

Developing online courses for an environmental portfolio

Theodor Panagiotakopoulos¹, Achilles Kameas¹, Ioannis Kalemis¹

Abstract: Global as well as European political agendas are investing heavily on an increased and sustainable use of natural resources towards reducing the environmental impacts associated with energy production and usage. The EPOQUE (Environmental PORTfolio for Quality in University Education) project addresses the necessity for building up the capacities of future professionals in the field of sustainable usage of natural resources proposing an environmental portfolio that consists of four courses, which will lead to a degree equivalent to MSc. A main objective of the EPOQUE project is to deliver an online version of its portfolio to support an e-learning process. This paper presents the e-learning framework that served as the basis for constructing the EPOQUE online courses and provides insight into the structuring of the 3rd online course of the EPOQUE portfolio, analyzing its contents and associated learning material. It then focuses on presenting the e-platform that was developed and implemented to support students and educators throughout the e-learning process and describing the results of the evaluation both of the EPOQUE's online Course III and the EPOQUE e-learning platform. The feedback we received is very encouraging, while revealing several opportunities for improvement mainly concerning the platform's functionality and content presentation.

Keywords: environmental portfolio, online courses, e-learning

Αναπτύσσοντας ηλεκτρονικά μαθήματα για ένα περιβαλλοντικό χαρτοφυλάκιο

Θεόδωρος Παναγιωτακόπουλος, Αχιλλέας Καμέας, Ιωάννης Καλέμης

Περίληψη: Οι παγκόσμιες και ευρωπαϊκές πολιτικές ατζέντες επενδύουν σε μεγάλο βαθμό στην αυξημένη και βιώσιμη χρήση των φυσικών πόρων για τη μείωση των περιβαλλοντικών επιπτώσεων που συνδέονται με την παραγωγή και τη χρήση της ενέργειας. Το έργο EPOQUE (περιβαλλοντικό χαρτοφυλάκιο για ποιότητα στην πανεπιστημιακή Εκπαίδευση) ανταποκρίνεται στην ανάγκη της κατάρτισης των μελλοντικών επαγγελματιών στον τομέα της βιώσιμης χρήσης των φυσικών πόρων, προτείνοντας ένα περιβαλλοντικό χαρτοφυλάκιο που αποτελείται από τέσσερα μαθήματα, τα οποία οδηγούν σε τίτλο ισοδύναμο με MSc. Ένας κύριος στόχος του έργου EPOQUE είναι η δημιουργία μιας ηλεκτρονικής έκδοσης του χαρτοφυλακίου του για την υποστήριξη μίας διαδικασίας ηλεκτρονικής εκμάθησης. Αυτή η εργασία παρουσιάζει το πλαίσιο ηλεκτρονικής εκμάθησης, που χρησιμοποιήθηκε ως βάση για την κατασκευή των ηλεκτρονικών μαθημάτων EPOQUE και παρουσιάζει τη διάρθρωση του τρίτου ηλεκτρονικού μαθήματος του χαρτοφυλακίου EPOQUE, αναλύοντας το περιεχόμενο και το σχετικό εκπαιδευτικό υλικό του. Στη συνέχεια, επικεντρώνεται στην παρουσίαση της ηλεκτρονικής πλατφόρμας που αναπτύχθηκε και εφαρμόστηκε για να υποστηρίξει τους φοιτητές και τους εκπαιδευτικούς σε όλη τη διαδικασία της ηλεκτρονικής εκμάθησης και στην περιγραφή των αποτελεσμάτων της αξιολόγησης τόσο του τρίτου ηλεκτρονικού μαθήματος του χαρτοφυλακίου EPOQUE όσο και της ηλεκτρονικής πλατφόρμας

¹ Hellenic Open University, Greece.

Corresponding author: Achilles Kameas, E-mail: kameas@eap.gr

EPOQUE. Η ανάδραση που λάβαμε είναι πολύ ενθαρρυντική, ενώ αποκάλυψε αρκετές ευκαιρίες βελτίωσης, κυρίως όσον αφορά στη λειτουργικότητα και την παρουσίαση του περιεχομένου της πλατφόρμας.

Λέξεις κλειδιά: περιβαλλοντικό χαρτοφυλάκιο, ηλεκτρονικά μαθήματα, ηλεκτρονική εκμάθηση

Introduction

Global as well as European political agendas are investing heavily on an increased and sustainable use of natural resources towards reducing the environmental impacts associated with energy production and usage. Reducing energy consumption and eliminating energy wastage are among the main goals of the European Union. To meet these objectives, several studies have been carried out, such as the roadmap to a resource efficient Europe (European Commission, 2011) that outlines the ways to move into a more sustainable economy in Europe by 2050. It proposes ways to increase resource productivity and decouple economic growth from resource use and its environmental impact and illustrates how policies interrelate and build on each other.

Contextualized in this framework, the EPOQUE (Environmental PORTfolio for Quality in University Education) project addresses the necessity for building up the capacities of future professionals in the field of sustainable usage of natural resources. It aims at developing an environmental portfolio ready to be integrated into the syllabuses of Higher Education Institutes (HEIs) shaping a new generation of environmental-friendly (green) teachers, scientists, and engineers in the context of higher education modernization agenda connected to SMEs and organizations (including schools).

Based on a structured research process that took into account the current situation of the environmental topics that are already part of the curriculums of HEIs in Greece, Finland and Italy and what adult education providers offer in Malta and Austria, the EPOQUE project proposed an environmental portfolio that consists of four courses which would lead to a degree equivalent to MSc:

- Course I: Participatory methods in sustainable management of natural resources
- Course II: Current state and future of the Baltic and Mediterranean Area in an interdisciplinary perspective
- Course III: Entrepreneurship-Intelligent energy
- Course IV: Applied Energy management systems in/for organizations (including schools)

Each of the four previously described courses is composed of 4 modules, the last of which is a case study. Each module consists of several topics covering different environmental aspects. Some indicative examples of these topics are participatory action research, practical applications in the sustainable management of natural resources, nature–biodiversity, eco/green-enterprises, intelligent energy and energy management systems. A main objective of the EPOQUE project was to deliver an online version of the entire EPOQUE portfolio, in order for the developed courses to be offered through an e-learning process.

