

*Environmental Portfolio for Quality in
University Education*

2014-1-EL01-KA200-001373

Intellectual Output
(O6)



*Environmental Portfolio for Quality in
University Education*

2014-1-EL01-KA200-001373

Intellectual Output
(O6)

University of Ioannina



On the way out of Poverty: Action through participatory methods to meet the right of living in sustainability

Katerina Plakitsi¹, Eleni Kolokouri¹, Athina Kornelaki¹

Abstract: This paper is grounded on the project ÉPOQUE which trains prospective teachers, scientists and engineers through an environmental portfolio ready to be integrated into the university syllabuses. In this sense, the Ioannina @fise researching group developed a workshop on poverty and sustainability following an expansive learning cycle. The main purpose of the workshop was to create appropriate settings for teachers and students to deal with issues of poverty and sustainability through participatory methods. During the implementation of the workshop forum theatre was used as a tool in order to involve participants in actions of change. The participants had to deal with three issues in their groups such as poverty and immigration, social justice and poverty and facing poverty in our everyday lives. The forum theatre episodes have been videotaped and we conducted a video analysis with emphasis on the interactions as well as the formation of rules and the moments of change in the activity systems. The preliminary results show how the forum theatre within the context of an expansive cycle can be a fruitful transformative activity for teachers training on issues of poverty and sustainability.

Key-words: poverty, sustainability, expansive cycle, forum theatre.

Καταπολέμηση της φτώχειας: Δράση μέσα από συμμετοχικές διαδικασίες για την αειφόρο ανάπτυξη

Κ. Πλακίτση, Ε. Κολοκούρη, Α. Κορνελάκη

Περίληψη: Η παρούσα εργασία βασίστηκε στο πρόγραμμα ΕΡΟΚΕ, ένα περιβαλλοντικό χαρτοφυλάκιο για την ποιότητα στην πανεπιστημιακή εκπαίδευση το οποίο ανταποκρίνεται στην ανάγκη της κατάρτισης των μελλοντικών επαγγελματιών και προτείνει τέσσερα μαθήματα για ενσωμάτωση στο πρόγραμμα σπουδών των πανεπιστημίων. Στο πλαίσιο αυτό, η ερευνητική ομάδα @fise group του Πανεπιστημίου Ιωαννίνων σχεδίασε ένα εργαστήριο με θέμα τη Φτώχεια και την Αειφορία ακολουθώντας τη μεθοδολογία του επεκτατικού κύκλου μάθησης. Βασικός σκοπός του εργαστηρίου είναι η δημιουργία μαθησιακού περιβάλλοντος μέσα στο οποίο οι συμμετέχοντες θα είναι σε θέση να διαχειριστούν την καταπολέμηση της φτώχειας μέσα από συμμετοχικές διαδικασίες. Ως βασικό εργαλείο έκφρασης χρησιμοποιήθηκε η τεχνική του θεάτρου του καταπιεσμένου, η οποία μπορεί να επιφέρει αλλαγή σε δυσμενείς συνθήκες. Τα θέματα τα οποία πραγματεύτηκαν οι συμμετέχοντες ήταν η φτώχεια και μετανάστευση, η κοινωνική δικαιοσύνη και φτώχεια και η αντιμετώπιση της φτώχειας στην καθημερινή ζωή. Στιγμιότυπα από το εργαστήριο βιντεοσκοπήθηκαν και η ανάλυση, η οποία βρίσκεται σε εξέλιξη, δίνει έμφαση στις αλληλεπιδράσεις των ομάδων, στη διαμόρφωση των κανόνων καθώς και στις μεταβολές στο σύστημα δραστηριότητας κάθε ομάδας. Τα πρώτα αποτελέσματα μας δείχνουν ότι η μέθοδος του θεάτρου του καταπιεσμένου συμβάλλει στη διαχείριση ζητημάτων σε σχέση με τη φτώχεια και την αειφορία ενώ παράλληλα ο επεκτατικός κύκλος μάθησης προσφέρει ευρύ πεδίο ανάλυσης και αναστοχασμού.

¹ School of Education, University of Ioannina, Greece.

Corresponding author: Katerina Plakitsi, E-mail: kplakits@cc.uoi.gr

Λέξεις-κλειδιά: φτώχεια, αειφορία, επεκτατικός κύκλος μάθησης, θέατρο του καταπιεσμένου.

Introduction

This paper is grounded on the project ÉPOQUE (<http://www.epoque-project.eu/>) which trains prospective teachers, scientists and engineers through an environmental portfolio ready to be integrated into the university syllabuses. Within this frame, six different institutions worked on the creation of a new generation of scientists who will be able to contribute to the sustainable development of various types of organizations. Apart from the formal partners there are many associated partners linked to the project like regional principals, financial agents as commerce, environmental oriented NGOs and, finally, green schools networks.

The objective of the project was to prepare a new generation of professionals working in the field of sustainability and support them to integrate scientific and humanistic knowledge. Furthermore, it aimed to change the European policies about the connection of higher education and adult learning. In this sense, the partners developed a set of four university courses along with the accompanying materials as well as an e-learning platform through which the courses were available to all the target groups, comparative studies, teaching manuals and an Energy Management Systems (EnMS) for schools. The ÉPOQUE project was built on the ERASMUS INTENSIVE PROGRAM 'LIGHT' carried out at the coordinating institution (University of Ioannina) for three successive years. Due to the previous experience, the project had a great impact to the regional development using tertiary education as a vehicle to achieve the Epirus regional priorities for convergence.

Following the basic norms of the first course of the ÉPOQUE project about participating methods in sustainable management of natural resources the Ioannina @fise researching group developed a workshop on Poverty and Sustainability following an expansive learning cycle (Engeström & Sannino, 2010). The research interests of the group concern transferring Cultural Historical Activity Theory (CHAT) into the fields of science education. As it is combined with other relevant case studies, it finally aims to validate CHAT as an evaluation tool of scientific activities in different learning environments and institutions, such as in the university laboratory, in the school classroom, in a museum or science centre etc.

Activity theory originated in the classical German philosophy (from Kant to Hegel), in the writings of Marx and Engels, and in the Russian studies in psychology of Vygotsky, Leont'ev, and Luria. The cultural- historical approach of the theory was expanded, organized and increasingly used to create contemporary research environments (Engeström, 2001).

The socio-cultural frame of Activity theory provides a context of human activity and links the individual to the social level (Engeström, 1999). The unit of analysis is the activity which includes the person or group who is acting towards an object, following certain rules and the dynamic relationships that develop within the activity system (Engeström, 1999, Barab et al, 2003). An activity system studies both the interpersonal and intrapersonal level of actions as well as the community (Engeström, 1987 & Leontiev, 1981).

The activity takes place in different levels that are not necessarily successive (Bertelsen & Bodkaer, 2003). Under the prism of CHAT learning involves a qualitative change of actions that may take place when people participate in meaningful cultural activities and receive scaffolding for improving of actions towards an inspiring object into the whole activity system. Within this frame, learning activities are connected with real problems and the consequences of different approaches and aim to develop competences in education that involves people as citizens.

Rationale and Purpose

Despite the immense technological advances and progress in many sectors of life in the 21st century billions of people all over the world continue to live in poverty and are denied a life of dignity. The inequalities that rise within and among countries as well as the enormous disparities of opportunity, wealth and power cause many people to lead an impoverished way of life. Apart from statistics about hunger, homelessness or low incomes, poverty is a state of life that affects all of humanity. In this sense, it is a complicated issue with multiple dimensions varying from economic standards and income levels to lack of basic human necessities, such as food, water, shelter, and education.

Oxfam (<https://www.oxfam.org/>) provides a list of facts about global poverty that raises concern about the issue and calls for immediate action and programs that provide sustainable solutions to extreme poverty. Furthermore, the 2030 Agenda for Sustainable Development of the United Nations Summit (<http://www.un.org/sustainabledevelopment/development-agenda/>) aims to the eradication of hunger and poverty by 2030 and to establish a life of dignity and equality in a healthy environment. According to the agenda, the foundation to improve people's lives and sustainable development is achieving a quality education at all levels. Basic literacy skills and access to life-long learning opportunities will help people to obtain life skills and gain opportunities to participate actively in society.

Towards this direction, the @fise research group as member of the academic community undertook the role of increasing the awareness about the impact of poverty in education. It is our belief that Science Education can lead to sustainable development and environmental awareness which are vital for the contemporary world (Kolokouri & Plakitsi, 2013). Thus, we invest on the socio-cultural background of the citizen that will learn science, develop a positive attitude towards nature and the environment and also contribute to reducing poverty and achieving sustainable development.

The main purpose of the workshop that was developed about poverty was to create appropriate settings for teachers and students to deal with issues of poverty and sustainability through participatory methods. Furthermore, it intended to equip participants with the appropriate tools to deal with issues of education towards sustainable development. Within the CHAT framework emphasis was put on the interactions that take place during the implementations of the workshop as well as the formation of rules and the moments of change in the activity systems. Collaboration of the participants in groups was planned under the perspective of creating dynamic activity systems in which the participants, the institutions, the methods, the tools, the objects are connected in a cultural, historical and social process.

Development of the workshop

The workshop has been tested in three different settings. First it was a regional teachers training workshop on poverty in the current times of crisis. Then a second cycle was at the Staffordshire University with a European community of teachers. The third cycle occurred during the International Congress at the University of Ioannina. In each case, the participants worked throughout the workshop in seven steps:

Step 1 (5-10 min): There was a short presentation of the topic which concerned the dimensions of poverty issues around the world, the methodology of the workshop and several questions that the participants would have to discuss in their groups. The @fise group posed the following general questions on the issue of poverty:

- Can people in the developed world help to eliminate global poverty? Do they have an obligation to do so?
- If not, why not? If so, why? And what would those obligations look like?

- What prevents us from preventing global poverty?
- Will elimination of poverty lead to changes in school reality?

Step 2 (20 min): a. The participants were divided in three groups with the aid of flashcards and there was an icebreaker activity in which they shared information about attitudes by answering the questions 'What is the attitude you like/dislike in a person? Provide only one word'.

b. The participants had to deal with three issues in their groups so each group received an envelope with material about the following issues:

- Poverty and immigration
- Social justice and poverty
- Facing poverty in our everyday lives

b. After looking through the material each group had to discuss and find research questions regarding their issue of poverty.

