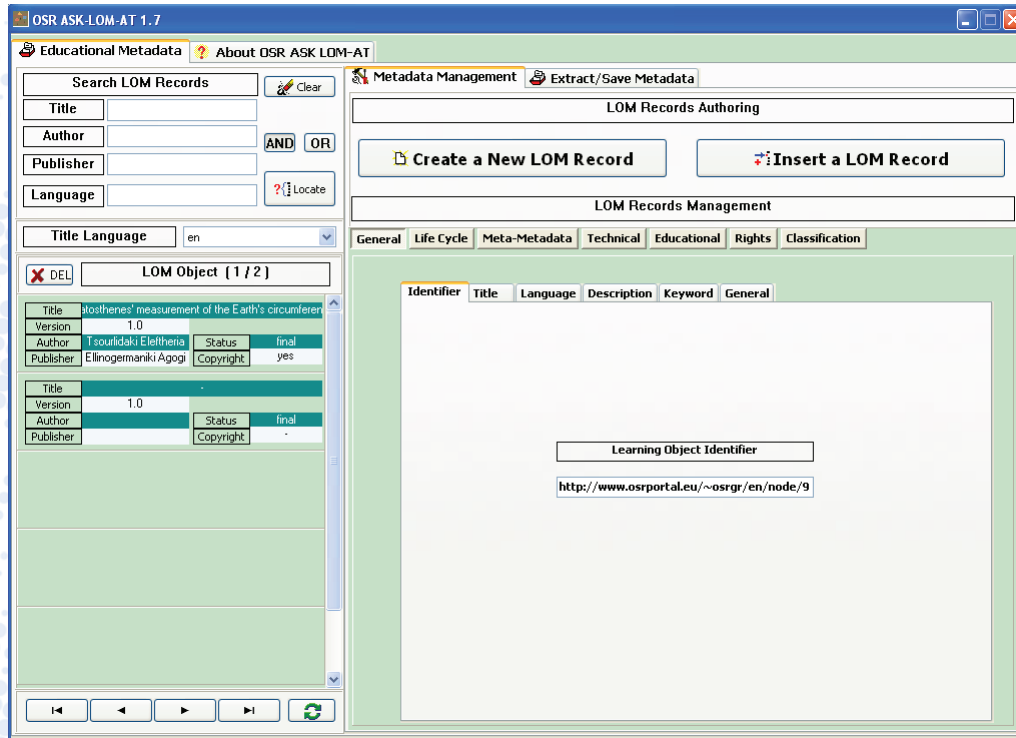
Figure 15. Mechanism of the OSR Portal for uploading a Learning Object

Characterising digital resources with standardised educational metadata

Every resource that the user wishes to share with the rest of the OSR community will need to be characterised by its contributor with standardised educational metadata. This is a prerequisite of the OSR Repository, as this practice makes the content better searchable and usable and the OSR Repository interoperable with other repositories which use the same, worldwide standard of educational metadata. In other words, educational metadata will make the resource more visible, not only to the OSR community, but potentially to the world community of people producing, storing and/or using educational digital content.

For the annotation of a resource with educational metadata the OSR Portal provides a dedicated tool with a simple, user-friendly interface: the OSR Educational Metadata Authoring Tool (Figure 16). This is a stand-alone application that the user will need to

install locally on their computer. The installation software can be accessed at the OSR Tool-Box area of the portal (Figure 17).



The screenshot shows the OSR ASK-LOM-AT 1.7 Educational Metadata Authoring Tool. The interface is divided into several sections:

- Search LOM Records:** Includes input fields for Title, Author, Publisher, and Language, along with search buttons (Clear, AND, OR, Locate).
- Metadata Management:** Includes buttons for "Create a New LOM Record" and "Insert a LOM Record".
- LOM Records Management:** Includes tabs for General, Life Cycle, Meta-Metadata, Technical, Educational, Rights, and Classification.
- LOM Object [1 / 2]:** A table showing metadata for a specific LOM object. The first object is titled "Moses' measurement of the Earth's circumference" with version 1.0, author Tsoulidaki Eleftheria, publisher Elinogemaniki Agogi, status final, and copyright yes. The second object is a blank template.
- Learning Object Identifier:** A text box containing the URL <http://www.osrportal.eu/~osrg/en/node/9>.

Figure 16. The OSR Educational Metadata Authoring Tool, a dedicated tool for the annotation of resources with educational metadata based on the OSR-IEEE-LOM standard

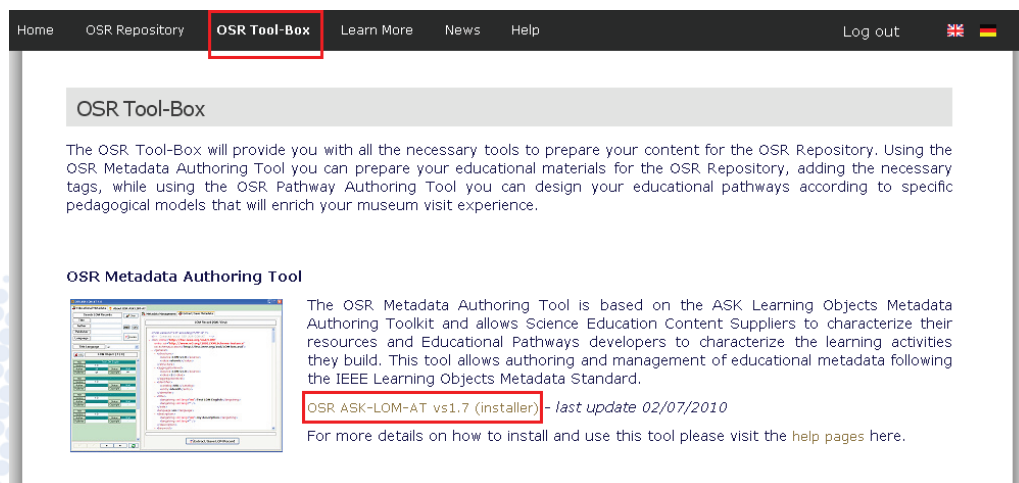


Figure 17. The software for the local installation of the OSR Educational Metadata Authoring Tool can be found in the OSR Tool-Box area of the OSR Portal

The final output of the process of annotation with metadata is an XML file, which the user uploads in the OSR Portal when submitting their Learning Object to the OSR Repository.

Uploading a pathway

Beyond individual learning Objects, the OSR Repository places an emphasis on inviting users to enrich it with learning designs that make use of digital resources (OSR Learning Objects or other) to build longer, meaningful and self-contained learning experiences. These are the OSR Educational Pathways. The OSR user is provided with online tools functions for authoring and uploading their pathways – of course, after they have annotated these resources, too, with standardised educational metadata as described for Learning Objects above. To author and upload an Educational Pathway, the user gets access to the relevant mechanism of the OSR Portal by following the corresponding link in the first page of the OSR Repository.

Authoring an Educational Pathway

Whether for building a pathway, the user of the OSR Portal is provided with an easy-to-use, intuitive online authoring environment, which is structured in the same way

that the final pathway will appear in the portal. In this, the author of the pathway will structure his/her content in stages (Figure 18), describing certain activities in each phase, editing them so as to achieve the wished completeness (e.g. by adding materials in each activity described), appearance (e.g. by including visual elements), and interactivity (e.g. by inserting hyperlinks), using the relevant editing tools.

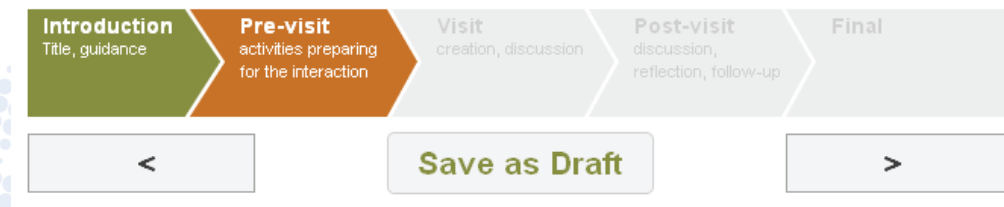


Figure 18. Authoring an Educational Pathway in stages

Evaluation

The OSR portal allows you to participate by rating resources and sharing your opinion adding social tags.

Follow-up

Why not share your resources with your colleagues? Check out also “Submit Educational Content” and “Submit Educational Pathways”.