This paper presents the e-learning framework that served as the basis for constructing the EPOQUE online courses and provides insight into the structuring of the 3rd course of the EPOQUE portfolio, analyzing its contents and associated learning

material. It then focuses on presenting the e-platform that was developed and implemented to support students and educators throughout the e-learning process and highlights the results of the evaluation both of the EPOQUE's online Course III and the EPOQUE e-learning platform.

E-learning framework

Having specified the EPOQUE courses, the next step was to determine how to deliver these to students in an online format. For this purpose, we initially focused on defining the e-learning process framework, where we took into account the following facts:

- According to the ECTS handbook (European Commission, 2015), a year of study contains 1.500 – 1.800 hours of study, 1 ECTS corresponds to 25-30 hours of study and an MSc course awards 60-120 ECTS
- The proposed EPOQUE courses award 15 ECTS each (the portfolio awards 60 ECTS in total) and each course contains approximately 450 hours of study. Thus the entire EPOQUE portfolio is marginally equivalent to an MSc course.
- There are no cognitive dependencies among the four courses, that is, students can take any course at any time and any order
- Online courses are structured based on the allocation of study effort on a weekly basis. The literature suggests the allocation of 10 hours of study per week per course (Jarvis, 2012)

Based on the above, we did the following calculations:

- 1 ECTS corresponds to 3 weeks of study for the online course
- 1 module should expand over 9 weeks of study, with the exception of the case study (4th module), which expands over 18 weeks of study
- 1 course expands over 45 weeks of study (that is, almost one calendar year)

And we propose the following:

- There should not be any restriction on the number of courses a student can attend in parallel; this means that one could complete the entire portfolio in one year if one chooses to attend all four courses in parallel. This would create a maximum study effort of 40 hours per week, which is acceptable. Students with less available time could choose a more relaxed approach.
- Each course should require a fixed 450 hours of study.
- The contents of each course will be structured on a weekly basis breaking down study effort in 10 hour chunks. One indicative structure per a 90 hours of study (=9 weeks) module could be:
 - 30 hours (=3 weeks) of study, further broken down as follows:
 - 1-3 hours of lecture per week (a total of 3-9 hours of lecture): lectures will be based upon powerpoint presentations or can be freely available third party online lectures,
 - 7-9 hours of study per week (a total of 21-27 hours of study): during these, the students will study resources (i.e. papers, web sites, reports, videos, etc) that we shall propose,
 - In this part, one can include collaborative activities, face to face meetings or teleconferences (i.e. 2 hours per week).
 - 30-40 hours of intermediate assessment projects (at least two): could include online tests, MCQ, etc, as well as project work.

- 20-30 hours of final assessment project: same as above.

As mentioned above, and according to principles of adult education, the e-learning process is structured on a weekly basis, where each week corresponds on a study effort of 10 hours (per course). In addition, an important element is to provide students with the Learning Objects (LObj) that they should study per week. To achieve these, two major activities were performed: instructional planning and development of appropriate learning material.

Instructional planning (Brown & Green, 2011) requires you to break down instruction in “chunks” (alternatively topics, learning modules - we will use the term topics hereafter): The smallest topic would last one week and require a 10 hour study effort (see Figure 1 for the e-learning process with respect to duration in weeks). Of course, there can be larger topics (multiples of 10 hours), but in our approach we chose to avoid smaller topics, as this may impose difficulty in planning and learning.

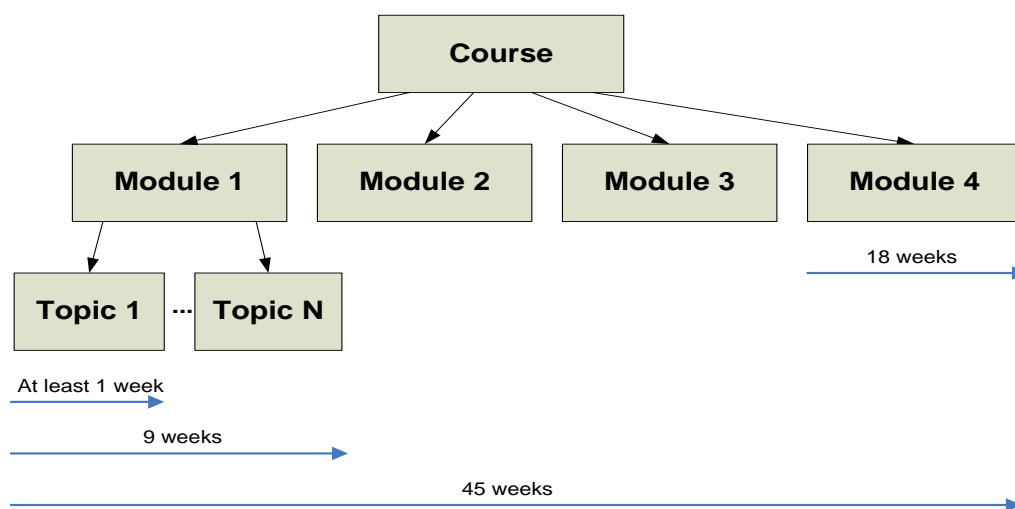


Figure 1. Graphical representation of the e-learning framework

Our basis of instruction is Learning Outcomes (LOut); students have to achieve a set of well-defined LOut per topic. The term “learning outcomes” refers to the set of knowledge, skills and/or competences an individual has acquired and/or is able to demonstrate after completion of a learning process, either formal, non-formal or informal (CEDEFOP, 2008). The actual methodology employed for expressing the learning outcomes adopted the following general guidelines:

- Use the ABCD / SMART (Mager, 1984) approaches in writing the learning outcomes.
- Each learning outcome should refer to one and only level in Benjamin Bloom’s taxonomy (Bloom, Engelhart, Furst, Hill, & Krathwohl, 1956; Anderson & Krathwohl, 2001).
- Avoid complicated sentences. If necessary use more one than one sentence to ensure clarity.
- Each learning outcome should contain one and only one action verb; use the list of verbs associated with each level in the taxonomy.
- Avoid vague terms like know, understand, learn, be familiar with, be exposed to, be acquainted with, and be aware of. These terms are associated with teaching objectives rather than learning outcomes.

- The learning outcomes must be observable, measurable and capable of being assessed.