Step 3(10 min): Each group voted in order to choose the most interesting research question and wrote it down in a post-it paper.

Step 4 (Collaborative group work, 45-50 min): Each group had to create a scenario and prepare a role-play connected with the issue of poverty they were dealing with. Each person in the group would play a role. The scenario could describe a problematic situation or a need state and provide the reasons, the consequences and possible solutions. The group could use the information they had been given about the issue and moreover connect the scenario with the general questions of the first presentation as well as with the research question of their group.

Step 5 (10 min): Each group acted on a performance of a forum theatre which showed a problem/situation on their issue of poverty. Each group could offer possible solutions for changing the series of events.

Step 6 (10 min): The performance was then repeated. At any time, anyone of the audience could out 'freeze', come up on stage and take the place of the protagonist in order to change the series of events. They could alternatively play characters that would be able to support other characters that wish to change. When calling out 'freeze' they could offer ideas for change to the group of actors who would then perform the suggestions. During the whole procedure there was always a person for support who acted as a mediator or facilitator.

Step 7 (10 min): The workshop closed with participants in a circle, relaxing, taking off any roles they undertook in the forum theatre and discharging any negative feelings they might have experienced.

Methodology

The methodology of this workshop is based on the expansive cycle of Engeström (figure 1), which satisfactorily interprets the strategic learning actions and corresponding contradictions, in expansive learning. According to Engeström & Sannino (2010), expansive learning is a theory that puts the priority on communities as learners who create and transform culture and finally form theoretical concepts. Through collective activity that involves change, learners construct new knowledge and put it in practice in new situations. The series of learning activities in an expansive cycle (Engeström 1999), which are used in this workshop, are:

Questioning: Participants investigate about certain aspects of accepted practice and existing knowledge on the issue of poverty. Furthermore, they discuss about the development of classroom activities and strategies concerning poverty.

Analyzing the situation: This part includes the analysis and comprehension of poverty situations and the use of tools in order to deal with them. Participants may move further to the symbolic and practical transformation of the state in order to discover the causes or illustrative mechanisms.

Modeling: Formation of newly explanatory relationship in a receptive and concrete model. This concerns the design and the development of the workshop.

Examining the new model: Implementation, operation and experimentation with this model so that the potentials, capabilities and limitations can be brought out.

Implementing the model: Implementation of the model in different settings, practical applications, enrichment and conceptual extensions so that the model can be put to practice.

Reflecting and evaluating: Process evaluation and final acceptance in a new, stable form of practice.

Consolidating the new practice: Final design of the workshop and choice of appropriate tools in order to deal with poverty situations in different educational settings and future implications.

The analysis of the activity theory and the development of the expansive learning by Engeström offer a new methodology to organized learning towards the development and organization of new teaching practices. Within this theoretical framework, the learners' context is associated with the implementation of new didactic strategies and evaluation processes which bring forward innovative aspects of science and a new mentality about teaching and learning.

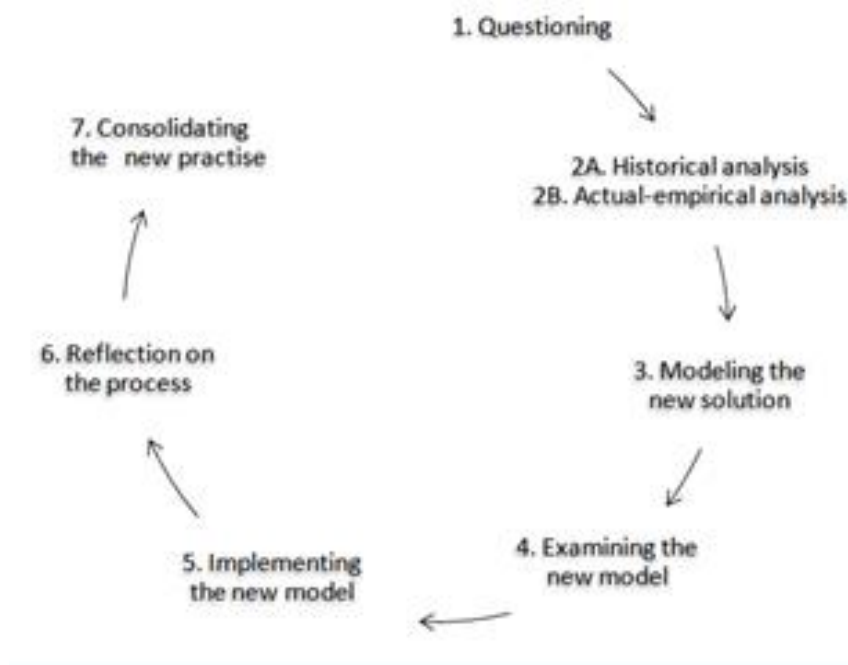


Figure 1: The cycle of expansive learning (Engeström & Sannino, 2010)

During the implementation of the workshop forum theatre was used as a tool in order to involve participants in actions of change. According to the methodology of Augusto Boal for forum theatre (Boal, 2002) there is a powerful interaction between the actors and the

audience that he calls spect-actors. The audience can suggest different actions for the characters to carry out or even take their place in the forum and make an attempt to change the outcome of what they are seeing.

In this attempt the spect-actor steps onto the stage in order to change an oppressive situation imposed by the scenario which may be at some point connected with lived experience of a particular social problem (Dwyer, 2004). The groups of the participants of this workshop were encouraged to build characters in accordance with their scenarios and moreover with personal characteristics of real persons such as name, age, family background, emotional state and relationship with other characters.

The scenario construction involved a complex problem connected with poverty and in most cases with a high probability of significant change. The scenarios that were developed within the groups concerned poverty issues such as children dropping out of school because of poverty, smuggling of people seeking for a better future, excessive use of pesticides because of ignorance of farmers, bullying in the school yard. Thus, the main applications of these cases were to motivate change and decision-making, to offer alternative solutions for future development, to build action networks within the group and finally to resolve the particular oppression topic of each case.

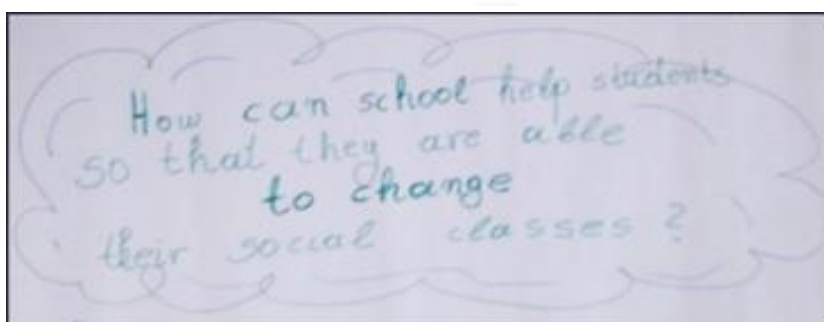
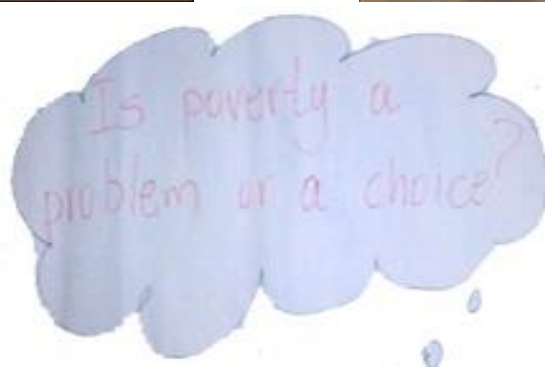
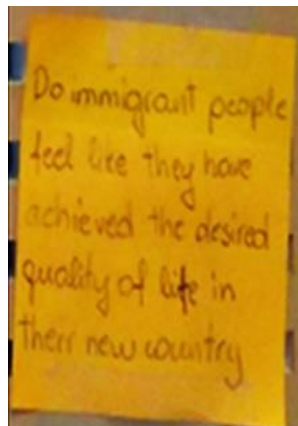
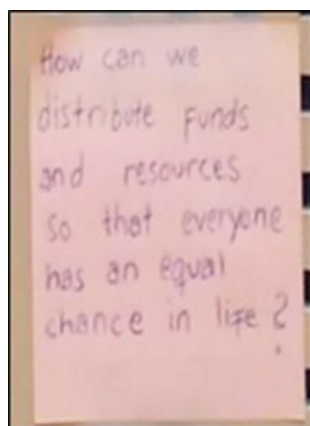
Before performing the groups of the participants went through a rehearsal process in which they discussed their stories, they created an outline of their performance and they chose roles. At the time of the intervention during the second performance of each group anyone of the audience who wished to become a spect-actor came up on stage after calling out 'freeze' and took the place of one of the characters and tried to create a positive solution to the problem. No physical interventions occurred at any case and at the end of each performance there was a short discussion of the facilitator and the actors as well as with the audience.

Data process

The Nvivo 9 QDA (Qualitative Data Analysis) research software has been used in this study to code and analyze all collected data. The analysis, which is in progress, includes videos of the forum theatre performances, photos, small extracts of the discussions with the participants and evaluation questionnaires of the project. The Nvivo 9 software has been used to classify, sort and arrange the collected data and examine the relationships as well as combine analysis with the theoretical framework of CHAT. The preliminary results show how the forum theatre within the context of an expansive cycle can be a fruitful transformative activity for teachers training on issues of poverty and sustainability.

During the implementation of the workshop with the different scenarios that were constructed within the groups, the units of analysis were the activity systems and the different levels of interaction within and between them. All the activity systems involved multiple participants who worked to achieve common objectives, considering scientific knowledge as cultural, historical and social process and using meditative and analyzing tools. Furthermore, internal and external contradictions within and between the activity systems lead to the evolution as well as change of interactions between mediations which affect all the activity systems in multiple ways. In this sense, participants share collective experiences and efforts which are necessary to bring change to oppressive situations through practice (Stetsenko, 2010).

In the illustrations below (Illustrations 1, 2, 3, 4) we can see the results of collective activity through which the groups of participants chose the most significant research questions of the issue of poverty within their group:



Illustrations 1, 2, 3, 4: research questions

In the following table there is an extract of the video analysis of the forum theatre process and the interpretation within the frame of CHAT theory. The scenario concerns a case of bullying that takes place during the break in the school yard where a girl (Millie) grasps the headphones and the food from one of her classmates (Giannis).