Links

- The OSR portal URL: <http://www.osrportal.eu/>
- OSR Repository: <http://www.osrportal.eu/en/repository>
- OSR Tool-box: <http://www.osrportal.eu/en/toolbox>
- On the portal there are several tutorials available: <http://www.osrportal.eu/en/node/95998>

6.2.2 Module example 2: Approach for Developing Technology Enhanced IBSE Scenarios Templates, Uploading and Sharing them: “The electromagnetic spectrum” case (OSR Project)

Details

In this learning module you will get familiar with an example of a pathway. The module demonstrates the function and power of the OSR Pathways as complete scenarios of using digital learning resources in the context of meaningful learning designs. The pathway is in accordance with the model of Inquiry Based Science Education (IBSE).

Pedagogical Objectives

This module aims at introducing the teachers to the use of tools for describing educational pathways. The tool developed in the context of OSR project is presented. The web-based tool is available in English, Greek, German, French, Portuguese, Finnish, Italian, and Hungarian.

Process

The teachers will first follow a presentation about the topic. Then, they can follow the link and be presented with the user interface and the basic functionalities of the OSR tool for describing and submitting educational pathways.

The electromagnetic spectrum



Original Title:
The Electromagnetic Spectrum

Classification
Electromagnetism - generally, Properties of light - generally, Colour, Vision, Vision, Vision

Short Description:
This pathway aims to introduce to students all kinds of radiation and familiarize them with the applications in which electromagnetic waves are used.

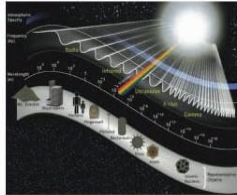
Educational objectives [show](#)

Type of Educational Pathway: Structured

[Educational Material](#)
[Report inappropriate](#)
[Comment this pathway](#)
[Add to favorites](#)


 Average: 4.6 (9 votes)





Social Tags: electromagnetic spectrum, wavelength, (see all)

Social Taggers: 3 people

Add your tags

Metadata File

[Edit](#) | [Share](#) | [Delete](#)
[Copy](#)

Figure 19. OSR pathway example

Underlying pedagogical design

A) Introduction

The user provides here basic information about the intended learning experience. This information should allow the teacher-user of the OSR Portal to assess the relevance of the resource to his/her teaching needs and particular circumstances, and provide him/her with guidance for the preparation of the learning experience. Note that much of this information comes directly linked from the standardised educational metadata (XML file) that will be attached to the pathway before its submission.

Pathway realisation

The electromagnetic spectrum

Please click on a phase to view related activities:



Introduction

Original Title:

The Electromagnetic Spectrum

Description:

This pathway aims to introduce to students all kinds of radiation and familiarize them with the applications in which electromagnetic waves are used.

Classification:

Vision, Vision, Electromagnetism - generally

Age Range:

12-15

Guidance for preparation

1. The teacher should prepare two small presentations with the proposed pictures, videos and relative material.

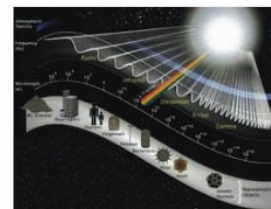
◊ **Prior to the visit the teacher**

- presents images and videos that illustrate the use of radiations in our every day life.
- writes down the tips and questions that will be used during the visit.

◊ **After the visit the teacher**

- presents videos and images of interesting phenomena that have to do with invisible radiations.

2. Students must have notepads and PDAs during the visit to the exhibit.



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Figure 20. Introduction to the pathway

Underlying pedagogical design

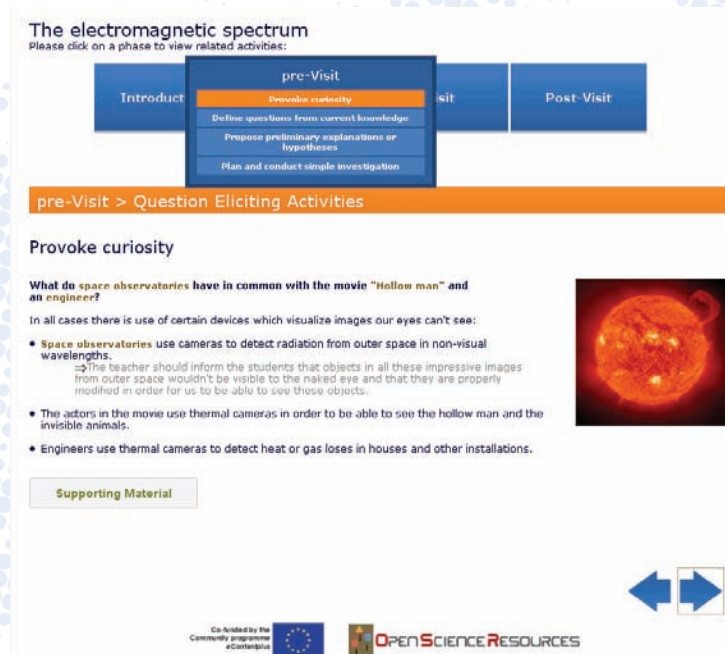
B) Pre-visit

Teaching Phase 1: Question Eliciting Activities

- **Provoke curiosity:**

Describe ways and materials (resources already available in the OSR Portal, or other) that the teacher will present to the students in the classroom to attract their attention to the targeted subject matter. Make sure they are easily available to the interested user in the OSR Portal, and give directions for finding them. Possibly and if appropriate, integrate them into one practical resource in the appropriate format (e.g. a slides presentation).

Pathway realisation



The electromagnetic spectrum
Please click on a phase to view related activities:

Introduce pre-Visit Visit Post-Visit

pre-Visit > Question Eliciting Activities

Provoke curiosity

What do space observatories have in common with the movie "Hollow man" and an engineer?

In all cases there is use of certain devices which visualize images our eyes can't see:

- Space observatories use cameras to detect radiation from outer space in non-visual wavelengths.
→ The teacher should inform the students that objects in all these impressive images from outer space wouldn't be visible to the naked eye and that they are properly modified in order for us to be able to see those objects.
- The actors in the movie use thermal cameras in order to be able to see the hollow man and the invisible animals.
- Engineers use thermal cameras to detect heat or gas losses in houses and other installations.

Supporting Material

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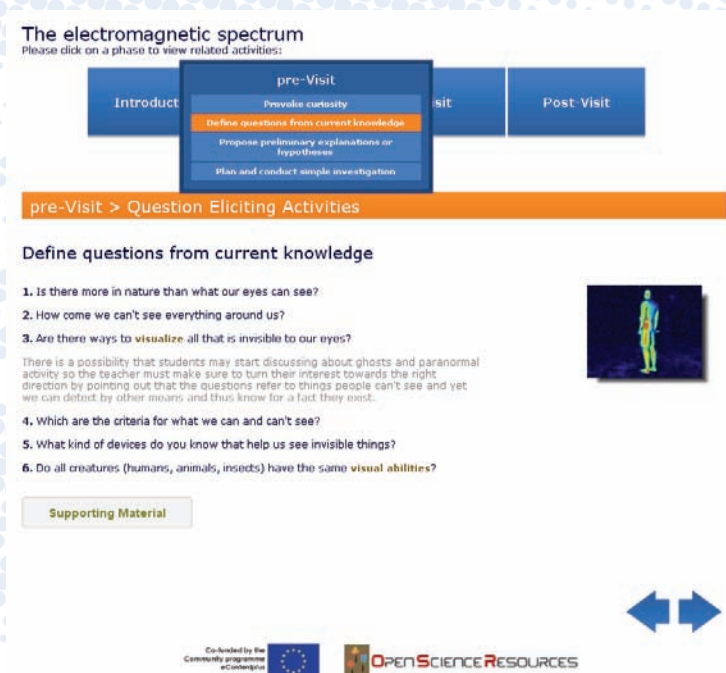
Figure 21. OSR question eliciting activities

Underlying pedagogical design

- **Define questions from current knowledge:**

Formulate the scientifically oriented questions that the teacher will present to the students to provoke their engagement in thinking about the target subject matter based on their existing knowledge. Make these questions digitally available and easily usable, e.g. by integrating them in the materials described in the previous step.

Pathway realisation



The electromagnetic spectrum
Please click on a phase to view related activities:

Introduce pre-Visit Visit Post-Visit

pre-Visit > Question Eliciting Activities

Define questions from current knowledge

1. Is there more in nature than what our eyes can see?
2. How come we can't see everything around us?
3. Are there ways to visualize all that is invisible to our eyes?

There is a possibility that students may start discussing about ghosts and paranormal activity so the teacher must make sure to turn their interest towards the right direction by pointing out that the questions refer to things people can't see and yet we can detect by other means and thus know for a fact they exist.

4. Which are the criteria for what we can and can't see?
5. What kind of devices do you know that help us see invisible things?
6. Do all creatures (humans, animals, insects) have the same visual abilities?