The learning process uses educational material. This material is structured in LObjs; a LObj usually leads to the achievement of at least one LOut. Examples of LObj are text documents, presentations, videos, lectures, assignments, etc. In general, we avoided using educational resources (i.e. entire books, reports, websites, etc) as LObj, as they are too big; if you want to use such a resource, it is better to point to the exact chapters, sections, etc. that the student has to study, in order to achieve the specific LOut. Moreover, the material that has been produced for face to face teaching (which had been developed in the early stages of the EPOQUE project) and most of the material that can be found on the web are not suitable for online adult education; thus, adaptation is necessary.

In order to adapt the educational material for the needs of the e-learning process we followed a structured procedure using the following forms:

- The Course Instructional Plan (CIP) to be filled for each course that provides general information about each course (i.e. course name, modules, topics and learning outcomes for each module)
- A Weekly Study Programme (WSP) to be filled for each course to facilitate the instructional planning, which is an excel file providing a holistic view of the educational program of each course on a weekly basis (topic to be taught, associated educational material and activities, etc.)
- The Online Topic (OT) containing information about each topic within modules (e.g. duration in weeks, key concepts, learning outcomes, learning material, means of evaluation, etc.)
- The Resource Metadata (RM) describing the metadata for each learning material
- The Course Resource Index (CRI) that is a list of the resources used as learning material in the context of each course

Assessment is an integral part of the instruction and learning processes. In distance adult education, we encounter two forms of assessment: self-assessment and evaluation. The former is achieved by including in the instructional planning a set of assessment activities (i.e. multiple choice/true-false etc questions, reflection activities, assignments etc) that would allow the learner to assess his/her progress. To ensure course sustainability, it is advisable that it should be possible to automatically assess the learner's responses to these activities and provide automated feedback. On the other hand, the aim of evaluation is to conclude on whether the learner has achieved the LOut planned for the topic. Thus, a different set of activities is included, which matches exactly the topic's LOut; a checklist may help the learner identify the important points of the topic. In our approach, evaluation activities are to be assessed by a tutor (thus no automatic certification will be supported).

Course structuring and educational material

Based on the framework described in the previous section, we proceeded in structuring the online versions of the courses that would be appropriate for the needs of the e-learning process.

This section presents the structure of the 3rd online course that was developed in the context of EPOQUE and is entitled "Entrepreneurship – Intelligent Energy". This course describes the basic principles of entrepreneurship, as well as the concept of

Intelligent Energy. It then provides an overview of green entrepreneurship along with various application sectors and presents a relative business plan to provide learners with a case study of how green entrepreneurship is actually realized. Following the generic model of each course that is composed of 4 modules, we created the topics of each module as described in table 1.

MODULE	TOPIC
Module 1 - Intelligent energy	Topic 1 - Introduction to intelligent energy
	Topic 2 - The smart grid concept
	Topic 3 - Smart grid components and technologies
Module 2 - Green entrepreneurship	Topic 4 - Introduction to green entrepreneurship
	Topic 5 - Understanding the green entrepreneur
	Topic 6 - Marketing management – Green marketing
Module 3 - Green entrepreneurship application sectors	Topic 7 - Smart energy cities
	Topic 8 - Smart energy in buildings
	Topic 9 - Smart energy in transport
Module 4 – Case study	Topic 10 - Case study 1 – Philips lighting
	Topic 11 - Case study 2 – Yalumba wine company
	Topic 12 - Case study 3 – Elvis&Kresse
	Topic 13 - Case study 4 – Royal mosa
	Topic 14 - Case study 5 – Eastex material exchange
	Topic 15 - Case study 6 – Siemens

Table 1. *EPOQUE's online Course III (Entrepreneurship – Intelligent Energy) structure*

As shown in Table 1, the EPOQUE's online Course III covers a wide range of aspects containing 15 topics. The latter last from two to four weeks and result to a total of 45 weeks of study. Aiming to provide a further analysis of these topics (showing the targeted learning outcomes, involved assignments, evaluation, etc.), we will describe those of modules 1 and 3 (as these were developed by the Hellenic Open University and the authors of this paper), as well as the related educational material developed to support the learning process.

Module 1 aims at familiarizing learners with the current energy status and introduces the fundamentals of the Intelligent Energy concept. It then presents various aspects of the Smart Grid providing a comparison between the traditional and the smart grid to help learners identify the fundamental characteristics that drive the evolvement

towards a more intelligent grid. A main scope of this module is to provide learners with information concerning a smart grid's architecture, components and major technological areas, in order to make them competent in designing smart grids for given settings and selecting the most appropriate technologies for their realization. To this direction, it consists of three topics as described below.

Topic 1 - Introduction to intelligent energy

This topic lasts 2 weeks and focuses on providing an overview of the current global energy status and introducing the intelligent energy concept. The expected learning outcomes for the learners are to:

- Have knowledge on the current status of global energy and associated infrastructure
- Have knowledge of the intelligent energy concept
- Be able to reason over the need to implement intelligent energy solutions

The educational material of Topic 1 includes a presentation (.pptx) that stands for the basic learning material of this topic, as well as additional learning material of two documents (one is mandatory and the other optional) with content relative to the topic's scope. In addition, there is an assignment where learners are asked to elaborate on an extended list of the drivers leading the adoption of the Intelligent Energy concept, and one highlighting its impact, classified in various fields (e.g. environment, society, economics, energy management, etc.). The evaluation of this topic is performed by grading the aforementioned assignment.

Topic 2 - The smart grid concept

This topic lasts 3 weeks and intends to describe the current power grid, the motivation of shifting towards the smart grid, as well as the smart grid's architectural overview, basic characteristics and benefits. The associated learning outcomes for the learners are to:

- Have knowledge of the smart grid's concept and generic architectural design
- Have knowledge of the smart grid's benefits and defining traits
- Have knowledge of the smart grid's market domains

Educational material of Topic 2 features a presentation (.pptx) that is the basic learning material of this topic and several documents as additional learning material. The assignment of this topic calls learners to write about smart grid opportunities in their countries. Evaluation of this topic is performed by grading this assignment.