<i>Sub-triangles connected with interactive systems and functions</i>	<i>Evolution within the activity systems</i>	<i>Video extracts of the forum theatre process</i>
1. Subject - Rules - Community (production)	The interactive system helps to activate and involve subject in the activity, and to create rules within the group. The rules are set within the community and play an important role in the activity system.	<p>1. Hey give it to me and that!!!</p> <p>3. Millie grasped Giannis headphones and food 4. By force, nasty?</p> <p>3. Yes</p> <p>4. Thank you, I will call both mums</p>

1. Subject - Rules - Community (production) 2. Community - Division of Labor - Object (exchange)	Community is expanded in order to reach the object and find solution in the oppressive situation.	1. Are you aware of the problem?... 2. I am not able to provide her lunch, let alone the headphones... 1. Is there anything we can do to help?
1. Subject - Rules - Community (distribution)	Expansion of the community supports collaboration and exchange of views within the group. Furthermore, different types of interactions take place within the community.	1. Are you aware of the problem? 2. No 3. Yes, your daughter... (describes the incident). Why don't you buy ... 4. Freeze!
1. Tool - Rules - Community (production, distribution)	Change happens by using different types of argument in a more dialectical way	1. Please I would like to ask for help... but I didn't dare 2. Has this been happening for a long time? 1. Yes, I know...I would really like to ask for school support.. 2. We can discuss on that direction..

Table 1: CHAT Interpretation of the video analysis

Discussion

Following an expansive cycle of learning in the design of this workshop contributes to a growing interest of CHAT-based education research. Within the CHAT frame, actions of learning are considered as a process of internalization from the society to the individual. The actions within an activity system which are directed towards an object with the tools, rules and division of labor can be connected with the societal needs and even with the entire civilization of the learners. The contradictions that arise generate the whole system and lead to transforming functions of the system. Learning is an on-going process which is affected by societal conditions while aims and goals can be modified according to current circumstances and learners' interest.

Within the activity systems of the groups there were production and consumption elements at the same time which in fact generated the whole system. This co-existence of production and consumption at the same time created a need state for new production. While constructing the scenarios societal needs and personal experience had to be attuned within the groups which followed a mode of production, consumption, distribution and exchange and managed to act in a way that the societal needs were met.

It seems that poverty scenarios that were developed within the groups were creative crises (Blunden, 2014) in which the impossible situations were made possible in the forum theatre interventions in such a way that the crises were resolved when spect-actors created new selves of the characters. This way, the participants resolved problems connected with issues of poverty through a collaborative inquiry using experience from real-life situations. During the forum theatre performances participants were extremely dialectical. When they

took up a role as a spect-actor who wanted to break the oppression they felt about the situation, they tried to provide counter-arguments or counteractions in order to resolve the problem. What is important in this process (Boal, 2002) is to achieve a successful debate rather than an instant solution as through discussion spect-actors are involved in transformative skills that strengthen their ability to resolve complex problems in the future.

In this sense, participants of the workshop experienced a great strength of CHAT which is collaborative learning as well as an interdisciplinary procedure with strong connections to society. Combined with other activities derived from the EPOQUE project, this workshop can form an expansive teachers learning cycle to meet the current European challenges of the 21st century. Furthermore, working with participatory methods increases learners' awareness about collaborating in common projects to promote social change towards a sustainable development.

References

- Barab, S. A., Evans, M., & Baek, E.-O. (2003). Activity theory as a lens for charactering the participatory unit. In: D. Jonassen (Ed.). *International Handbook on Communication Technologies V2* (pp. 199-214). Mahwah, NJ: Lawrence Erlbaum Associates.
- Bertelsen, O. & Bodker, S. (2003). Activity Theory. In J. Carroll (ed.), *HCI Models, Theories and Frameworks: Toward a Multidisciplinary Science* (pp. 291-324). Amsterdam: Morgan Kaufmann.
- Boal, A. (2002). *Games for Actors and non-Actors*. New York: Routledge.
- Blunden, A. (2014). *Collaborative Projects: An Interdisciplinary Study*. Leiden, Boston: Brill.
- Dwyer, P. (2004). Making bodies talk in Forum Theatre, Research in Drama Education. *The Journal of Applied Theatre and Performance*, 9:2, 199-210.
- Engeström, Y. & Sannino, A. (2010). Studies of expansive learning: Foundations, findings and future challenges, *Educational Research Review*, 5, 1-24.
- Engeström, Y., (2001). Expansive Learning at Work: toward an activity theoretical reconceptualization. *Journal of Education and Work*, 14:1, 133-156.
- Engeström, Y. (1999). Activity theory and individual and social transformation. In Y. Engeström, R. Miettinen & R-L. Punamääki (Eds.), *Perspectives on Activity Theory*. Cambridge: Cambridge University Press.
- Engeström, Y. (1987). *Learning by expanding*. Helsinki: Orienta - Konsultit.
- Kolokouri, E. & Plakitsi, K. (2013). A Cultural Historical Scene of Natural Sciences for early learners: A Chat Scene. In K. Plakitsi (Ed.). *Cultural perspectives in science education: Research dialogs. Activity theory in formal and informal education* (pp. 197-228). The Netherlands: Sense Publishers.
- Leontiev, A. N. (1981). *Problems of the development of the mind*. Moscow: Progress.
- Stetsenko, A. (2010). Teaching-learning and development as activist projects of historical Becoming: Expanding Vygotsky's approach to pedagogy. *Pedagogies: An International Journal*, 5:1, 6–16.

Citation

Plakitsi, K., Kolokouri, E., Kornelaki, A. Ch. (2016). On the way out of Poverty: Action through participatory methods to meet the right of living in sustainability. *Science Education: Research and Praxis, Special Issue*, 58: 10-18. ISSN:1792-3166 (www.lib.uoi.gr/serp).



Environmental Portfolio for Quality in University Education

2014-1-EL01-KA200-001373

Intellectual Output (O6)

University of Helsinki



Bridging environmental education across disciplines

Jarkko Lampiselkä¹, Noora Kivikko¹

Abstract: Five Finnish university departments were compared the way in which environmental education is organised in their teacher training programmes. The data pool comprised of the curricula of teacher training programs and professors' and lecturers' replies to questionnaire. Inductive content analysis revealed that environmental issues are taken into consideration only superficially in all partner universities'. Some successful measures have been made in Helsinki and Turku, however, more thorough actions are needed. The exemplary arrangements in Helsinki University's HENVI centre may be taken as a model for a swift and systematic reorientation of environmental education issues at partner universities.

Keywords: Science education, teacher training, scholars' conceptions.

Η Περιβαλλοντική Εκπαίδευση ως γέφυρα διαφορετικών επιστημονικών πεδίων

Jarkko Lampiselkä, Noora Kivikko

Περίληψη: Σε πέντε φινλανδικά πανεπιστημιακά τμήματα έγινε αναζήτηση σε σχέση με τον τρόπο που είναι οργανωμένη η περιβαλλοντική εκπαίδευση στα προγράμματα κατάρτισης των εκπαιδευτικών. Τα δεδομένα αντλήθηκαν από τα προγράμματα σπουδών των προγραμμάτων κατάρτισης των εκπαιδευτικών και από τα ερωτηματολόγια που απάντησαν καθηγητές και λέκτορες. Η επαγωγική ανάλυση του περιεχομένου έδειξε ότι τα περιβαλλοντικά ζητήματα λαμβάνονται υπόψη μόνο επιφανειακά σε όλα τα συνεργαζόμενα πανεπιστήμια. Ωστόσο, παρά τα ορισμένα επιτυχημένα μέτρα που σημειώθηκαν στο Ελσίνκι και το Τουρκού, απαιτούνται περισσότερο εμπειριστατωμένες δράσεις. Οι υποδειγματικές διατάξεις στο Περιβαλλοντικό κέντρο HENVI του Πανεπιστημίου του Ελσίνκι μπορεί να ληφθούν ως πρότυπο για έναν άμεσο και συστηματικό τρόπο επαναπροσανατολισμού της περιβαλλοντικής εκπαίδευσης στα συνεργαζόμενα πανεπιστήμια.

Λέξεις Κλειδιά: επιστημονική εκπαίδευση, κατάρτιση εκπαιδευτικών, αντιλήψεις ακαδημαϊκών.

Introduction

Environmental topics are included in the curricula of universities but there is still a lot of steps to be made to connect information to awareness of sustainable future (Ardoin, Clark, & Kelsey, 2013; United Nations Educational, Scientific and Cultural Organization, 2013; González-Gaudiano, 2005). In high energy sectors such as buildings, manufacturing, energy conversion and transport has the significant potential for reducing consumption. Consequently, environmental education has become a cross-disciplinary challenge; the curricula should aim both to encourage multidisciplinary research and interdisciplinary action that may lead to deeper theoretical approaches, to deeper content knowledge. Moreover universities' and corporate partnerships' should have common goals in environmental issues, and therefore there is ongoing need to modernise curricula in all education levels to promote sustainable development (Keen, Brown, & Dyball, 2005).

¹ University of Helsinki, Department of Teacher Education

Corresponding author: Jarkko Lampiselkä, E-mail: jarkko.lampiselka@helsinki.fi

The Époque project promotes a sustainable enrichment of the future curricula provided from the Universities in the sectors of Sciences and Engineering. This task will be direct through the development of an environmental portfolio. This portfolio can be implemented in the current courses and knowledge provided. This portfolio creates a generation of green professionals in the context of higher education modernisation agenda connected to SMEs and enterprises. They will contribute to the sustainable development in all organization levels and this environmental portfolio aims to it. The project involves partners through the Europe from North to South and is based on a transfer of know-how and good practices between partners.

The objective of the Époque project was to bring out the gaps in the contemporary University curricula in terms of the knowledge and skills that are fostered through them, while on the other hand highlight the importance for the inclusion of Environmental issues, across the different disciplines. In specific, the partners in the project aims at identifying the trends in the curricula of the participating countries and highlight the importance for including issues related to the environment, the sustainable usage of natural resources and especially how energy can be managed.