Supporting Material

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Figure 22. OSR questions from current knowledge

Underlying pedagogical design

Teaching Phase 2: Active Investigation

- **Propose preliminary explanations or hypotheses:**

Describe ways in which the teacher can encourage students to propose possible explanations to the questions that emerged from the previous activity. The teacher should be guided here to identify possible misconceptions in students' thinking. If applicable, locate or make relevant assistance materials available in the OSR Portal, and give directions for finding them. If appropriate, you may consider integrating them in the materials described in the previous steps (e.g. a slides presentation).

Pathway realisation



The electromagnetic spectrum
Please click on a phase to view related activities:

Introduce **pre-Visit** Visit Post-Visit

pre-Visit

- Provokes curiosity
- Define questions from current knowledge
- Propose preliminary explanations or hypotheses**
- Plan and conduct simple investigation

pre-Visit > Active Investigation

Propose preliminary explanations or hypotheses

Common Misconceptions

1. Light (Visual) and radiations (other kinds of radiations such as Ultraviolet or Infrared) are two different things.
2. Radiations used in our everyday life, like Microwaves or X-rays are developed by people for certain uses and have nothing to do with the Sun.
3. What distinguishes different radiations?
The teacher introduces the terms of wavelength, frequency and that of electromagnetic radiation and spectrum, along with the related equations.
4. How can we categorize all these different radiations?

After students propose their ideas about the classification of radiations the teacher points out that the electromagnetic spectrum is divided based on the different interactions with matter.

[Supporting Material](#)

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OPEN SCIENCE RESOURCES

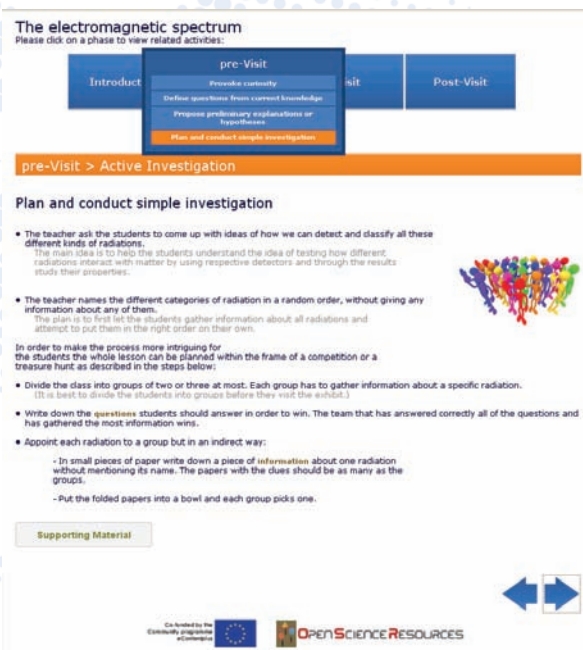
Figure 23. OSR preliminary explanations or hypotheses

Underlying pedagogical design

- **Plan and conduct simple investigation:**

Describe ways and materials (resources already available in the OSR Portal, or other) that the teacher can use to facilitate the students to focus on evidence as a source of answers to scientific questions. This is the phase in which students are being prepared for the subsequent phase of evidence gathering during observation. Locate or make relevant assistance materials available in the OSR Portal, and give directions for finding them. If appropriate and relevant, it is possible to guide the teacher to use OSR resources of an 'exhibit nature' (exhibits, simulations, experiments, etc.) at this stage – in which case this activity should be moved to the 'Visit' section of the Educational Pathway. However it should be noted that the use of physical observation is concentrated mainly in the next Teaching Phase of 'Creation', under the 'Visit' section of the Educational Pathway.

Pathway realisation



The screenshot displays the 'The electromagnetic spectrum' page on the OSR portal. At the top, a navigation bar includes 'Introduce', 'pre-Visit', 'Visit', and 'Post-Visit'. The 'pre-Visit' tab is active, showing a list of activities: 'Provide context', 'Define questions from current knowledge', 'Propose preliminary explanations or hypotheses', and 'Plan and conduct simple investigation'. Below this, the 'pre-Visit > Active Investigation' section is titled 'Plan and conduct simple investigation'. It contains a list of bullet points detailing the activity's goals and procedures, such as asking students to come up with ideas of how to detect and classify different kinds of radiations, naming categories of radiation, and dividing the class into groups to gather information. A small graphic of a colorful molecular structure is visible on the right. At the bottom, there is a 'Supporting Material' button and a navigation bar with 'Go back to the Curriculum programme' and 'Open Science Resources'.

Figure 24. OSR plan and conduct simple investigation

Underlying pedagogical design

B) Visit

Teaching Phase 3: Creation

- **Gather evidence from observation:**

This is the core element of the 'Visit' phase, and can be realised either in the school classroom/lab, by remotely using science learning resources made available by the science museums/centres on the web, or during a physical visit which will involve the use of digital resources. Locate the appropriate resource in the OSR Portal. Explain its use to the teacher, and provide access to any accompanying user support materials. The selected resource (e.g. a simulation, an experiment, an animation, a graph or other exhibit of similar nature) must provide students with an opportunity to collect evidence addressing the scientific questions posed in the previous stages through direct or indirect observation phenomena of the natural world. Provide guidance to the teacher organize and manage the activity most effectively and efficiently. It is recommended to introduce at this stage group work. Guide the teacher to divide students in groups, each of which will be facilitated by the teacher to formulate and evaluate explanations to the scientific questions based on the collected evidence. If applicable, locate or make relevant assistance materials available in the OSR Portal, and give directions for finding them.

Pathway realisation

The electromagnetic spectrum

Please click on a phase to view related activities:



Visit > Creation

Gather evidence from observation

- The class visits **exhibit B5** at "Eugenides Foundation".
- Each group uses the exhibit to familiarize with the electromagnetic spectrum and based on the clue they have been given, students find out which radiation they have to gather information for. While teams wait for their turn to use the exhibit, they begin their research using their PDAs.



⇒ Although the internet is a much better source of information in comparison to the exhibit, the latter offers students a much stronger stimulus because of its direct interaction with them.

- After using the screen, students use PDAs to access the OSR database as well as other online resources in order to gather more **information**. The teacher should encourage them to take as many notes as possible.
- Students gather all the information they need and organize their findings into a small presentation. (The teacher should make clear that presentations shouldn't last more than 5 minutes.)

⇒ Having students take their own notes rather than handing printed notes to them is of great importance because this way they stay focused on their research at all times, it helps improve their critical ability and they learn to depend only on themselves rather than rely on others doing their work for them.

Supporting Material



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OPEN SCIENCE RESOURCES

Figure 25. OSR gather evidence from observation

Underlying pedagogical design

Teaching Phase 4: Discussion

- **Explanation based on evidence:**
Guide the teacher to provide the correct explanation for the researched topic. Describe ways and materials (resources already available in the OSR Portal, or other) she/ he can use to this end, and give directions for finding them. If appropriate, integrate them into one practical resource in the appropriate format (e.g. a slides presentation).

Pathway realisation

The electromagnetic spectrum
 Please click on a phase to view related activities:

Introduction

Pre-Visit

Visit
 Gather evidence from observation
Explanation based on evidence
 Consider other explanations

Post-Visit

Visit > Discussion

Explanation based on evidence

- The students' last task is to place the radiations in the correct order.
 - Before the presentations begin, the teacher mentions this last task.
 - The teacher points out that students should be very careful of their fellow students presentations and take notes that will help them complete the last task.
 This last task besides covering an important part of what students should know about EMR, also ensures that they will pay attention during the presentations.
- The teams present their findings and the winner team is announced.
 It is best, if possible, to have the presentations at the exhibit.
- A very interesting activity especially for younger students is to ask them to come up with a small funny poem where each word begins with the same letter with the respective radiation. This a fun way to remember the correct order.
- Students read their order to the class. In order to have the highest possible interaction between students it is advisable to ask each of them to read the order and the poems they wrote and compare them before the teacher corrects any mistakes.
- The teacher writes down the **correct** order.

Supporting Material







Figure 26. OSR explanation based on evidence

Underlying pedagogical design

- **Consider other explanations:**

Guide the teacher to facilitate the student groups to evaluate their own explanations in the light of alternative explanations, particularly those reflecting scientific understanding. Describe ways and materials (resources already available in the OSR Portal, or other) the teacher can use to this end, and give directions for finding them. If appropriate, integrate them into one practical resource in the appropriate format (e.g. a slides presentation).

Pathway realisation

The electromagnetic spectrum

Please click on a phase to view related activities:

Introduction

Pre-Visit

Visit

Gather evidence from observation

Explanation based on evidence

Consider other explanations

Post-Visit

Visit > Discussion

Consider other explanations

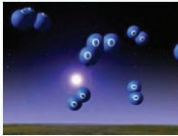
The teacher:

- Explains how scientists came to believe that the electromagnetic spectrum **extends** beyond visible light.
- Informs the students about some interesting **phenomena** such as the Doppler Effect and the ozone hole.