Topic 3 - Smart grid components and technologies

This topic lasts 4 weeks and aims to present the major components and the most important ICTs implemented in the smart grid. The expected learning outcomes for the learners are to:

- Have knowledge of the smart grid's major components and technologies
- Be able to abstractly design smart grids for given settings
- Be able to select appropriate ICTs and related applications for designing smart grids, based on given needs and requirements

Educational material of Topic 3 consists of a presentation (.pptx) that is the basic learning material of this topic and several documents as additional learning material. The assignment of this topic asks learners to design a smart grid architecture for a large university campus integrating renewable energy resources and define an energy management policy to achieve sustainability and maximize efficiency of energy

consumption, based on the presented generic architecture of a smart grid and their knowledge upon university settings and needs. Evaluation is performed through grading the assignment described above.

Module 3 concerns the green entrepreneurship application domains. Green entrepreneurship refers to businesses that target products, services or processes with an ultimate objective of benefiting the environment. The term “green” focuses on various aspects, such as creating and consuming energy without polluting the environment, integrating renewable energy sources and minimizing the use of fossil fuels and managing energy as efficiently as possible towards a sustainable consumption and exploiting produced energy at the maximum level while implementing low-waste processes. Green entrepreneurship has already found its pace and currently expands in various application sectors, such as smart cities and transport. Motivation, scope and impact of green approaches vary along these domains, where several ICTs are combined to achieve efficient and sustainable use of energy. In light of the above, this module aims to provide an overview of some main green entrepreneurship application sectors along with the basic features of intelligent energy implementation.

Topic 7 - Smart energy cities

This topic lasts 3 weeks and targets at describing the smart energy city concept and major applications of intelligent energy in cities. The expected learning outcomes for the learners are to:

- Have knowledge of real world applications of green entrepreneurship
- Have knowledge of the current energy status in a city level and the smart city concept
- Understand how district heating and cooling works and how it benefits from intelligent energy
- Be aware of smart street lighting basics
- Be able to find city-wide opportunities of intelligent energy applications

The educational material of Topic 7 includes a presentation (.pptx) as the basic learning material of this topic, as well as various documents (either mandatory or optional) as additional learning material. This topic also includes an assignment where learners are asked to identify the implemented technologies and required system components for the realization of intelligent street lightning. The evaluation of this topic is performed by grading the aforementioned assignment.

Topic 8 - Smart energy in buildings

This topic lasts 3 weeks and describes how intelligent energy is applied to buildings, discuss the implemented ICTs and presents relative applications. The expected learning outcomes for the learners are to:

- Have knowledge of the current status of energy consumption in building and the need for a smarter/greener approach
- Have knowledge of the smart building concept
- Have knowledge of major technologies and applications of smart buildings

Educational material of Topic 8 consists of a presentation (.pptx) that is the basic learning material of this topic and several documents as additional learning material. The assignment of this topic calls learners to describe the concept of green Heating Ventilating and Air Conditioning (HVAC) systems, their basic components and the

main technologies used for their realization. Evaluation is done through this assignment's grading.

Topic 9 - Smart grid components and technologies

This topic lasts 3 weeks and presents the application of smart energy in transport and the electric vehicles. The expected learning outcomes for the learners are to:

- Have knowledge of the current status of energy in transport and the motivation of introducing intelligent energy
- Be aware of the electric vehicle types and associated charging infrastructure

The educational material of Topic 9 includes a presentation (.pptx) as the basic learning material of this topic, as well as various documents as additional learning material. The assignment of this topic asks learners to provide an overview of the existing electric vehicle charging infrastructure and describe the perspectives of its evolution. The evaluation of this topic is performed by grading its assignment.

E-learning platform

Following the completion of the EPOQUE online courses' structuring we had to determine and implement the appropriate means of delivering these courses to students. To this end, we developed an e-learning platform (home page is shown in Figure 2) to support the e-learning process acting as intermediate between teachers and students. This platform was based on Moodle v2.8.3+ (Modular Object Oriented Developmental Learning Environment), which is a free Learning Management System that offers integrated services of asynchronous e-learning. The platform uses a mySql database running on a Linux operating system.

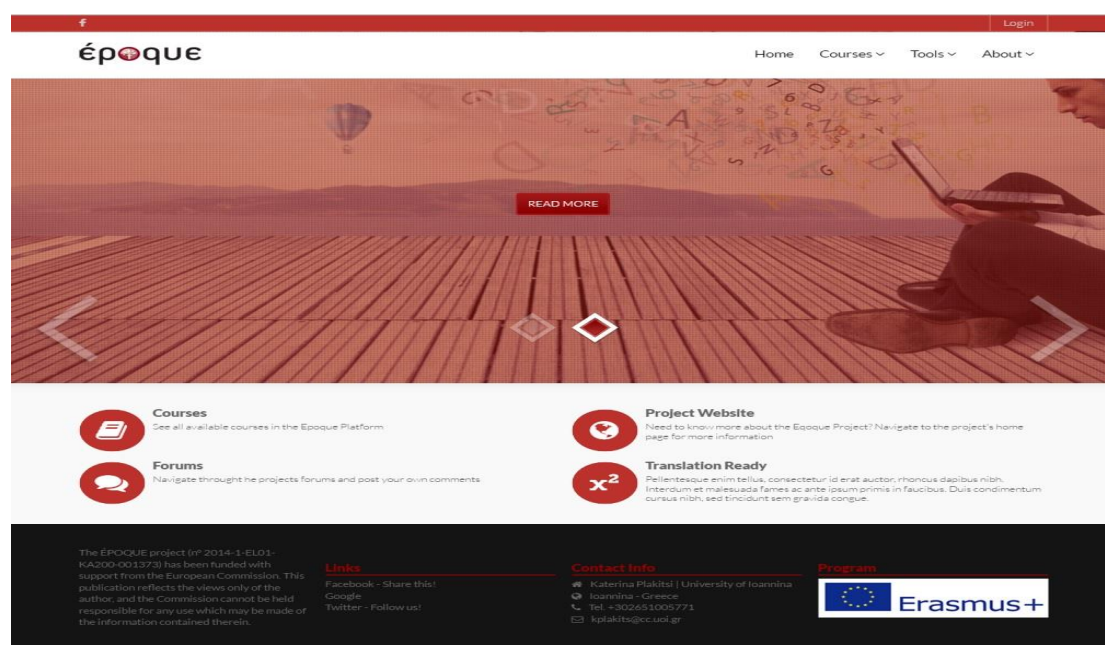


Figure 2. Home page of the EPOQUE e-learning platform

After logging in the EPOQUE platform, the users can navigate to the offered courses, access the platform's tools (e.g. forums) and various links (e.g. the EPOQUE website) through the menu located at the top right of Figure 2. Users may also access courses, forums and other important content directly from the homepage, as well as see contact and social media information. When accessing the EPOQUE courses (either

from the top menu or using the direct link in the homepage) users are directed to the page of Figure 3.