We believe that teachers are the real driving force behind educational change in schools and in society. Moreover, the teacher should be an organiser, guide and adviser for the students in his or her development and quest for knowledge. However, recent investigations have shown that the way sciences is taught in schools is not optimal and needs improvement (e.g. Black & Atkin, 1996; Monk & Osborne, 2000; Bloom & Davis, 2001; Sjøberg, 2003; Organisation for Economic Cooperation and Development, 2008). It has been documented that it is common for students to lose interest in, and to develop negative attitudes to sciences, resulting in declining enrolment in tertiary studies. . Without solid knowledge in sciences, the students are apt to interpret their observations and other forms of new information, such as climate change, air pollution, or chemical waste disposal, in terms of their previous knowledge rather than in terms of its own scientific context.

In the process of setting objectives for common model of environmental education in partner countries of the Époque project, the goals, contents, procedures and tasks in the curricula in the participating countries need to be analysed. In theoretical level, the analysis process can be viewed in the light of the Goodson's (1994; 1998) curriculum studies. According these studies, curriculum supports the embedded power relationships and informal institutional forces of particular educational environment. The debate about the role and status of curricula could refer to conflict between disciplines and status, resources and territory. Therefore we need evaluate the current practice not only from university level teachers' perspective, but as well intended users, i.e. school teachers' and students', point of view.

The activity in Époque project aims at providing a solid basis for the development of set of courses of environmental education. To achieve that the partners undertook a desk research to identify the extent to which environmental issues are being included in the university curricula in the participating countries. The study questions were as follows:

1. To what extent the environmental issues are included in the teacher training curriculum?
2. To what extent the environmental issues are available in the courses?
3. How important the professors and lecturers regard the implementation of environmental topics in their own teaching
4. To what extent these implementations are included in the curriculum?

Also opinions of the study targets about the labour market sensitiveness of environmental issues were considered.

Method

We conducted an internal and external desk research. Desk research makes use of existing resources, such as, internet databases and statistical publications. Internal desk research involved research done inside the Helsinki University and collecting relevant information, the external desk research outside the Helsinki University.

The class teacher education programmes are offered in 14 locations in Finland of which class teacher programmes are offered in 11 places: Helsinki, Joensuu, Jyväskylä, Kokkola, Oulu, Rauma, Rovaniemi, Savonlinna, Tampere, Turku and Vaasa. Kokkola is part of the University of Jyväskylä consortium, Joensuu and Savonlinna are part of the University of Eastern Finland consortium, Rauma is part University of Turku consortium and Vaasa is part of Åbo Academi consortium. Hence, altogether eight universities offer education in class teacher programme. In 2010, altogether 12 589 students applied to class teacher programmes nationwide and 735 students enrolled the studies (Opetus- ja kulttuuriministeriö, 2011). Our data pool comprised of five of these eight universities: Helsinki, Joensuu, Jyväskylä, Tampere and Turku. These universities were selected based on their availability on that time. We contacted the head of the department of each previously mentioned eight universities and five of them replied. We asked the head of the department to distribute the questionnaire to their personnel. Sample size was regarded representative, because these five universities represents 68% of the applicants (8506 out of 12 589) and 56% of the enrolled students (413 out of 735). The analysis was targeted on the study programmes and on the teaching staff in these programmes.

In curricula analysis, we searched for the following keywords: environment, environmental portfolio, green technology, sustainable development, renewable energy sources, retrofitting in the title/syllabus/learning outcomes of each programme. If these concepts were not found, we searched for the concept of the sustainable future. The analysis was targeted on master level teacher training programmes.

We also paid special attention to the HENVI-centre that operates in the University of Helsinki. Among other things, the HENVI-centre offers didactically oriented environmental studies for the students of the class teachers' programme. Moreover, the HENVI-centre was included in the analysis because it was introduced in the project proposal as one of the existing models how to organise environmental education in the university that could support interdisciplinary learning. The analysis was targeted on the curriculum plan of the HENVI-centre.

Researchers of the study read, independently, the curricula several times and conducted initial categorisation following the principles of inductive content analysis (Patton, 2002). They discussed the initial categories and read responses again to have consensus of the categorisation as an interpretation of aims, contents, methods, organizational aspects and tasks mentioned in the curriculum. Responses thus lent themselves to examination through the methods of triangulation and data saturation (Denzin & Lincoln, 2011). Of course, the methods were mutually overlapping and interrelated, but these were the prime approaches of the analyses.

The questionnaire was targeted to professors, lecturers and to other scholars relevant to these job positions. Altogether 29 scholars replied to the questionnaire. From the staff of universities were asked their position, responsible status, opinions about labor marked, the implementation of environmental issues in their courses and interest of include new environmental topics to curricula. With these questions the researchers wanted to find out is there knowledge, understanding and will to implement environmental issues in their teaching.

The steps of the material gathering

1. Head of the teacher training programme in each university were contacted and asked to send their teacher training programmes.
2. The questionnaire about environmental issues was targeted to university professors and lecturers.
3. The teacher training programmes were analysed. Inductive content analysis (Patton, 2002) was used to analyse the curricula.
4. The responses to the questionnaire were analysed. Inductive content analysis (Patton, 2002) was used to analyse the written responses.
5. The phases 1 to 4 were made in parallel
6. Conclusions were made based on material analysis.

Results*Curricula analysis*

The curricula analyses are based on the official documents of the participating institutions. ("Curricula Guides 2014-2015, University of Tampere," n.d.; "Curriculum plans 2014-2017, University of Jyväskylä", n.d.; "Flamma: University of Helsinki Intranet," n.d.; "Opetusohjelma, Jyväskylän yliopisto," n.d.; "Opinto-opas, Turun yliopisto," n.d.; Peltoperä, 2015).

Firstly, there is no one single common curriculum of teacher training to all universities in Finland. On the contrary, each university has legitimate privilege to define their own curriculum and study plans. Moreover, there is no one single document that could be regarded as faculty level curriculum in any Finnish university. The best match of a document or compile of documents that could be regarded as curricula are set on department level.

Typically, university curricula were comprised of two documents: the one that sets the framework for teaching and learning and the other that sets the framework for study plan, ie. how and where the teaching of the particular course is actually carried out. However, none of these documents were identical to for example to Finnish National Core Curriculum for Comprehensive School. From this point onwards we refer to these university level documents, one or many, as the curriculum of the particular department even though we acknowledge the limitation and robustness of the decision of this kind.

The analysis showed that typically the environmental topics were present in the courses of didactics of natural sciences, such as, the biology didactics course. In the University of Eastern Finland include sustainable development in nutrition and food systems in their curriculum of master of education degree programme and in the courses of subject specific didactics (typically biology and geography). In the University of Jyväskylä the principles of sustainable future are introduced in the course of craft education target for the master of education degree programme. The curriculum of teacher education degree programme in Tampere University does not introduce sustainable future in any courses. In the University of Turku, the environmental education and principles of sustainable future are introduced in few courses of subject specific didactics. The department of teacher education in the University of Helsinki sets the sustainable future as one of core views of all education in the department of teacher education.

Nevertheless, as a conclusion we could find only few mentions of the sustainable future in the department level curricula documents of these five Finnish universities. The concepts of the environmental portfolio, green technology, sustainable development, renewable energy sources, and retrofitting were not used at all. However, we acknowledge that what is written in the documents and what is actually taught in the lessons differs from each other more than less. Therefore, the analysis of the written curriculum does not mean that the lecturers and professors would not introduce these issues in their courses. However,

what makes this alarming is that, clearly, environmental issues do not have similar emphasis on departments' curricula as, for example, multicultural issues or need for special education issues has.

The role and position of the university professors

Respondents' characteristics

The majority of the lectures and professors in this study were older than 50 years (about two thirds) (Figure 1) and most of them they have been teaching over than 15 years in the departments of teacher education (Figure 2). About half of the respondent were members of University committee(s) (Figure 3) and about everyone has responsibility at least course level (Figure 4). Most of the respondents' were full time lecturers or full time professors (Figure 5). In few cases the affiliation of the respondent was unclear. One respondent categorized herself as associate professor, but made a comment to free text field that her position is a graduate student. Another case was similar and the respondent categorized himself/herself as assistant professor with tenure, but made comment to free text field that his/her position is the university researcher.

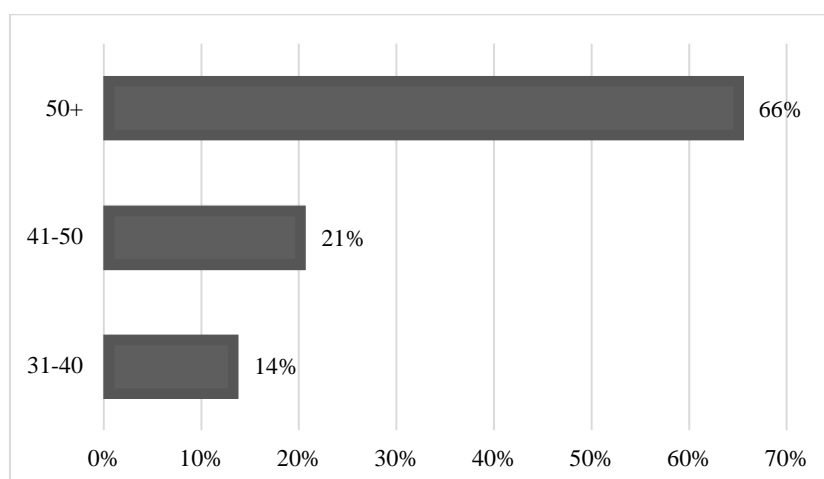


Figure 1: Distribution of respondents to different age groups

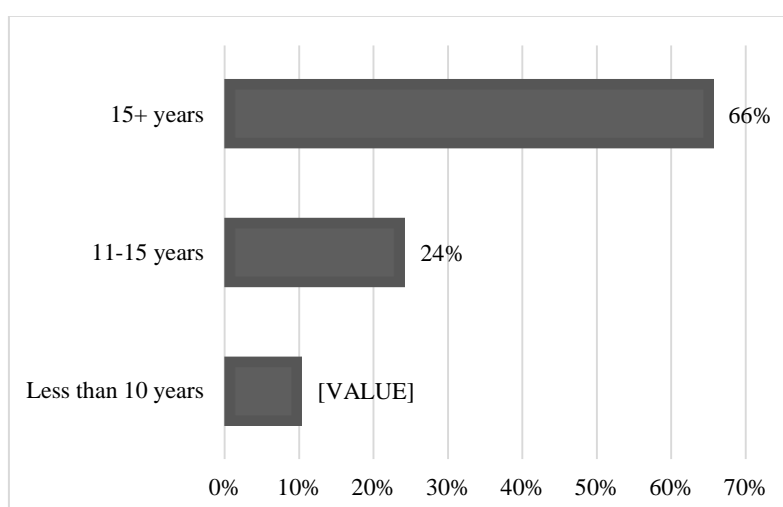


Figure 2: Respondents' teaching experience

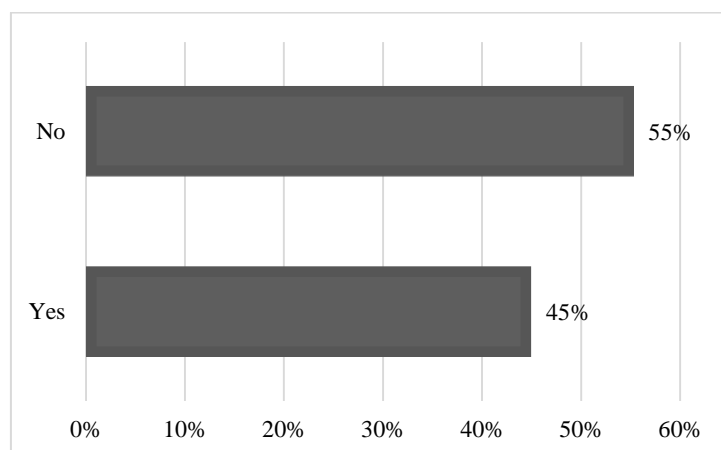


Figure 3: Respondents' participation in university committee(s) that deal with academic / educational / research / student issues.