⇒ Students may come up with different explanations about the origin of radiations and their use.

- Radiation where invented by scientists.
- Radiations are always harmful.
- There are more radiations then those already known to us.

Supporting Material



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Figure 27. OSR consider other explanations

Underlying pedagogical design

C) Post-visit

Teaching Phase 5: Reflection

- **Communicate explanation:**

Guide the teacher to facilitate each student group to reflect on the previous experiences and produce a report with its findings, presenting and justifying its proposed explanations to other groups and the teacher. Make available or direct to materials (resources already available in the OSR Portal, or other) which the teacher can use to help the students familiarize themselves with and become effective in scientific writing.

Pathway realisation

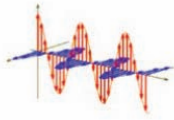
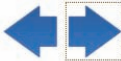
The electromagnetic spectrum
Please click on a phase to view related activities:

Introduction	Pre-Visit	Visit	Post-Visit Communicate explanation Follow-up activities and materials Sustainable contact
--------------	-----------	-------	---

Post-Visit > Reflection

Communicate explanation

- The teachers answers any questions students have.
- Students discuss what was the most impressive thing they have learned.

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Figure 28. OSR communicate explanation

Underlying pedagogical design

Follow-up activities and materials

Describe and direct the user to any follow-up activities or materials that can be used to ‘wrap-up’ the main ‘visit’ experience. These could include appropriate learning assessment and/or reminder materials (e.g. quizzes, games, other user-friendly tests), hints for further activities, suggestions for other relevant ‘visits’, etc.

Pathway realisation

The electromagnetic spectrum

Please click on a phase to view related activities:

Introduction

Pre-Visit

Visit

Post-Visit

Communicate explanation

Follow-up activities and materials

Sustainable contact

Post-Visit > Reflection

Follow-up activities and materials

Useful Links:

<http://www.eugenfound.edu.gr/frontoffice/popup.asp?cpage=CD0G&oid=124>

http://en.wikipedia.org/wiki/Electromagnetic_spectrum

http://coolcosmos.ipac.caltech.edu/cosmic_classroom/classroom_activities/

<http://encyclopedia.kids.net.au/>



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OPEN SCIENCE RESOURCES

Figure 29. OSR follow-up activities and materials

Underlying pedagogical design

Sustainable contact

Describe and direct the user to any existing possibilities for maintaining contact with the digital resource and its provider, or with other users of the same learning experience.

Pathway realisation

The electromagnetic spectrum
Please click on a phase to view related activities:

Introduction	Pre-Visit	Visit	Post-Visit - Communicate explanation - Follow-up activities and materials Sustainable contact
--------------	-----------	-------	---

Post-Visit > Reflection

Sustainable contact

el.tsourlidaki@gmail.com
eleftheria@ea.gr

← →

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eContentplus

  **OPEN SCIENCE RESOURCES**

Figure 30. OSR sustainable contact

Evaluation

The OSR portal allows you to participate by rating resources and educational pathways and sharing your opinion adding social tags. To continue, the teachers will be encouraged to use the OSR Pathway Authoring Tool to create and submit their own learning pathways.

Follow-up

The pathways will be re-examined in a later stage of the training program, to evaluate the progress of the teachers.

Links

- The OSR portal: www.osrportal.eu
- On the portal there are several tutorials/manuals available:
<http://www.osrportal.eu/en/node/95998>
http://www.osrportal.eu/files/help/OSR_Educational_Pathway_Authoring_Tool_Manual.pdf
http://www.osrportal.eu/files/help/OSR_Educational_Metadata_Authoring_Tool_Manual.pdf
- OSR- Toolbox: <http://www.osrportal.eu/en/toolbox>
- OSR Submit Educational Pathways: <http://www.osrportal.eu/connect.php>

6.2.3 Module example 3: Explore the Natural Europe Educational Pathway ‘Renewable, Green, Clean? Wind Energy and Solar Energy’ and its classroom use

Details

In this learning module you will get familiar with an example of a pathway and its classroom use in combination with educational visits to scientific natural museums. The module demonstrates the function and power of the Natural Europe Pathways as complete scenarios of using digital learning resources in the context of meaningful learning designs. The pathway is in accordance with the model of Inquiry Based Science Education (IBSE).

Pedagogical Objectives

This module aims at introducing the teachers to the application and use of a complete educational pathway/learning scenario entitled “Renewable, Green, Clean? Wind Energy and Solar Energy”. The tool developed in the context of Natural Europe project is presented, thus giving the opportunity to the trainees to upload their own pathways.

Process

The teachers will follow the link of the specific pathway and be presented with the user interface and the basic functionalities of the Natural Europe tool for describing and submitting educational pathways, but mostly will get informed about the classroom use and application of the specific pathway.

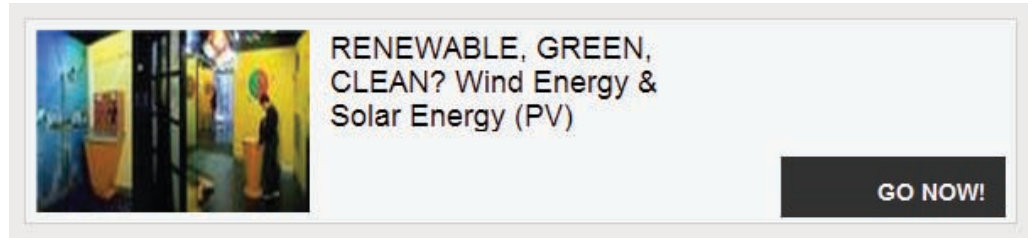


Figure 31. Pathway starting point

‘Renewable, Green, Clean? Wind Energy and Solar Energy’ is an educational pathway that aims to provoke students’ curiosity on renewable energy resources and urge them to examine their advantages and disadvantages. Students engage in hands-on and minds-on activities to collect the information requested and fully comprehend the operation of wind turbines and photovoltaics. The educational pathway involves visit to and activities in a Centre for Environmental Education. All the information required for the pathway’s completion is offered to the teachers in the form of resources and documents. The educational pathway is linked to the module of science (primary school, 6th grade, Greece).



Sign-In

You are here: [Natural_Europe](#) > [Pathways](#) > [RENEWABLE, GREEN, CLEAN? Wind Energy & Solar Energy \(PV\)](#)

RENEWABLE, GREEN, CLEAN? Wind Energy & Solar Energy (PV)

Last Modified: 26/09/2011

[Introduction](#) [Pre-visit Phase](#) [Visit Phase](#) [Post-visit Phase](#)

Introduction

Guidance for preparation

- The teacher should collect the supplies necessary for the creation of the boards (4 large pieces of boards, color pencils, scissors etc.), and for the construction of the models (photovoltaics - wind turbines).
- The teacher should visit Europeana or OSR to collect information on the two renewable resources.
- The teacher should contact the museum to arrange the students' visit.
- A computer with connection to the Internet and a projector will be needed in the pre-visit phase.
- PDAs or cell-phones with Internet connection will be need during visit phase.

Connection with Curriculum

primary school - 6th grade, Science (alternative energy resources)



Supporting Materials

[NATURAL EUROPE](#)

[EUROPEANA](#)

[ADD YOUR TAG](#)

 Share

Given Metadata:
 Creator : museumat011 museumat011
 Title : RENEWABLE, GREEN, CLEAN? Wind Energy & Solar Energy (PV) ; Language : en ; Description : examination of two renewable energy sources ; Learning Resource Type : Lesson Plan ; Intended End User Profile : Teacher ; Learning context : School Connected ; Learning context : In the Natural History Museum/Centre (physical visit) ; Typical Age Range : 9-12 ; Difficulty : Medium ; Copyright and other restrictions : yes ; Cost : no ; Cognitive Domain : To understand ; Cognitive Domain (Knowledge) : Procedure knowledge ; Affective Domain : To respond and participate ; Psychomotor Domain : To perform independently, skillfully and precisely ; Educational level : Primary school ; Educational level : Secondary school

Figure 32. Introduction

The teacher aims to provoke students' curiosity on the two examined renewable energy sources by showing them a web-based video on traditional energy plants and their impact on the environment. A relevant photo from Europeana (<http://www.europeana.eu/portal/>) helps them get an even clearer image on the subject.

RENEWABLE, GREEN, CLEAN? Wind Energy & Solar Energy (PV)

Last Modified: 01/07/2011

[Introduction](#)
[Pre-visit Phase](#)
[Visit Phase](#)
[Post-visit Phase](#)

Pre-visit Phase

Provoke curiosity



The teacher, prior to any discussion, shows to the students

- a video for the production of energy in a traditional energy plant and the climate change,
- a photo of a traditional energy plant.