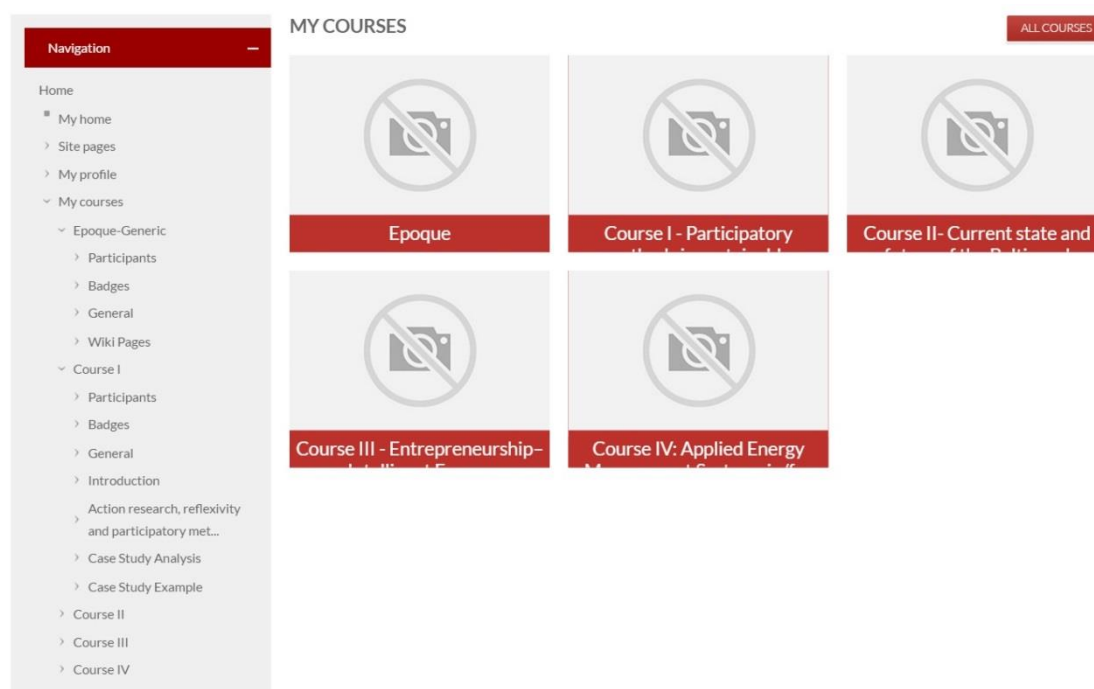


Figure 3. *Course and user navigation*

On the left of Figure 3 the user navigation panel is shown, through which users are able to access their profiles where they can set their preferences, modify their personal information, access forum discussions they participate, view their blog entries and go through their private messages. They can also navigate to the four EPOQUE courses and their respective content, while being able to access forums and wikis. The EPOQUE platform structure includes the following:

- A Generic Course hosting:
 - News forum, Generic question forum, Q & A forum
 - Collaboration wiki
- The four EPOQUE courses each including:
 - General Forum
 - News forum
 - File repository
 - Chat Room
 - Course material reflecting 45 weeks (documents, presentations, videos, use cases, external urls, etc.)

With regards to the generic course, Figures 4 and 5 show the generic question forum and the collaboration wiki respectively as they were formed during an Intensive Study Program (ISP) that took place in Ioannina, Greece with approximately 30 students and 10 teachers that focused on engaging and enhancing the knowledge of the participating students from three countries (Greece, Italy and Finland) through the EPOQUE environmental portfolio. During ISP all participants used the EPOQUE e-learning platform to access available tools and learning material. Concerning the platform tools, forums were used to communicate questions, perspectives,

observations, announcements, activities, assignments and announcements, while the wiki was used in a collaborative manner to develop a glossary of terms relative to the delivered educational content.

Generic Question Forum

This is a generic Q & A forum

Add a new discussion topic

Topic	Author	Replies	Last Reply	Status
loss of biodiversity	Anastasia Goulgouti	0	Anastasia Goulgouti Tue, 17 May 2016, 9:44 PM	*
Intelligent energy in industry	Anastasia Goulgouti	0	Anastasia Goulgouti Tue, 17 May 2016, 9:42 PM	*
Baltic sea	Anastasia Goulgouti	0	Anastasia Goulgouti Tue, 17 May 2016, 9:41 PM	*
Activity theory	Anastasia Goulgouti	0	Anastasia Goulgouti Tue, 17 May 2016, 9:40 PM	*
Internship in Finland	Vasiliki Mantziou	0	Vasiliki Mantziou Thu, 12 May 2016, 2:56 PM	*
Final Assignment for 6 GreenMusketters	Paraskevi Topali	0	Paraskevi Topali Wed, 11 May 2016, 6:14 PM	*
Internship diary	Lina Vraka	0	Lina Vraka Thu, 5 May 2016, 3:53 PM	*
daily assignments	Lina Vraka	0	Lina Vraka Thu, 5 May 2016, 3:47 PM	*

Figure 4. *The generic question forum*

Glossary

TABLE OF CONTENTS	
1. Course 1 - Participatory methods in Sustainable Management of Natural Resources	[edit]
1.1. Participatory Approach	
1.2. Climate Change	
2. Course 2 - Current state and future of the Baltic and Mediterranean Area in an interdisciplinary perspective	[edit]
2.1. Sewage	
2.2. HELCOM	
3. Course 3 - Green Entrepreneurship and Intelligent Energy	[edit]
3.1. Smart Grid	
3.2. Smart power meter	
4. Course 4 - Energy Management Systems	[edit]
4.1. Energy Management System (EnMS)	
4.2. Energy Standard	

Figure 5. *Collaboration wiki used to create a glossary of terms*

Figure 6 provides a segment of the EPOQUE's online Course III (which was discussed in the previous section). Its structuring is week-based and weekly content is available through appropriate content blocks, while users are able to quickly navigate to the 45 weeks of the course by the respective menu shown on the left of Figure 6,

which also provides access to user profiles as described above. Moreover, the students have access to the chat room, file repository, news forum and general forum that are available for this particular course. It is noted that students are able to access learning material through embedded browsers, pdf readers, etc., though which they also have the ability to download learning material.