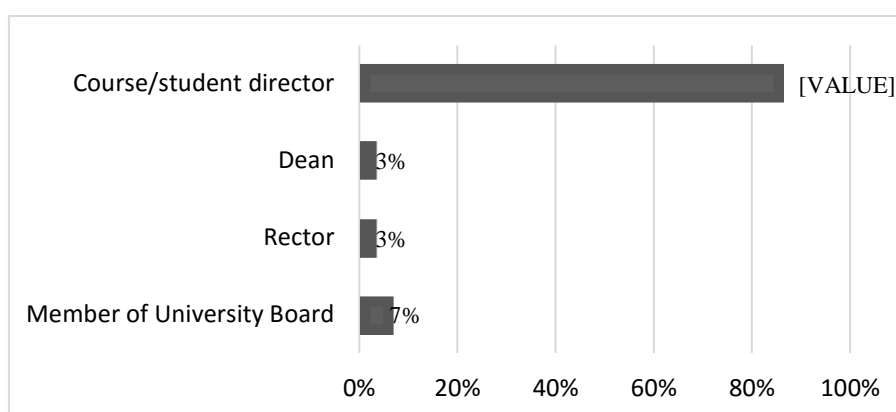


Figure 4: Respondents' responsibility in university administration.

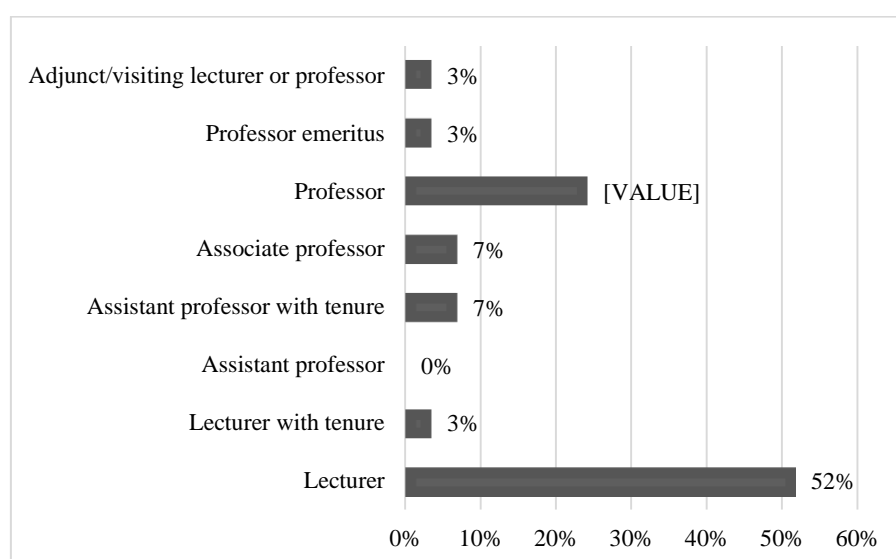


Figure 5: Distribution of respondents' based on their affiliation.

The respondents made following comments to their position in the university administration

- Responsible for the discipline up to PhD-level
- Responsible for music didactics
- No position
- Vice director of class teacher training programme
- Textile craft course director
- Professor in Early Childhood Education; leading this department

In few cases it was not self-evident to the reader what the respondent mentioned meant by his/her comments, such as; “Science education course” or “Minority studies of early years education”. Also one respondent replied that her answer was wrong, but she can’t remove it. Another one commented that they don’t have specific positions as indicated in the questionnaire.

- Some respondents commented on their role in the university administration in the following way: Member of research committee of department
- Member of the Committee of Degrees and Studies, Faculty of Behavioral Sciences
- I have served all levels up to the faculty dean.. and university Colloquium
- Board of doctoral school
- Faculty
- Student selection process
- Member of board of Jyväskylä University Science Museum
- University Colloquium
- a member of doctoral school
- Committees for developing research and for recruitment, Teams for curriculum development
- Member of the board of department

The linkage between their participation in university administration and its impact on environmental issues remains vague. However, some of the respondents hold a position, such as member of the board of the department, which has a knock-on effect on environmental issues. For example, in Finland in many cases the curriculum level documents are approved officially in the department level decision making boards. Therefore participation in the board has a knock-on effect on the general and particular guidelines that directs the education in the department, eventually on environmental issues too.

Respondents’ views on environmental issues

We were interested to find what lecturers’ and professors’ views were about environmental issues. Most of the lectures and professors had experience of teaching an environmentally related topic in many different subjects. When asked their for opinion about if they think that the implementation of environmental topics would significantly enhance the employability of your students after graduation, the answers distributed roughly in one third to each yes (31%), no (41%) and I don’t know (28%). This is, however, in contrast to their view on the working life. Almost everyone (83%) believed that labour market was becoming more sensitive in environmental issues now.

More variation arose when asked about the implementation of environmental issues in their own courses (Figure 6). Little above one third of the respondents thought that not many related courses are available. Little less than one third answered that some courses are available and their theoretical part is in balanced if compared to the practical part. The last third of the respondents’ answers were scattered, but based on the answers there could be more courses available in environmental education.

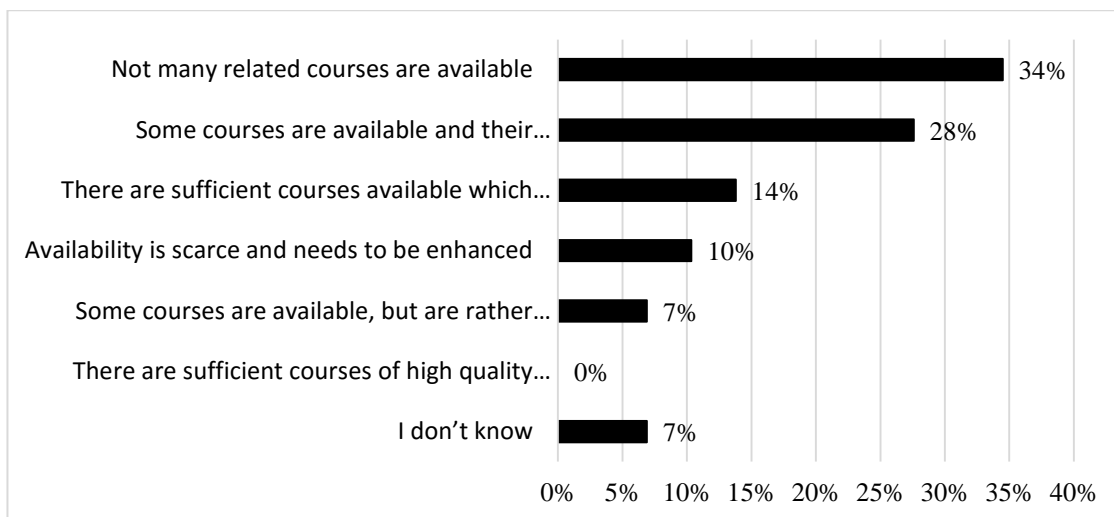


Figure 6: How do you rate the incorporation of environmental issues (as a horizontal discipline) in your courses?

Professors' and lecturers' opinions about the implementation of the new topics to their teaching varied (Figure 7). Solely, the basic principles of environmental impact assessment was regarded as most important, however its' share remained to around 20%. Recycling in its different forms comprised another relatively large proportion of all answers (36%; recycling and self-management issues). Third most frequent was general environmental and energy management issues (18%). The green technology and green entrepreneurship formed another combination, however not particular large proportion of answers (12% altogether). This was interpreted that it might reflect to some extent the students' lack of knowledge of how environmental issues are dealt in corporate life.

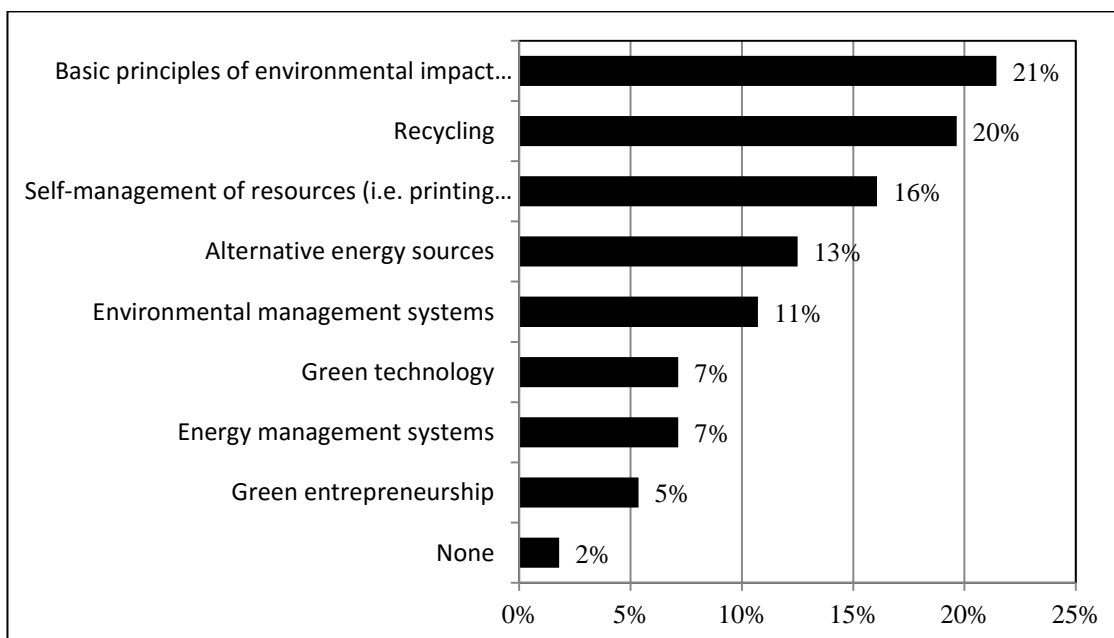


Figure 7: Which are the topics you think it is essential to be implemented in the University curricula?