In the end of the projection, the teacher asks the students to comment and describe the content of the video.



Supporting Materials

NATURAL EUROPE

LIGNITE – HOW TO TRANSFORM IT INTO ENERGY

Energy sources

MYTHS AND TRUTHS WIND POWER PLANTS

MYTHS TRUTHS SOLAR ENERGY

Solar energy advantages

Solar energy disadvantages

Wind energy advantages

Wind energy disadvantages

EUROPEANA

Power station, Isle of Grain, Kent

ADD YOUR TAG

Figure 33. Pre-visit Phase - Provoke curiosity

Next, the students are asked to answer certain questions on electrical energy and renewable energy resources. For the teacher's guidance, documents and links with information and guidance related to the questions asked are provided in this section.

Define questions from current knowledge



How is electrical energy mainly produced today?

- *lignite power plants*

Are there any other ways for producing energy? If yes, can you name them?

- *alternative ways for producing energy*

The energy resources are divided in two categories according to the source used. Can you name these two categories?

- *renewable and non-renewable energy sources*

Is electricity really *necessary*?

Coal and petroleum reserves are expected to be exhausted within the *next 50 years*. If that occurs, will it be feasible to continue in the same *modus vivendi*?

Please indicate the *methods you adopt* to save energy.

Figure 34. Pre-visit Phase - Define questions

Following that, the teacher is urged to ask students some questions, in order to clarify whether they have mixed their knowledge on photovoltaics and wind turbines with conceptual misunderstandings. Again, documents on the respective myths and truths are provided in this section for the teacher's guidance. This and the previous activity help the teacher comprehend the knowledge ability of students on the examined matter.

Propose preliminary explanations or hypotheses



The teacher is asked to indicate and confront possible misconceptions in the classroom, and then lead the students to propose possible explanations to the questions raised from the previous activity.

The most common questions concern **photovoltaics** and **wind turbines** and are known as "myths". The goal of this exercise is to assist students to overcome the misunderstandings.

- Both solar and wind energy are unreliable.
- Each one of the energy sources is the ultimate solution to the energy problem.

A general discussion is proposed to help students build a strong base to discuss the matter within their teams in the next phases.

Figure 35. Pre-visit Phase - Propose explanations

Just before the visit phase, the teacher organizes the students in work groups, each of which is assigned to answer specific questions. Students are offered some resources, while they are also informed on the way they will be expected to present their findings; more specifically, each group will form a card board and complete it with arguments in favor and against each form of renewable resource.

Plan and conduct simple investigation



Plan and conduct simple investigation

The teacher divides students in four groups: two occupied with solar energy and two occupied with wind energy (advantages-disadvantages-operation). With material found on the World Wide Web and especially from [Europeana](#), the teacher directs the students to look for answers to the questions already posed.

The students are given 2 days to perform their research and then return to their teams with their findings. Through this team work they will create a card board with the information discovered, and their thoughts, which they will enrich during the visit to the museum.

Figure 36. Pre-visit Phase - Plan investigation

The school group visits the museum chosen. Here, the students will experiment with the exhibits and play an online interactive game. Then they will be separated in the work groups indicated in the previous stage and start looking for information on the questions assigned to them.

RENEWABLE, GREEN, CLEAN? Wind Energy & Solar Energy (PV)

Last Modified: 01/07/2011

Introduction Pre-visit Phase **Visit Phase** Post-visit Phase

Visit Phase

Gather evidence from observation

The students visit the "Energy Challenge" section of GAIA Centre - Goulandris Natural History Museum, which deals with renewable resources and the use and abuse of energy at the modern world. Each team is asked to recognize the exhibit related to their personal research:

- photovoltaic
- wind turbine

During their visit, the students are expected to complete three actions with their teams:

- First of all, they will experiment with the exhibits and with the teacher's assistance they will come to a conclusion in regards to the operation mode of each energy production appliance (photovoltaics - wind turbines).
- Secondly, they will seek information in the space to enrich the context of their boards.
- Thirdly, they will use a cell phone with Internet connection to play an online energy-related game.



Supporting Materials

NATURAL EUROPE

Wind Turbines Gaia center exhibit

PV Gaia center exhibit

EUROPEANA

ADD YOUR TAG

Figure 37. Visit Phase - Gather evidence

When the work groups have collected the information needed, they work together to format their card board and complete it with the information discovered.

Explanation based on evidence



Following experimentation and quest, the time for team discussion has come. The students are asked to work together and, based on the information collected, come to a conclusion on the questions posed by the teacher.

Students form their card boards, which they will have to present to their classmates later on.

Figure 38. Visit Phase - Explanation based on evidence

Having finished that, students are expected to examine the alternative energy resources exhibited in the same wing and compare them to the renewable source form they were asked to examine, also discussing them with the museum educator.

Consider other explanations



In the "Energy challenge" section of GAIA Centre alternative renewable energy sources examples are presented. The teacher discusses the possibility that there be a more efficient option than wind or solar energy. In this scope, the students are asked to examine the other options and respective exhibits to come to a conclusion. Regarding nuclear energy, which is the most controversial energy form, examples such as Fukushima and Chernobyl can be used to better explain the subject.

Figure 39. Visit Phase - Other explanation

Upon return to school, the different work groups will present their card boards with their findings to each other. When this discussion is completed, the teacher focuses on the subject of alternative energy sources and especially nuclear energy.

RENEWABLE, GREEN, CLEAN? Wind Energy & Solar Energy (PV)
 Last Modified: 01/07/2011

Introduction
 Pre-visit Phase
 Visit Phase
 Post-visit Phase

Post-visit Phase

Communicate explanation



Based on the research findings, the teams are expected to complete and perfect their card boards, and present them to the rest of the class.

Following the presentations' conclusion, students under the teacher's guidance will discuss and vote the energy source which they consider better.

The teacher continues the talk related to nuclear energy that was initiated in GAIA Centre. The extend of destruction caused today from power plants should be pointed out here, to help students understand the necessity for finding a viable solution.



Supporting Materials

NATURAL EUROPE

EUROPEANA

ADD YOUR TAG

Figure 40. Post-visit Phase - Communicate explanation

The educational activity is almost completed now; in the final stage students will engage in hands-on activities that will help them better understand the operation of solar energy and wind energy constructions. To complete them, they will work in the same groups they have been cooperating with since the beginning of the activity.

Follow-up activities and materials

Following discussion, the students are divided in two groups (solar energy - wind energy), according to the subject they examined in the previous stages. Each team, under the teacher's instructions and guidance, will construct a model: the "solar energy" team will create a model operating with solar energy, whereas the "wind energy" team will create a model operating with wind energy.

Each team will experiment with their model and use it to demonstrate its operation to the other team.

After the completion of this hands-on activity, students are expected to have formed an overall view on the two energy resources (construction - operation - advantages and disadvantages - alternatives).

- guide to constructing a model - understanding solar energy
- guide to constructing a model - understanding wind energy

Sustainable contact

Ellinogermaniki Agogi
Research and Development Department

Vassiliki Markaki
vmarkaki@ea.gr

Figure 41. Post-visit Phase - Follow-up

Evaluation

The Natural Europe portal allows you to participate by rating resources and educational pathways and sharing your opinion adding social tags.

Follow-up

Participants should test their knowledge by designing innovative Educational Pathways, using the online software tool created by the Natural Europe project, the Natural Europe Pathway Authoring Tool (http://education.natural-europe.eu/natural_europe).

Links

- Natural Europe project, <http://www.natural-europe.eu/>
- For step by step instructions on how to create your own pathways online, please use the Natural Europe Pathway Authoring Tool Manual: <http://wiki.agroknow.gr/agroknow/index.php/Resources>.

6.2.4 Module example 4: Approach for Developing Technology Enhanced Educational Scenarios Templates: The Natural Europe Educational Pathway Template case

Details:

In this learning module, the teachers will be introduced to an Approach for Developing Technology Enhanced Educational Scenarios Templates and more specifically in the case of the template used in the context of the Natural Europe project entitled “Natural Europe Educational Pathway” Template. The teachers will be introduced to the Inquiry Based Science Education (IBSE) approach and thus work on the mapping of teaching phases with the template activities description, experiencing the development of learning designs.

Pedagogical objectives

This module aims at introducing teachers to the methodology of learning design and specifically using a scenario template following the inquiry-based approach to teaching and the combination of classroom activities with physical or virtual visit to Natural History Museums.