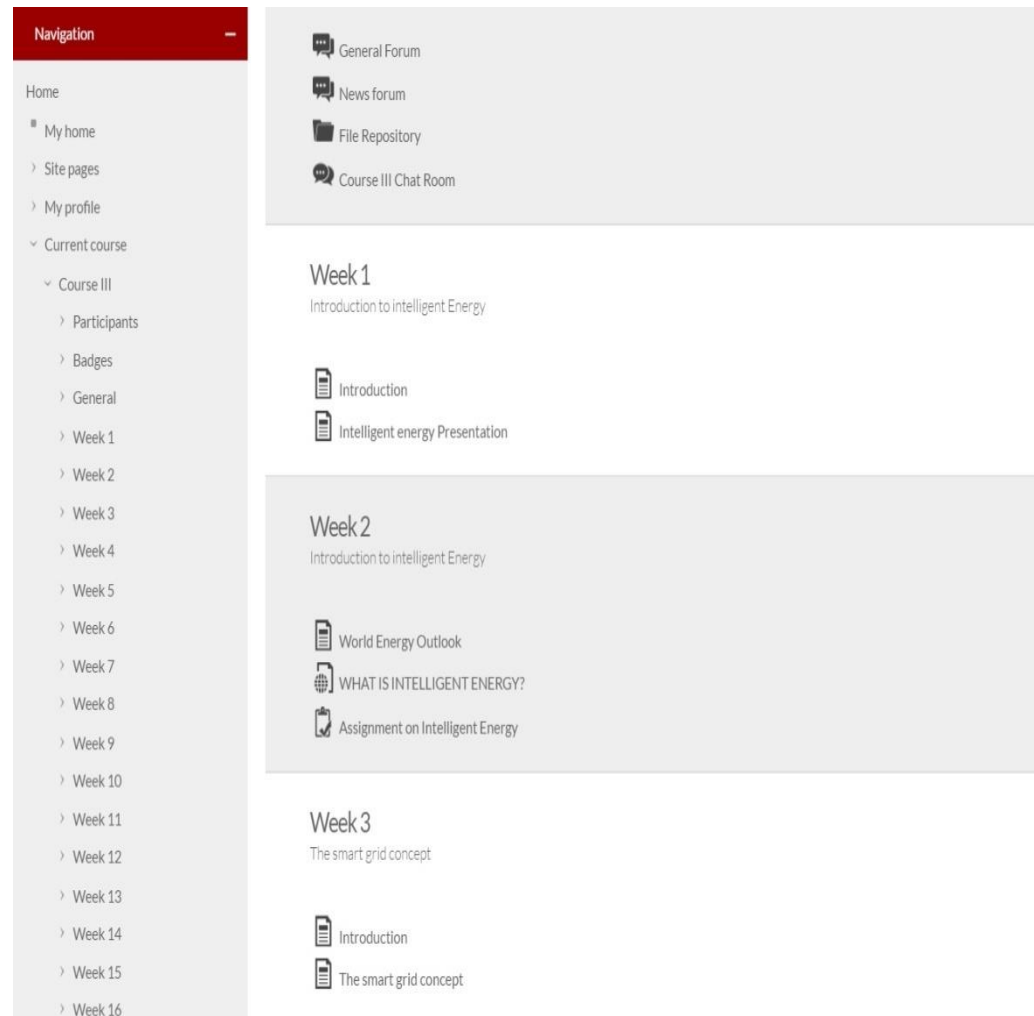


Figure 6. A segment of the EPOQUE's online Course III

The course structuring offered by the EPOQUE platform helps students identify exactly what they have to do at any point in time during their course attendance. For example, concerning Topic 1 of Course III, the first week they have to study the basic learning material and the second one they may read some additional learning material and write their assignment of this topic. The same goes with all the topics and the duration of activities (i.e. study, assignment submission) depend on the volume of the basic/additional learning material and the difficulty level of assignments. It is obvious that the provided learning environment assists students to appropriately organize and schedule their study effort and time by guiding them in their weekly obligations, while providing all necessary resources for their fulfillment.

Evaluation

Apart from the ISP, both the online version of the EPOQUE Course III and the e-learning platform were presented and used during a workshop that took place in the

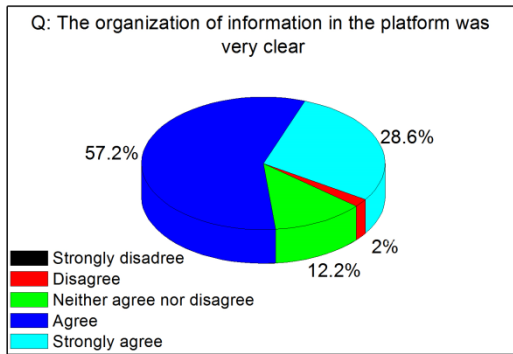
context of the main EPOQUE conference held at Ioannina in May 21, 2016. This workshop was attended by 49 participants aged between 20 and 52 years, who were mainly students of the department of primary education of the University of Ioannina, as well as teachers of primary and secondary education in Greece.

The main objectives of the workshop were to demonstrate the e-learning platform developed in the context of EPOQUE and train participants in the contents of the EPOQUE's online Course III using this platform. To achieve these goals, the overall e-learning platform's functionality was initially presented (e.g. navigating through the EPOQUE courses, managing user profiles, uploading documents etc.). Then, the participating people got trained in the learning modules "Intelligent Energy" and "Green entrepreneurship application sectors" using the e-learning platform to access relevant educational material. Subsequently, they were given a brief period of time to navigate through educational material and platform tools (e.g. forums and wikis) on their own. Finally, the participants were asked to assess both the e-learning platform and the educational content of the aforementioned EPOQUE's course through appropriate questionnaires.