The surveys also showed that clear minority of the lectures and professors were interested to participate in blended courses (31% were interested) and only 38% of the respondents were interested to know more about the project or the project results. This, in turn, is in contrast to their suggestions of topics that are essential to be implemented in the university curricula:

- Green consumption
- Please visit the webpages as www.perlprojects.org www.ifhe.org
- Understand system nature of environmental issues. They are cultural, ecological, economical.... As well as understanding of behaviour change
- Bioenergy resources
- Anthropological and ethical questions about humanness and relations between humans and non-humans (wider concepts of justice, democracy, maintenance and promotion of life etc.)
- This questionnaire is handling only natural science. Sustainable principles must be implemented also into every disciplines and into every subjects and must create new sustainable theories for children education and for teacher training, like I have created (Ulla Härkönen)
- This is depended of the main subject of the student. Environmental awareness and participation is most important for everybody.
- I would like to say that the important topics depend on the field of studies. All above mentioned are essential but everything depends on the field in which you are working.

Case HENVI -centre

HENVI is an umbrella organisation within the University of Helsinki. It concentrates on environmental research and teaching. In addition HENVI organises seminars, science days and interactive events.

The goal of the HENVI centre is to be an active actor in a society. HENVI actively follows and promotes topical environmental research and raises important issues to public awareness. HENVI also develops new forms of fundraising. HENVI collaborates with environmental administration, research institutes and other interest groups both nationally and internationally.

HENVI employs a coordinator of environmental research and a university lecturer in environmental studies. HENVI is led by a steering committee accompanied by the environmental scientific board. In addition HENVI has an advisory board representing interest groups and partners. Altogether 40 researchers and teachers take part in the functions of HENVI.

HENVI coordinates and arranges minor subject studies called Environmental multidisciplinary study module. The study module includes the following courses taught in English. The courses are open to all students.

- Global Environmental Challenges (6 ECTS)
- Urban Environmental Movements (5 ECTS)
- Environmental Problems, Physics and Chemistry (7 ECTS)
- Environmental GIS (5 ECTS)
- Multidisciplinary environmental teaching in DENVI seminar Urban sustainability - climate change and ecosystem services (1 ECTS)
- Environmental special course and workshop at HENVI (4 ECTS)
- Horticulture for human well-being (5 ECTS)
- Multidisciplinary environmental teaching in HENVI seminars (1 ECTS)
- Participatory methods in sustainable management of natural resources (5 ECTS)

- Plant Production in the Tropics (5 ECTS)
- Sustainable agri-food systems (3-5 ECTS)
- Sustainable forest ecosystem management (4 ECTS)
- Sustainable Agricultural and Rural Development (3 ECTS)
- Tropical forest and climate change (5 ECTS)

Also many other courses are organised, both pre-graduation and post-graduation levels, such as special seminars that concentrates on some current theme. For example, HENVI and World Wide Fund for Nature (WWF) Finland organized a joint seminar 2012. The topic of the seminar was Green Economy and Biodiversity. The objective of the seminar was to find out connections and complementary interactions between green economy and global biodiversity protection. The panel discussion highlighted possibilities of better management of biodiversity with greening economy.

Conclusions

In this study, university professors' and lecturers' views on environmental issues were studied who were working on the department of teacher education. Five Finnish universities were contacted and altogether 29 answers were received. The inductive content analysis method (Patton, 2002) was used to analyse the written responses. Also, the teacher training curricula were analysed. The researcher searched in the text for reoccurring words environment, environmental portfolio, green technology, sustainable development, renewable energy sources, retrofitting, or if these concepts were missing, the theme "sustainable future" was searched after. The target of the analysis were the title, the syllabus, and the learning objective of the curricula.

Only in a few occasions the concept of the sustainable future was found in the curricula documents of five Finnish universities. The concepts of the environmental portfolio, green technology, sustainable development, renewable energy sources, retrofitting were not used at all. One of the problems might be the *conceptual ambiguity* of the above mentioned concepts: it is not always self-evident what is meant by, for example, the green technology or sustainable future. Consequently, for the professors and lecturers not experts in the field, the principles of the sustainable future may appear as an unclear and unstructured compilation of ideas and approaches that have a little to do or nothing at all with their own work. It appears that the concept of "the sustainable future" has become too abstract for most of the actors of the educational field.

Another problem might be the *loose commitment* to the principles of the sustainable future. Typically, the strategic implementation plans at the university, faculty and department level lacks concreteness, which generates the basic dilemma: if it is everybody's task in praxis it means that it is nobody's tasks. These strategic documents are written a more abstract level and therefore it is not self-evident to professors and lecturers how they should apply the principles of the sustainable future to their own work. Consequently, the implementation remains to those few individuals who are personally interested in the issue or whose job description requires them to address these issues in their work. If these individuals actively demonstrate their implementations, for example, in teachers' meetings, it might generate an erroneous view to the administrative bodies of the department that things are progressing well. It seems that lack of guidance, lack of know-how and lack of recourses give rise to loose commitment.

To sup up, it seems that environmental issues does not have similar emphasis on the universities', faculties' and departments' strategic documents, degree programme descriptions or curricula as, for example, the multicultural issues have or the need for special education issues have. Sustainability is becoming more and more central to all disciplines and we see that the teachers are the real driving force of that attitude change. Important steps

are taken in the University of Helsinki where is launched the interdisciplinary environmental studies in HENVI-centre. These studies are open to class teacher students among others, but at the moment the studies are free willing. Our view is, however, that they should become compulsory at least in some extent in the near future like language studies are in Finnish universities.

Recommendations

Sufficient recourses

Problems are increasing in maintaining a proper balance between research and teaching duties to the academic staff. The workload of professors and lecturers are at unacceptable level. The process of implementation of the principles of sustainable future needs to be funded properly. It cannot be left on some academics' own interest and willingness upon. Professors and lecturers need recourses to become familiar with the principles of the sustainable future, to plan and implement these principles in their own work. This is time consuming and expensive, but will return the money invested many times in the long term.

Easy implementation

The implementation of the principles of the sustainable future needs to be easy for the university professors and lecturers. Universities can adapt models from each other and the exemplary arrangements in University of Helsinki (HENVI –centre) may be taken as a model for a swift and systematic reorientation of the environmental education at faculty level. Moreover, the principles of the sustainable future should be performed as major responsibilities for all departments. The professors and lecturers need to be provided concrete models of implementation. They need to be provided clear understanding on what is meant by the concept of the sustainable future, how they can implement the principles in their own teaching, what kind of learning and teaching materials are available.

Focusing on teacher training

Training in reflective teaching is an essential part of the initial teacher training and strongly connected to practice in schools. It is seen that teachers are the real driving force behind educational change in schools and in society. The teachers can be an organiser, guide and adviser to the pupil in his or her development and quest for knowledge, to a more sustainable future. The future is sitting in the classrooms at the moment.

References

- Curricula Guides 2014-2015, University of Tampere.* (n.d.). Retrieved from <https://www10.uta.fi/opas/index.htm>
- Curriculum plans 2014-2017, University of Jyväskylä.* (n.d.). Retrieved from https://www.jyu.fi/edu/laitokset/okl/opiskelu/luokanopettajakoulutus/luokanopettajakoulutus/Curriculum2014_English.pdf
- Flamma: University of Helsinki Intranet.* (n.d.). Retrieved from <https://flamma.helsinki.fi/portal/home/login>
- Opetusohjelma, Jyväskylän yliopisto* [Syllabus, University of Jyväskylä]. (n.d.). Retrieved from <https://www.jyu.fi/edu/laitokset/okl/opiskelu/luokanopettajakoulutus/luokanopettajakoulutus/luokon-opetusohjelma>
- Opinto-opas, Turun yliopisto* [Study guide, University of Turku]. (n.d.). Retrieved from <http://www.utu.fi/fi/yksikot/edu/opiskelu/oppaat/Sivut/home.aspx>
- Ardoin, N. M., Clark, C., & Kelsey, E., (2013). An exploration of future trends in environmental education research. *Environmental Education Research*, 19(4), 499–520.