Process

Trainees are presented the Approach for Developing Technology Enhanced Educational Scenarios Templates and specifically the use case of the Natural Europe Educational Pathway. As a follow up practice participants can use the Natural Europe Authoring tool in order to create their own pathway and share it with the community, but also make use of a large collection of pathways, digital resources and collections available on the NE Repository.

The Natural Europe Educational Pathway Template

The Inquiry-based model presented applied to science education leads to an approach most often referred to as Inquiry Based Science Education (IBSE), mostly applied to science of nature and technology.

In order to facilitate the integration of NE Educational Pathways in the classroom and to encourage teaching practices built around the observation of objects or phenomena in the natural world, in our case, in Natural History Museums, we propose a Template with **five (5) stages** that correspond to the three steps of the NE Educational Pathway (Pre-visit, Visit and Post-visit). The proposed template is also based on the highly successful model used in Open Science Resources European project (www.opensciencesources.eu/).

The five Teaching phases of the NE Educational Pathways are:

- **Question Eliciting Activities:** the teacher will *provoke curiosity* and try to attract students' attention by presenting or showing them appropriate material. The teacher will try to engage the students with the help of *scientifically oriented questions*.
- **Active Investigation:** Students *propose some possible explanations to questions* that emerged from the previous activity. The teacher identifies possible misconceptions. Students *give priority to evidence, which allows them to develop explanations* to address scientifically oriented questions. The teacher acts as a facilitator.
- **Creation:** Teacher divides students in groups. Each group of students *formulates and evaluates explanations from evidence* to address scientifically oriented questions.
- **Discussion:** The teacher *gives the correct explanation* for the specific research topic. Each group of students *evaluates its explanations* in light of alternative explanations, particularly those reflecting scientific understanding.

- **Reflection:** Each group of students *produces a report with its findings, presents and justifies its proposed explanations* to other groups and the teacher.

Table 3 presents the NE Educational Pathway Template illustrating the connection between the three Pathway steps and the five Teaching phases.

Pathway step	Teaching phase	Steps
Pre-visit	1. Question Eliciting Activities	Provoke curiosity
		Define questions from current knowledge
	2. Active Investigation	Propose preliminary explanations or hypotheses
		Plan/ conduct simple investigation
Visit	3. Creation	Gather evidence from observation
	4. Discussion	Explanation based on evidence
		Consider other explanations
Post-visit	5. Reflection	Communicate explanation

Table 3. The Educational Pathway template

Follow up:

Participants should test their knowledge by designing innovative Educational Pathways, using the online software tool created by the Natural Europe project, the Natural Europe Pathway Authoring Tool (http://education.natural-europe.eu/natural_europe/).

Links:

- Natural Europe project, <http://www.natural-europe.eu/>
- For step by step instructions on how to create your own pathways online, please use the Natural Europe Pathway Authoring Tool Manual: <http://wiki.agroknow.gr/agroknow/index.php/Resources>.



7. Training for each case

7 TRAINING FOR EACH CASE

7.1 Teachers training

Table 4 presents the overall training modules and in which cases can be used. The modules will be available at the LD-Skills portal <http://www.ea.gr/ep/ld-skills>.

Topic Area		Topic	Beginner	Average	Expert	Trainees	Pedagogically focused	Generic
Introduction	1	Introduction to Technology Enhanced Learning (TeL)	☑	~		Teachers	☑	☑
	2	eLearning Model	☑	~		Teachers		☑
	3	An introduction to Learning Design	☑	~		Teachers		☑
	4	Issues related to Copyright and Intellectual Property Rights			☑	Teachers		☑
IBSE principles, skills, ideas	5	The inquiry-based approach	☑	~		Teachers	☑	☑
	6	Types of Inquiry Activities	☑	~		Teachers	☑	☑
Learning Resources, Repositories and Metadata	7	Practical demonstration of learning resources and their classroom use	☑	~		Teachers	☑	☑
	8	Introduction to learning design repositories and learning communities (ratings, comments)	☑	~		Teachers		☑
	9	Review and demonstration of popular learning design repositories	☑	☑		Teachers	☑	☑
	10	Introduction to educational metadata, metadata-based searching, metadata schemas (IEE LOM, DC-ed)		☑		Teachers		☑
	11	Social metadata and Web 2.0 tools (folksonomies and social tagging)		☑		Teachers		☑
Learning Activities	12	Learning activities definition	☑	~	~	Teachers	☑	☑
	13	Approach for Developing Technology Enhanced Educational Scenarios Templates	☑	~		Teachers	☑	☑
	14	IBSE Activity Scenario Templates and the concept of the Educational Pathway	☑	~		Teachers	☑	☑
Learning Courses/ Lesson Plans	15	Designing an eLearning Course	☑	~		Teachers		☑
	16	Demonstration of Learning Courses based on the IBSE templates	~	☑		Teachers	☑	☑
Learning Programmes	17	Popular tools for electronic classroom/ content management systems	☑	~		Teachers	☑	☑
Assessment	18	Problem-solving Competences	☑	~		Teacher	☑	☑
	19	PISA assessment framework for assessing students' acquired problem-solving competences	~	☑		Teachers	☑	☑

Topic Area		Topic	Beginner	Average	Expert	Trainees	Pedagogically focused	Generic
Hands-on sessions	20	Pedagogical strategies and best practices for using digital teaching and learning resources in the classroom	~	☑		Teachers	☑	☑
	21	Practical examples of learning resource descriptions with educational metadata			☑	Teachers	☑	☑
	22	Searching and retrieving learning resources through dedicated portals (such as COSMOS, OSR, Natural Europe)	☑	~		Teachers		☑
	23	Hands-on session working on resources related to science education (use of COSMOS, OSR, Natural Europe)			☑	Teachers	☑	☑
	24	Supporting teachers to share resources through social tagging in portals (such as OSR, Natural Europe)	~	☑	☑	Teachers		☑
	25	Scenarios with the use of educational software related to science education			☑	Teachers	☑	☑
Technical session [Optional]	26	Introduction to Web 2.0 tools for encouraging the sharing and use of developed inquiry-based activities and the support of teachers' communities of practice			☑	Teachers, ICT Staff		☑
	27	Introduction for teachers to set up and use metadata authoring tools in order to describe their resources with metadata			☑	Teachers, ICT Staff		☑
	28	Introduction for teachers to set up and use learning design authoring tools in order to describe the scenario they developed			☑	Teachers, ICT Staff		☑
	29	Introduction for uploading content in a Content Management System or dedicated repositories			☑	Teachers, ICT Staff		☑

Table 4. LD-skills training modules



8. Training Content Requirements

8 TRAINING CONTENT REQUIREMENTS

8.1 Format of the training material

The traditional seminar material will comprise of slides online available through Slideshare, as well as detailed supporting notes.

8.2 Development of the training material

The training material is to be developed as follows:

- Initial version to be developed in English with partners responsible for specific areas of the training curriculum (partners will work on particular aspects of the curriculum that they have particular expertise in).
- Revised version of the training material to be developed following comments on the initial version by all partners.
- Partners to agree on revised version of the content.
- Each individual partner country to then add specific local content and examples to the generic material that has been developed in order to provide the practical input that local teachers really benefit from.

8.3 On-line Blogs

Each individual LD-Skills partner country will be required to develop their own on-line blogs. These will provide an opportunity for teachers to share experiences of creating and implementing lesson plans and discussing the results from the renewed teaching practice.

8.4 On-line knowledge Repository

In contrast, the knowledge repository, located at the LD-Skills project site would provide a number of essential supporting documents to help teachers. It was decided that this portfolio of resources should include the following:

- **FAQs:** Frequently Asked Questions.
- **Articles:** For example, on European state-of the art reports regarding Learning Design.
- **Guides:** Such as “How to register to the LD-Skills portal?”
- **Demos:** For instance, demos on using Learning Design Tools used during the training.

8.5 On-line Sessions

Each partner country will also run an on-line session with a number of teachers. This process will involve inviting teachers to try out the tasks, as well as to find relevant training material within the LD-Skills Portal. They will also be encouraged to use the blog to contact their trainer should questions or difficulties arise or if they have a comment to make. The participating teachers will also be required to evaluate the training programme and the LD-Skills Portal.



9. Conclusions

9 CONCLUSIONS

This deliverable arises from user needs analysis results which are summarized in a trainee's guide, and is summarizing both the case study specific aspects and the generic patterns arising from the previous work. This is made available both as a printed document, as well as in electronic format. The report presents a guide containing a description of the participating case studies and the general characteristics/ patterns that differentiate the case. For each case study, there will also be a list of relevant educational activities especially designed for this class of school environments.

This deliverable is addressed to project partners and the school teachers all around Europe and contains a description of the participating case studies and the general characteristics/ patterns that differentiate the case. For each case study, there is also a list of relevant educational activities especially designed for this class of school environments.