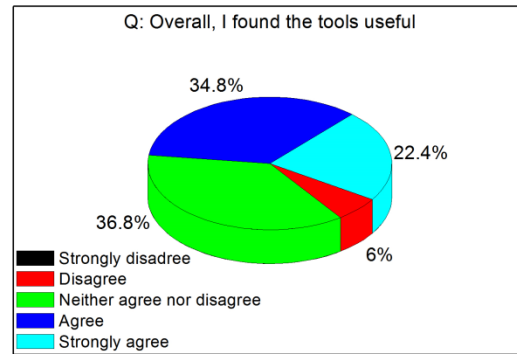
The sample comprised of 41 females (~86%) and 8 males (~16%). Approximately 67% of the attendants were students, 20% were teachers, 8% were out of and looking for work, while lower percentages corresponded to people out of and not looking for work or self-employed. Moreover, 61% of the attendants were high school graduates, 27% were university graduates and 12% had master's or doctorate degree. The first questionnaire the attendants were called to fill, referred to the evaluation of the EPOQUE e-learning platform and had 6 sections. Each section included 2 to 6 questions, while the Likert scale was used for the answers that ranged from 1 to 5 (1. Strongly disagree, 2. Disagree, 3. Neither agree nor disagree, 4. Agree, 5. Strongly agree). Table 2 shows the sections along with the most indicative and aggregative questions of each section of the e-learning platform evaluation questionnaire and Figure 7 the results of the answers provided by the attendants to these questions.

Section	Indicative question
Platform in general	The organization of information in the platform was very clear
Tools	Overall, I found the tools useful
Ease of use	It was easy for me to become skillful at using the platform
Learnability	Learning to use the platform was easy for me
Attractiveness	Overall, the interface of the platform was pleasant
Satisfaction	Overall, I am satisfied with the platform

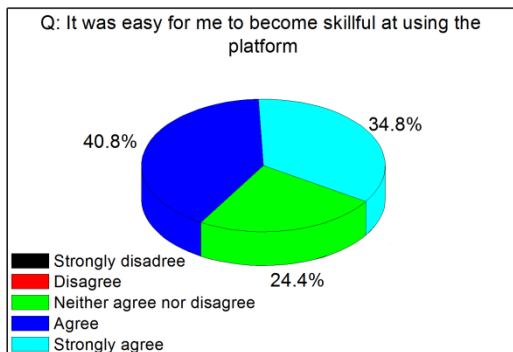
Table 2. *Sections and indicative questions of the e-learning platform evaluation questionnaire*



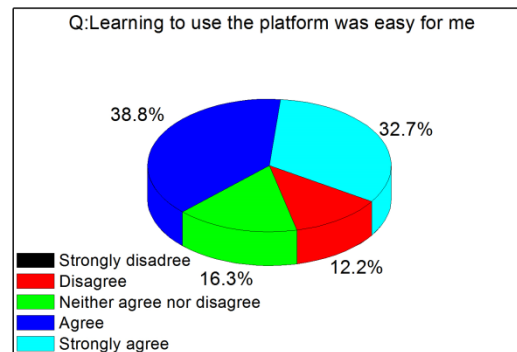
Platform in general



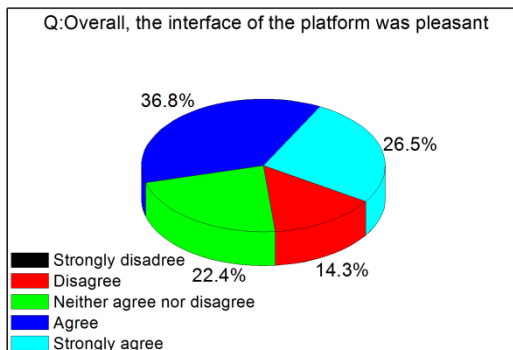
Tools



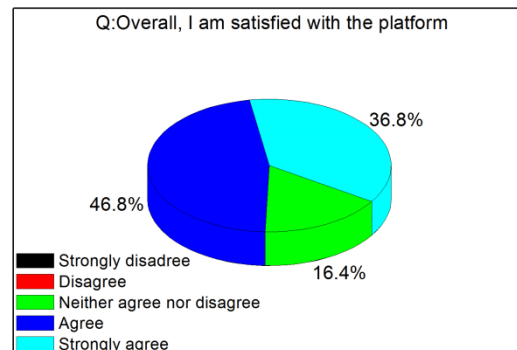
Ease of use



Learnability



Attractiveness



Satisfaction

Figure 7. Results of the answers to the questions of Table 2_[U1]

As shown in Figure 7, the feedback we received for almost every category of the platform was very positive. In particular, the overall impression of the platform was very good, as 85,8% of the attendants either agreed or strongly agreed that the information organization of the platform was clear. With regards to the usefulness of the tools, there was a noticeable amount of people (36,8% - over one third of the participants) that were neutral (neither disagree or disagree) and this can be justified by the fact that a user needs to use the platform tools for a considerable amount of time, in order to recognize their value and usefulness.

Concerning the easiness in the use and the learnability of the platform, 75,6% and 71,5% of the attendants respectively, were either positive or strongly positive. However, these percentages are related to some extent to the fact that the EPOQUE

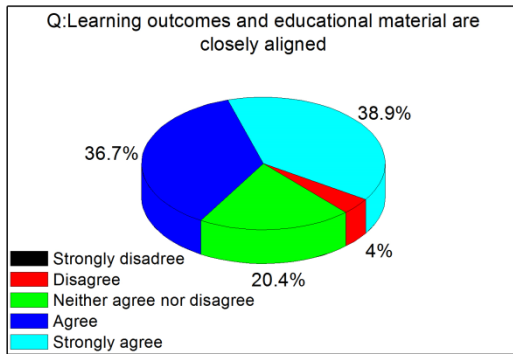
platform is rather simple in its current form and they are expected to drop as various more complex functionalities are integrated (e.g. assignment submission system). Attractiveness is deemed good or very good by 63,3% of the attendants, which is mainly due to the simple template the current version of the EPOQUE platform has. This percentage is expected to rise as better templates may be used increasing the user-friendliness of the platform's front page. Finally, the vast majority of the attendants (83,6%) are either satisfied (46,8%), or very satisfied (36,8%) with the platform in general, which is very encouraging for the effectiveness of the developed e-platform.

Moreover, the e-learning platform evaluation questionnaire included one open question for each of the examined sections that revealed several opportunities for improvement concerning the e-platform's functionality and content presentation. An indicative example refers to a comment received in the section evaluating the attractiveness of the platform, which mentioned that it would be more attractive to include various environment-related photos next to texts to align the platform's appearance with the courses' content and objectives. Another comment proposed the integration of environmental news feed, so that the users can remain informed of the latest news with respect to various environmental issues. Some other comments mentioned the need for additional tools, such as a calendar presenting both the history and forthcoming activities for the academic year and enabling them to create events and relative notifications. A few teachers also mentioned the need for a functionality/tool that would facilitate online grading and viewing of the performance of their students.