- Black, P., & Atkin, J. (1996). *Changing the subject. Innovation in science, mathematics and technology education*. London, Routledge/OECD.
- Bloom, G., & Davis, B. (2001). *Supporting new teachers. A fundamental responsibility*. Santa Cruz: University of California.
- Denzin, N., & Lincoln, Y. (2011). Introduction. The Discipline and Practice of Qualitative Research. In N. Denzin & Y. Lincoln (Eds.), *Handbook of Qualitative Research* (pp. 1-28). Thousand Oaks: Sage Publications.
- González-Gaudiano, E. (2005). Education for Sustainable Development: Configuration and Meaning. *Policy Futures in Education*, 3(3), 243–250.
- Goodson, I. F. (1994). *Studying curriculum*. UK: Open University Press.
- Goodson, I. F. (1998). *The making of curriculum*. London: The Falmer Press.
- Keen, M., Brown, V.A., & Dyball, R. (2005). *Social learning in environmental management: towards a sustainable future*. London: Routledge.
- Monk, M., & Osborne, J. (Eds.) (2000). *Good practice in science education. What research has to say*. Buckingham: Open University Press.
- Opetus- ja kulttuuriministeriö (2011, November 14). Selvitys opettajankoulutuksesta. Retrieved from http://www.minedu.fi/export/sites/default/OPM/Koulutus/ammattikorkeakoulutus/opiskelu_ja_tutkinnot/Selvitys_opettajankoulutuksesta_14112011.pdf
- Organisation for Economic Cooperation and Development (OECD) (2008). *Encouraging Student Interest in Science and Technology Studies*. Paris: OECD.
- Patton, M. Q. (2002). *Qualitative research & evaluation methods*. Thousand Oaks: Sage.
- Peltoperä, P. (2015). Opinto-opas, Itä-Suomen yliopisto, filosofinen tiedekunta, soveltavan kasvatustieteen ja opettajankoulutuksen osasto. [Study guide, University of Eastern Finland, Faculty of Philosophy, Department of Applied Sciences of Education and Teacher Training unit.] Retrieved from http://www.uef.fi/documents/11461/2450661/Skope_opinto-opas+2014-2015_netti.pdf/504967cd-e252-463d-8950-b2344c4c0b0b
- Sjøberg, S. (2003). Science and technology education: A high priority political concern in Europe. In D. Psillos, P. Kariotoglou, V. Tselfes, E. Hatzikraniotis, G. Fassoulopoulos and M. Kallery (Eds.), *Science education research in the knowledge-based Society*. Dordrecht: Kluwer Academic Publishers, 211-220.
- United Nations Educational, Scientific and Cultural Organization (UNESCO) (2014). *Shaping the Future We Want. UN Decade of Education for Sustainable Development (2005-2014). Final Report*. Paris: UNESCO. Retrieved January 16, 2015, from <http://unesdoc.unesco.org/images/0023/002303/230302e.pdf>

Citation

Lampiselkä, J., Kivikko, N. (2016). Bridging environmental education across disciplines. *Science Education: Research and Praxis*, Special Issue, 58: 19 - 30. ISSN:1792-3166 (www.lib.uoi.gr/serp).

*Environmental Portfolio for Quality in
University Education*

2014-1-EL01-KA200-001373

Intellectual Output
(O6)

University of Naples



Citizen Science and Environmental Education in Italy. Possible Developments and the Role of Universities

Emilio Balzano¹, Caterina Miele¹, Marco Serpico¹

Abstract: *In the first phase of ÉPOQUE activities we have analyzed the state of the environmental education in Italian universities. The analysis was conducted by integrating two investigations: a desk research on general official data and some insights on the curricula offered by Italian Universities and a field research involving, through questionnaires and interviews, education professionals on issues that complement the information collected through the desk research. The analysis shows that much has been done during the last decades, in terms of introducing elements related to environmental issues in the University didactics of scientific disciplines; nevertheless, very little has been done (if anything) in order to introduce environmental science as an independent discipline in high-level University and post-University courses. In some cases, the presence in singled-out Universities of research groups active in the field has given birth to promising experimentations. Referring to the international debate and the difficulties that education for sustainability meets in different countries we think that it is necessary to radically revise the relationship between science and citizens. Science education should not be aimed to increase the talents in scientific and technological area in order to stimulate economic competitiveness which induces the resource depletion and the development of growing inequality. On the contrary, there is a growing need to involve students, teachers, scientists and citizens in discussing about the meaning and objectives of doing science. Based on these assumptions and deepening the results of our investigation with researchers and activists involved for years in education for sustainability we have designed an academic course to prepare a new generation of green professionals in the context of higher education. The course, which is based on a training about participatory methods and on the way to address the complexity of the phenomena that affect environmental protection and sustainability, has been pretested and revised in a pilot activity. It will be used and validated at European level in subsequent activities. The course is based on the possibility of training a new generation of educators able to interact with citizens in a participatory research involving citizens, scientists and policy makers on a par in analysis and decision making processes. Many initiatives that emphasise participatory forms of democracy are in their early stages, local environmental initiatives are not adequately referenced in the academic literature and it is difficult to provide evidence of citizen science activities in universities curricula. In this paper, moving from an experience carried out within our region, we discuss a scenario in which the academic staff, collaborating with activists of environmental and non-governmental associations, can learn how to innovate curricula and see itself as contributing to bring change in the direction of gaining a more productive relationship with citizens.*

Keywords: *environmental education, core ideas and crosscutting concepts in science education, participatory methods*

¹ Università degli Studi di Napoli Federico II, Italy.

Corresponding author: Emilio Balzano, E-mail:balzano@na.infn.it

Εκπαίδευση του Πολίτη και Περιβαλλοντική Εκπαίδευση στην Ιταλία. Οι Δυνατότητες Εξέλιξης και ο Ρόλος των Πανεπιστημίων

Emilio Balzano, Caterina Miele, Marco Serpico

Περίληψη: Στην πρώτη φάση των δραστηριοτήτων του *Eroque* αναλύσαμε το επίπεδο της περιβαλλοντικής εκπαίδευσης στα ιταλικά πανεπιστήμια. Η ανάλυση αυτή πραγματοποιήθηκε ενσωματώνοντας δύο διερευνήσεις: μία έρευνα γραφείου (έρευνα δευτερογενών στοιχείων) των επίσημων δεδομένων για τα προγράμματα σπουδών των Ιταλικών Πανεπιστημίων και μία έρευνα πεδίου η οποία εμπλέκει, δια μέσου ερωτηματολογίων και συνεντεύξεων, επαγγελματίες της εκπαίδευσης. Η ανάλυση δείχνει ότι υπάρχει πρόοδος κατά τη διάρκεια των τελευταίων δεκαετιών, στην εισαγωγή στοιχείων σχετικών με περιβαλλοντικά ζητήματα στη διδακτική των Φυσικών Επιστημών στα Πανεπιστήμια. Ωστόσο, ελάχιστες προσπάθειες έχουν γίνει προκειμένου να εισαχθεί η περιβαλλοντική επιστήμη ως ανεξάρτητο αντικείμενο στην τριτοβάθμια εκπαίδευση. Σε ορισμένες περιπτώσεις, η παρουσία ερευνητικών ομάδων σε μεμονωμένα Πανεπιστήμια έχει δημιουργήσει πρόσφορο πεδίο ανάπτυξης. Αναφερόμενοι στη διεθνή συζήτηση και τις δυσκολίες που αντιμετωπίζει η εκπαίδευση για την αειφορία σε διάφορες χώρες, πιστεύουμε ότι είναι απαραίτητο να αναθεωρηθεί ριζικά η σχέση μεταξύ επιστήμης και των πολιτών. Η εκπαίδευση των Φυσικών Επιστημών δε θα πρέπει να επικεντρώνεται στο να προάγει ταλέντα στον επιστημονικό και τεχνολογικό τομέα, με σκοπό να τονωθεί η οικονομική ανταγωνιστικότητα, που προκαλεί την εξάντληση των πόρων και την ανάπτυξη της αυξανόμενης ανισότητας. Αντίθετα, υπάρχει μια αυξανόμενη ανάγκη να εμπλακούν μαθητές, καθηγητές, επιστήμονες και πολίτες στη συζήτηση για την έννοια και τους στόχους της επιστήμης. Με βάση αυτές τις παραδοχές και εμβαδύνοντας στα αποτελέσματα της διερεύνησής μας με ερευνητές και ακτιβιστές, που συμμετέχουν εδώ και χρόνια στον τομέα της εκπαίδευσης για την αειφορία, σχεδιάσαμε ένα ακαδημαϊκό μάθημα, το οποίο προετοιμάζει μια νέα γενιά επαγγελματιών που ενδιαφέρονται για την προστασία του περιβάλλοντος, στο πλαίσιο της τριτοβάθμιας εκπαίδευσης. Το μάθημα, το οποίο έχει επικυρωθεί μέσω πιλοτικής δράσης, βασίζεται σε συμμετοχικές μεθόδους και έχει ως σκοπό να επισημάνει την πολυπλοκότητα των φαινομένων που επηρεάζουν την προστασία του περιβάλλοντος και την αειφορία. Επόμενος στόχος είναι η υλοποίηση και επικύρωση του μαθήματος σε ευρωπαϊκό επίπεδο. Το μάθημα επικεντρώνεται στην κατάρτιση μιας νέας γενιάς εκπαιδευτικών, οι οποίοι θα είναι σε θέση να αλληλεπιδράσουν με τους πολίτες μέσω μιας συμμετοχικής έρευνας, που θα εμπλέκει πολίτες, επιστήμονες και φορείς σε διαδικασίες λήψης αποφάσεων. Ορισμένες πρωτοβουλίες που δίνουν έμφαση στις συμμετοχικές μορφές της δημοκρατίας βρίσκονται σε πρώιμο στάδιο, ενώ συγχρόνως οι πρωτοβουλίες για το περιβάλλον σε τοπικό επίπεδο δεν αναφέρονται επαρκώς στην ακαδημαϊκή βιβλιογραφία. Σε αυτή την εργασία, έχοντας ως έναυσμα την εμπειρία μας σε τοπικό επίπεδο, αναπτύσσουμε ένα σενάριο στο οποίο το ακαδημαϊκό προσωπικό, σε συνεργασία με περιβαλλοντικούς ακτιβιστές και μη κυβερνητικές οργανώσεις, θα δημιουργήσει καινοτόμα προγράμματα σπουδών και θα συμβάλλει στην επίτευξη μιας πιο παραγωγικής σχέσης με τους πολίτες.

Λέξεις Κλειδιά: περιβαλλοντική εκπαίδευση, βασικές ιδέες και διεπιστημονικές έννοιες στην εκπαίδευση των φυσικών επιστημών, συμμετοχικές μέθοδοι.

Introduction

Research in science education indicates several strategies to improve scientific knowledge that are based on a number of assumptions such as the benefits of inquiry-based

learning and learning by doing, the importance of a social dimension of learning, the need for active learning and the existence of various learning styles based on individual, cultural and gender-related factors. However, scientific knowledge while playing an important role in developing the critical thinking does not guarantee changes in behaviours. Education for sustainability requires the development of participatory actions in which scientists and humanists are working with citizens and politicians sharing and negotiating solutions. So our ambition is to work on a programme in which the citizens can recognize that scientific knowledge is part of the culture and can improve our life. In our vision working for a sustainable development means reviewing the meaning and objectives of “doing science”. Scientific research is not always aimed at the well being of citizens, but often linked to the interests of the production and enrichment for a few people. It seems increasingly clear that the scientific community alone cannot respond to the complexity of the problems affecting the management of complex phenomena connected to protection of the environment. For example, in many cases it became clear that a risk assessment performed in purely probabilistic ways was not satisfactory. There is a general agreement that increased community participation in government decision making produces many important benefits. But despite the good intentions in many cases participation is designed to accept solutions that have already been taken by the scientific community and policy makers.