This deliverable was designed in order to help teachers' professional development in:

- Stimulating new approaches to teaching and learning (e.g. inquiry and problem-based learning) as a means of strengthening students' acquisition of learning skills.
- Developing a training framework for helping teachers to engage in learning practices using appropriate educational design tools whilst ensuring that the framework is based on sound pedagogic principles.
- Training teachers about the best ways of representing and sharing lesson plans for articulating complex educational intentions and outcomes in multiple environments such as face-to-face, online and other technology mediated learning.
- Developing a community of practice that will facilitate the sustainability of the project.
- Developing teachers' training materials in terms of creating training scenarios that will demonstrate how educational content and ICT tools may be used for enhancing students' problem-solving skills.

For further future development of the teachers training the project will develop more this deliverable that will be published at the end of the project and is expected to briefly present the project, its implementation, and its main outcomes, as well as discuss benefits and recommendations for the further application, improvement and integration of the project results in training policies and practices. This deliverable will be made available from the project web site, and will be communicated to the networks of the project members.

To sum up with certain conclusions for future projects the answer is that there are definitely quite many people eager to implement ambitious ICT projects, in our case many of them are teachers, which is very optimistic itself as parameter, given that teacher can and should work as change agents in a school society. Under this perspective certain focus should be placed in the development of human resources and training facilities widely available for the acquisition of skills, which would guarantee sustainable development of teacher communities.

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ANNEX A:

A review of currently applied blended learning approaches

1. Introduction - what is blended learning?

Blended Learning is a further development of e-learning and traditional face-to-face educational systems and consists in a combination (“mix”) of multiple approaches to learning, involving different methodologies, technologies, media and environments. Typically, e-learning uses electronic media, applications and processes in different forms: Web-Based learning/Training (WBT), Computer-Based learning/Training (CBT), virtual classrooms, digital collaboration, on-line seminars.

In addition to this, Blended Learning can be accomplished through the use of both virtual and physical resources – e.g. combinations of electronic and printed materials and traditional face-to-face on-line sessions.

The main advantage of using Blended Learning is the possibility to build/create the most effective and efficient learning process to gain required knowledge and skills, combining the information widely and precisely diffused by electronic means with the direct contribution of teachers and the opportunity of developing practical experience.

With today's prevalence of high technology in many countries, blended learning often refers specifically to the provision or use of resources which combine e-learning (electronic) or m-learning (mobile) with other educational resources.

Some would claim that key blended-learning arrangements can also involve e-mentoring or e-tutoring. These arrangements tend to combine an electronic learning component with some form of human intervention, although the involvement of an e-mentor or an e-tutor does not necessarily need to be in the context of e-learning. E-mentoring or

e-tutoring can also be provided as part of a “stand alone” (“un-blended”) e-tutoring or e-mentoring arrangement.

It should also be noted that some authors talk about “hybrid learning” (this seems to be more common in Northern American sources) or “mixed learning”. However, all of these concepts broadly refer to the integration (the “blending”) of e-learning tools and techniques with traditional methods. Two important factors to consider are the time spent on online activities and the amount of technology used.

The term “blended learning” can also be used to describe arrangements in which “conventional”, offline, non-electronic based instruction happens to include online tutoring or mentoring services. This combination of e-tutoring plus conventional learning, although it is a perfectly valid example of blended learning, is the “opposite way round” to most current blended learning arrangements, in that the solution is driven by conventional learning techniques, not by the electronic techniques.

2. Blended learning concepts

Blended Learning concerns not only different methods, but also different theories of learning and applies these theories by using traditional and new media. It affects different levels:

- the theoretical level (combining different theories of learning, like constructivism, cognitivism, behaviorism)
- the methodical level (combining self-directed with instructor-led learning, individual with cooperative learning, receptive with explorative learning, etc.)
- the level of the media (combining face-to-face with on-line elements; using different media, like books, video, CBT, etc.)

A formal classification of learning scenarios based on the criteria of form, function and method, may help to structure different potential blended learning concepts.

“Form” describes the organisational form of e-learning and its integration into institutions. Organisational forms can be traditional classroom sessions or pure e-learning.

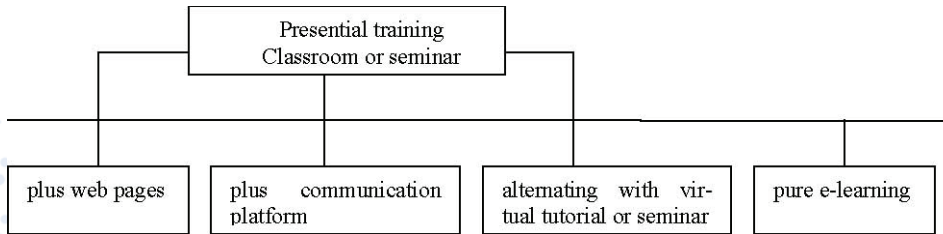


Figure 1: Organisational forms of e-learning

“Function” might be mere information, direct communication or synchronous co-operation.

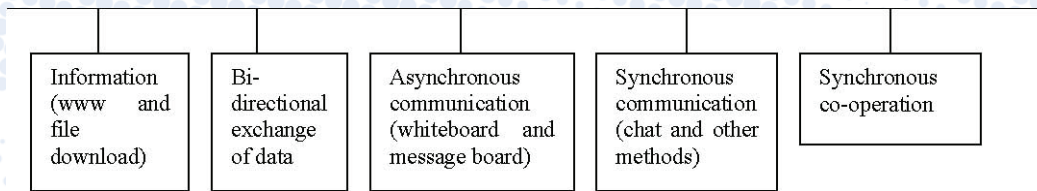


Figure 2: Functions of learning

“Method” refers to the different theories of learning and comprises instructor-led training, interactive courses or self-directed learning.

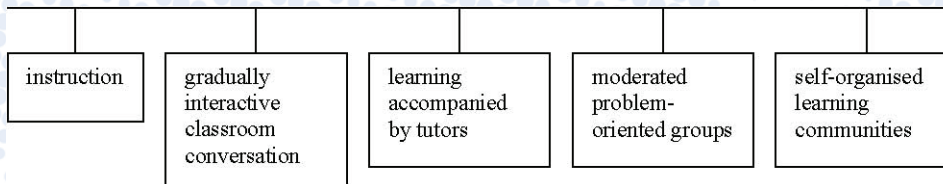


Figure 3: Methods of learning

Combining the above three concepts leads to four different learning scenarios (Tables 1-4).

	Presential component	Virtual component
Form	Priority given to classroom training	Web components additionally used
Function	Varying	Information
Method	Varying	Instruction

*Table1. Classroom training accompanied by web components (priority given to classroom training)
(Scenario I)*

	Presential component	Virtual component
Form	Classroom training equally important	Website and platform equally important
Function	varying	Information and communication
Method	varying	Instruction, tutor support

Table 2. Equal importance of classroom training and web components (Scenario II)

	Presential component	Virtual component
Form	Classroom training integrated	Website and Platform integrated
Function	varying	Information and co-operation
Method	varying	Moderated groups

*Table 3. Integration of presential and virtual component
(Scenario III)*

	Presential component	Virtual component
Form	No classroom training	platform, cooperative tools
Function	Not applicable	communication and co-operation
Method	Not applicable	Groups and learning communities

*Table 4. Virtual seminars and learning communities (no presential activities)
(Scenario IV)*

While answering the question what kind of scenario should be used the crucial issues are preferences of the target group. If e-learning is not a preferable solution of trainees then scenario I is recommended. While planning to develop training which can be easily repeated (repository of training materials ready for reusing) most suitable solution is scenario II or III. Virtual seminars and learning communities (scenario IV) is the best solution while thinking about future and building links between trainees and experts.

3. Blended learning models

Blended learning can be categorised into three models (Valiathan, 2002):

- skill-driven learning, which combines self-paced learning with instructor or facilitator support to develop specific knowledge and skills;
- attitude-driven learning, which mixes various events and delivery media to develop specific behaviours;
- competency-driven learning, which blends performance support tools with knowledge management resources and mentoring to develop workplace competencies.

In Table 5 the following questions are answered:

- What are the key features of each approach?
- In which situations is an approach adopted?
- What blended techniques can be adopted to enhance learning?