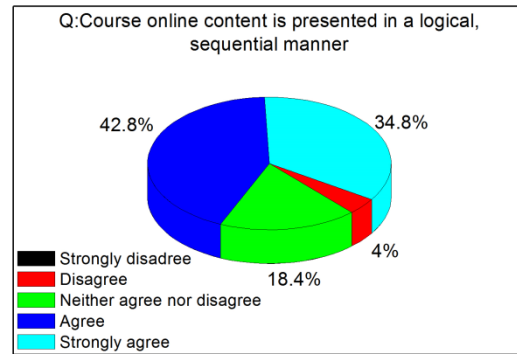
The second questionnaire concerned the evaluation of the EPOQUE's online Course III, and, more specifically, its 1st and 3rd modules that were previously described. In the same manner, this questionnaire had 4 sections, each of which included 3 to 7 questions, while the Likert scale was used for the answers that ranged from 1 (I disagree) to 5 (I agree). Table 3 shows these sections along with the most indicative and aggregative questions of each section of the EPOQUE's online Course III evaluation questionnaire and Figure 8 the results of the answers provided by the attendants to these questions. It is noted that this questionnaire also included some open questions to each section (e.g. "if not why?" questions after the ones shown in Table 3), but the attendants did not provide any relative feedback.

Section	Indicative question
Learning outcomes	Learning outcomes and educational material are closely aligned
Online content presentation	Course online content is presented in a logical, sequential manner
Educational material and assignments	Educational material covered a wide range of aspects in relation with the course subject
Satisfaction and effectiveness	Overall, I am satisfied with the quality of the course

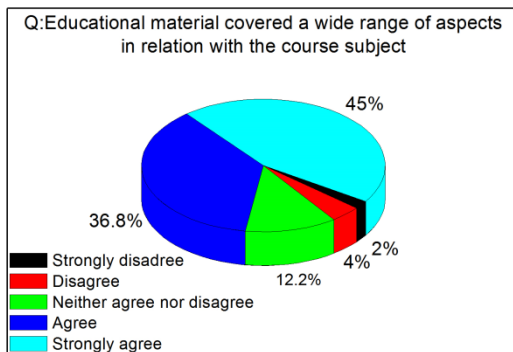
Table 3. *Sections and indicative questions of the EPOQUE's online Course III evaluation questionnaire*



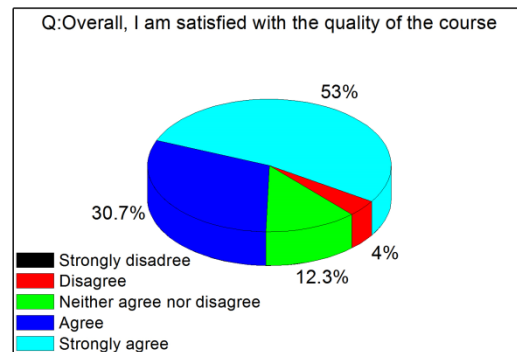
Learning outcomes



Online content presentation



Educational material and assignments



Satisfaction and effectiveness

Figure 8. Results of the answers to the questions of Table 3_[U2]

As shown in Figure 8, the attendants' feedback for the EPOQUE's online Course III was again very positive. Concerning learning outcomes against the educational material, 75,6% of the evaluators agreed or strongly agreed that they were closely aligned, which shows that we achieved a good level of cohesion between the course objectives and offered learning material. Furthermore, 77,6% of the evaluators agreed or strongly agreed that the online course content followed a logical, sequential manner advocating to the fact that the course structuring was efficient. An even higher percentage of the attendants (81,8%) agreed or strongly agreed that the learning material covered a wide range of aspects in relation with the course subject, which means that the selected topics and developed learning material were rich and provided a multidimensional approach to the course subject. This is also reflected to the final section and the answers to the question regarding the attendants' satisfaction with the overall quality of the course, where 83,7% of them replied positively, showing the high potential of the EPOQUE's online Course III towards being included in a relevant syllabus.

Concluding remarks

As it is projected, world energy consumption will grow by 56% and carbon dioxide emissions will have a 46% increase between 2010 and 2040 (U.S. Energy Information Administration, 2013). To address the challenges emerging by these projections and associated issues like climate change, the energy sector is changing and focuses on renewable energy sources, in order to facilitate a more sustainable and effective use of energy. In addition, a main objective is to increasingly integrate digital technologies

throughout all stages of the energy value chain to provide an advanced power infrastructure, actively engage consumers and smoothly integrate renewables among others. These lead to a rapidly growing economic sector creating new jobs that will require qualified professionals to staff them. In this context, the EPOQUE project aims to deliver an integrated environmental portfolio for university education to provide adequate training to such potential professionals. The EPOQUE portfolio consists of four distinct courses, which are also provided in an online version for the needs of an e-learning process.

This paper presents the e-learning framework that served as the basis for the online courses structuring and the EPOQUE e-platform design and development. This platform aims to support the e-learning process and provide the means for the delivery of the EPOQUE portfolio to students. The EPOQUE's online Course III and the e-platform were evaluated by 49 people and the received feedback was very positive for both. This is very encouraging for the appropriateness and effectiveness of the e-platform, as well as the quality of the developed online course.

However, it has to be noted that the developed platform is rather simple in its current version and it is expected to become more complex as it will be implemented from different educational institutes that will customize it, based on their requirements, preferences and needs. Moreover, several modifications could be made in terms of the platform layout aiming to achieve a more user-friendly and functional interface. Again, this is an issue that will be individually addressed by each educational institute that will adopt this e-platform.

Furthermore, the content of the EPOQUE's online Course III could have several variations based on the type of students that it will be offered. For instance, if it is aimed to be taught to engineers, the content could contain a lot more technical details. On the contrary, if it is aimed for economics' students, the green entrepreneurship and marketing part could be enriched and highlighted, limiting the technical information and just providing an overview of this aspect. Naturally, several factors, such as culture, industrial status, political agendas and other national particularities could also play a significant role in specifying this course's content.

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