Model	Why	How
Skill-Driven	Learning specific knowledge and skills requires regular feedback and support from the trainer, facilitator, or peer.	• create a group-learning plan that's self-paced but bound to a strict schedule • pad self-paced learning material with instructor-led overview and closing sessions • demonstrate procedures and processes through synchronous online learning labs or a traditional classroom setting • provide email support • design long-term projects
Attitude/ behaviours-Driven	Content that deals with developing new attitudes and behaviors requires peer-to-peer interaction and a risk-free environment.	• hold synchronous Web-based meetings (Webinars) • assign group projects (to be completed offline) • conduct role-playing simulations
Competency-Driven	To capture and transfer tacit knowledge, learners must interact with and observe experts on the job.	• assign mentors • develop a knowledge repository (LCMS/LMS)

Table 5. Blended learning models

Skill-driven model

Blended learning that's skill-driven mixes interaction with a facilitator through email, discussion forums, and face-to-face meetings with self-paced learning, such as Web-based courses and books. This type of approach is analogous to a chemical reaction, in which interaction with the instructor or facilitator acts as a catalyst to achieve the desired reaction-learning.

According to a 2000 survey by the Masie Center, 88% of learners and 91% of managers recommend that the trainer or facilitator be an active part of the online training program. Survey respondents placed a high value on having the trainer monitor progress and contact the learner, evaluate online project work, build and facilitate an online community for the course participants, and be available via email or threaded discussion to respond to content questions. It's clear that combining self-paced learning with facilitator support keeps the learner from feeling isolated, which assists in the successful completion of the self-paced modules. Indeed, this approach works best when people are learning content at the knowledge or application levels.

Techniques to incorporate skill-driven blended learning include:

- creating a tightly scheduled group learning plan;
- using instructor-led overview and closing sessions;
- using synchronous learning labs;
- providing support to learners through email.

Attitude/behaviours-driven model

This approach blends traditional classroom-based learning with online collaborative learning events. At times, the nature of the content, as well as the desired outcome (developing attitudes and behaviour) necessitates the inclusion of collaborative learning that's facilitated through face-to-face sessions or technology-enabled collaborative events. Developers should use this approach to teach content that requires learners to try out new behaviours in a risk-free environment. For example, soft skill courses that require role playing a performance evaluation or negotiating with a customer should employ a behaviour-driven approach. Activities that developers should incorporate into the overall learning experience include discussion forums, Webinars, group projects, and online debates that use chat modules.

Competency-driven model

The success of knowledge workers depends on how quickly employees make decisions in the work place. While part of the decision-making process is guided by common facts and working principles, people also need tacit knowledge that's often retained by experts. Learning that facilitates the transfer of tacit knowledge requires a competency-driven approach. Because people absorb tacit knowledge by observing and interacting with experts on the job, activities may include a blend of online performance support tools with live mentoring.

It is recommended using all three models. Poor design of blended learning material can lead to much poorer learning results in a blended environment compared with a single method delivery. Several authors developed frameworks to react to this challenge (Moebs and Weibelzahl, 2006). Wenger and Ferguson (2006) describe how they have come up with a framework to guide the design and deployment of trainings and courses. It reflects the idea that most learning environments are blended already, considering that even a classroom-only course incorporates a variety of different learning modalities.

Their approach consists of three steps:

- In a first step the learning ecology matrix was developed. The x-axis illustrates the focus on the delivery of instruction that varies from “content delivery focus” to “experience and practice focus” and the y-axis illustrates who controls the navigation of the learning process which varies from “guided navigation” to “learner self-navigation”.
- In a second step four general learning modalities are included, studying, practicing, teaching and coaching. These modalities do not refer especially to either classroom or e-learning, but are rather applicable to both.
- In a last step the matrix is completed with distinct instructional, learning and knowledge elements.

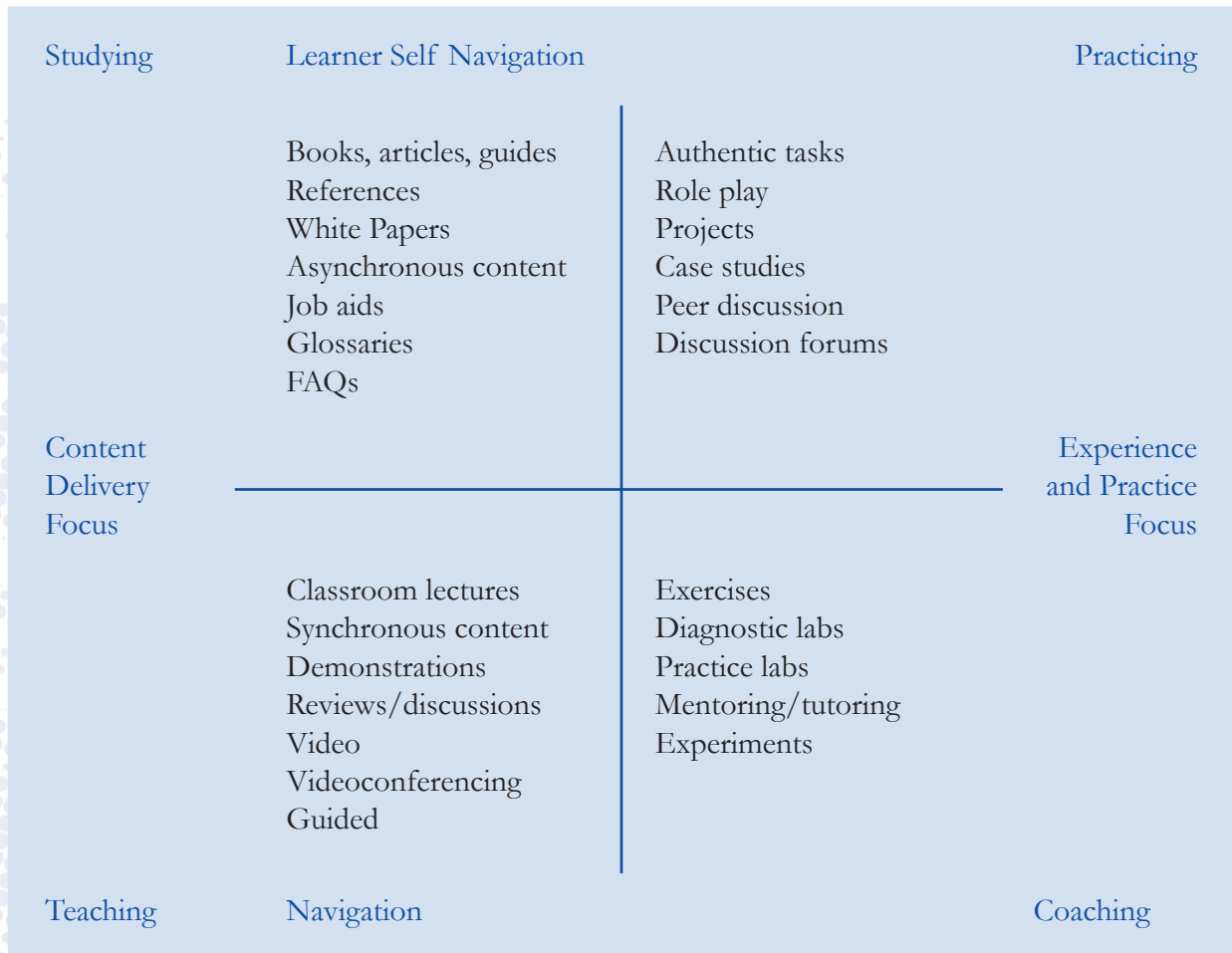


Figure 4. Sun Learning Ecology Matrix (Wenger and Ferguson, 2006)

The learning ecology matrix aims at delivering a high quality learning experience and to provide control over the learning experience for both, the learner and the instructor. It strives at combining formal and informal learning rather than positioning them as opponents. The social nature of learning has to be considered in all learning elements.

The aspect of cost-effectiveness is recognised, but merely in the sense that any project aims at a combination of learning outcomes at a total minimum cost.

It is intended to be used to provide guidance for the selection of delivery methods, considering the learning needs as well as available resources. Benefits, difficulties, constraints, but also complementary methods are listed to provide the information necessary to develop the right blend. The generic framework is then applied to specific learning needs.

Finally link to blinc (Blended Learning Institutions' Cooperative is recommended) which is the umbrella organisation of a transnational network for developers, experts and users of Blended Learning products and services (e.g. courses, modules, learning objects) is recommended.

The blinc cooperative has been developed in the framework of the “eL3” project funded by the EU and it is an exchange instrument for producers and users of blended learning and offers a platform for exchange of know-how and experiences and the dissemination, marketing and distribution of their services and products.

The blinc information consists of four links:

- In the “Blended Learning Literature Database” currently more than 75 articles about blended learning issues are located.
- Under the point “blinc Publications” articles and scientific studies on blended learning established by authors of blinc community are located.
- Under the link “Web Based Tools for Evaluation and Planning of Blended Learning” assessment and evaluation instruments are made available as online or offline tools for blended learning practitioners and have already been introduced in several other European projects and courses.

NOTES

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