The debate on citizen participation in decision making is still open and a fundamental contribution was given by the theory of post-normal science (Ravetz, 2006). The post-normal science paradigm is based on the acknowledgement of the limitations of “normal” science approaches. Normal science is a puzzle-solving attempt to force nature to fit within a certain paradigm “predicated on the assumption that the scientific community knows what the world is like” (Kuhn, 1962) in which all the evaluations are made by the scientific community itself. In a post-normal science approach Extended Peer Communities (EPC) involve citizens joining the policy process, collaborating with others and reaching consensus to bring about positive social and environmental change (“facts are uncertain, values in dispute, stakes high and decisions urgent” (Funtowicz & Ravetz, 1991); “extended peer community: judges, journalists, scientists from other fields or just citizens” (Funtowicz & Ravetz, 1994). Such an extension improves the democracy of science for governance and enhances the quality of the decision-making process and its outcomes.

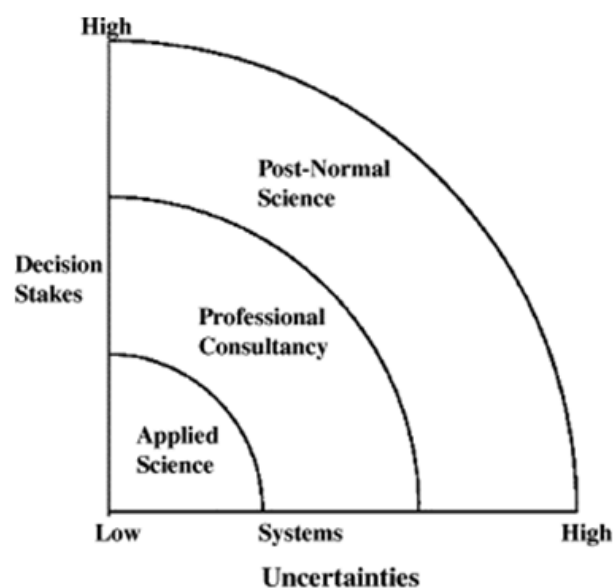


Figure 1. The Post-Normal Science diagram (Funtowicz & Ravetz, 1991).

Again, establishing the legitimacy of the EPC requires a rethinking of the meaning of “doing science” within the policy process. That's why we think that the preparation of a new generation of professionals working in the field of sustainability must integrate scientific and humanistic knowledge with particular interest in the study of complex systems and participatory methods. An interesting way to rethink science involving citizens is proposed in the field of activities that relate to Citizen Science (CS). CS generally refers to research collaborations between scientists and volunteers, providing the latter with opportunities for scientific data collection and access to scientific information that is usually aimed at scientists only. In our vision the citizen engagement should not be limited to collection of data but may relate to fundamental aspects of doing science (what is investigated, by what means and what funding, what are the priorities). And citizens can be effectively involved in action research activities aiming for an active role that schools can play in their communities. This obviously requires a focus in educating for sustainability. Sustainability must increasingly involve citizens (individuals and communities) to develop critical thinking aimed at facing complex problems. Sustainability presents a valuable paradigm for rethinking pedagogy but there are not yet relevant examples of what to do. *“So despite the growing recognition in society that sustainability concerns need to become more in focus in education and learning, particularly among young people, it is not clear how to do this. ... Sustainability represents what some refer to as wicked problems (Gibson and Fox, 2013): problems that defy definition, have no single solution that works always and everywhere, drenched in ambiguity, and are submerged in conflicts among multiple stakeholders. (Figure 2.) Sustainability, in a sense, cannot be taught... teaching sustainability becomes an educational design challenge”* (Wals, 2016).

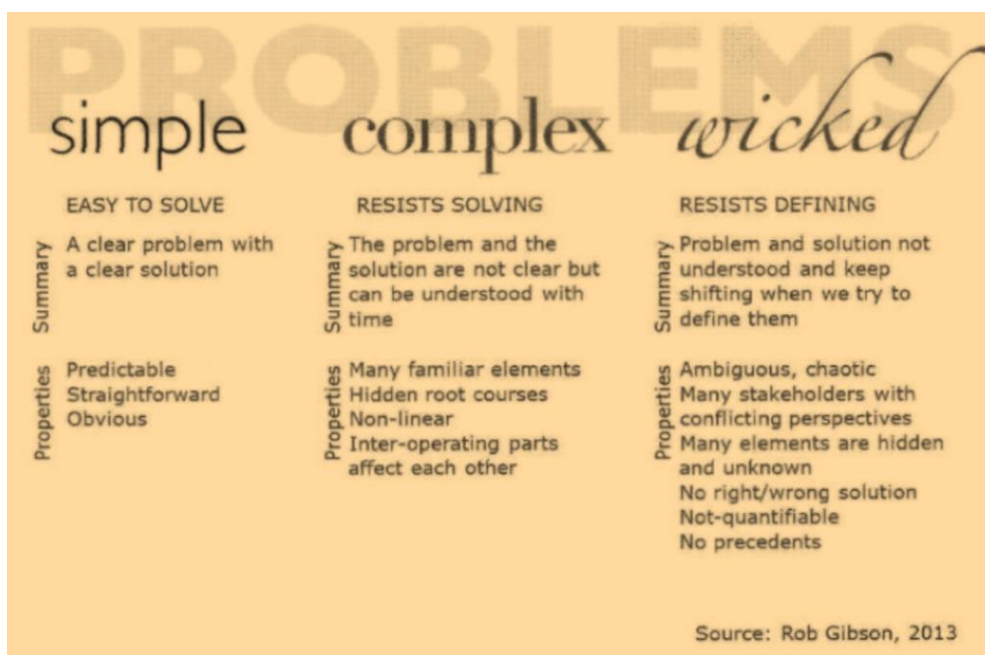


Figure 2. A Typology of problems (source: <http://mofox.com/pdf/simple,complex,wicked.pdf>).

This is a process which requires a gradual collective growth and a key role can be played by schools that are open to interact with their socio-cultural context. An example of activities with an environmental focus which involved schools in relation to the university and

the public is given by experiences we are developing in our region in the ENVIRAD-Radiolab project (Balzano et al. 2006). This project is focused on radioactivity measurements and to the perception of the risks associated to radioactivity. More specifically, the project is based on a radon survey which was carried out in 49 schools, involving about 1000 students. Pupils were directly involved in radon long-term measurements (LR115 detectors), being responsible of the data taking. In some cases they also performed radon concentration measurements in sites other than the schools, in order to promote the awareness of this issue among citizens. The main aim of the ENVIRAD-Radiolab project is the achievement of scientific results that are tangible and immediately useful for both research community and students themselves. This approach is a way to back up the connection between science and society and to improve the students' awareness of multiple connections between various disciplines involved in the proposed topic.

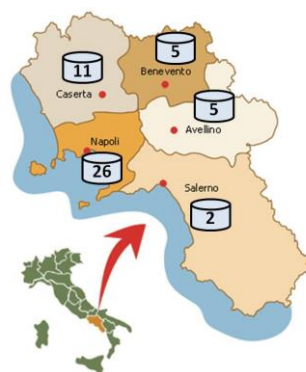


Figure 3. Distribution of the schools' buildings involved in the ENVIRAD project in Campania (a volcanic region whose territory is characterized by the high indoor radon concentrations)

Environmental Issues in the Italian University Curricula

In order to investigate the present inclusion of environment-related topics in the Italian universities syllabuses we combined the analysis of the answers to a short questionnaire administered to a sample of 20 university professors with the official data made available by the Ministry of Education. In order to deepen the analysis we also had short interviews with some of the professors who answered the questionnaire. Although very small, the sample we chose for the questionnaire is still reasonably representative of the Italian scenario as it includes a significant diversity in terms of age ranges, teaching experience and research interests. Moreover the sample includes both people who have been actually involved in teaching environmental-related subjects and people who have been not.

According to the official data made available by the Ministry of Education around ten thousands students are today **attending** degree courses focused on environment-related topics in Italian universities. The structure of these degree programmes is based on a culture of environmental issues that fails to embody their huge complexity and more in particular fails to connect the strictly scientific and technological aspects of these issues with their broader cultural, social, economic, political implications. While these programmes pretend to be based on a multidisciplinary approach, they actually fail in developing environmental science as an independent discipline and they construct competencies that are the result of a sum rather than a mix of traditional disciplinary contents. A couple of decades ago environmental curricula were substantially absent in the educational offer of Italian universities. This means that much has been done already. But still most of the courses included in these programmes are what we can call “green washed” traditional disciplinary

courses. In order to revert this trend a change of perspective is needed that could be inspired by the framework that the international debate has defined as *environmental education*.

The bachelor and master degree programmes we analysed are oriented to train professionals who are supposed to get a job in the field of public and private environmental services, but – as most of the people we interviewed underlined – their actual job opportunities are often shifted towards a variety of different working contexts. This is of course due to the general bad trend in the Italian labour market but is also linked to the lack of a widespread public culture of environmental and sustainable development issues and therefore to a lack of demand for environment-related jobs. What actually lacks is a strong public commitment towards the implementation of structural programmes devoted to citizen-oriented environmental education, environmental impact assessment, environmental risk management, energy management, etc. Something similar can be said about university research on environmental issues, which counts a number of groups spread around the national territory but is lacking coordination and common programming at the national level.

The Design of the EPOQUE Course

Based on the comments we collected during the interviews, we claim that a reverse in the cultural perspective about the environment is needed in our country. Of course such a process involves a **number** of different social and cultural contexts rather than the academic ones alone. But if one focuses the attention on what could be done in the university context, actions cannot be limited to bringing some environmental-related issues into the traditional disciplinary contexts. What is needed is rather a shift towards an *environmental education* perspective. The course that we present below thus takes into account the assumptions discussed in the introduction and the indications emerging from the desk and field research. We have chosen to refer the issues of the course to three main perspectives (Science Education, Scientific Research and Societal Issues) which are interrelated, trying to engage students in understanding what is lost if they are not simultaneously considered. The question we tried to answer was: what is the contribution that each single perspective can give by itself? What is lacking in each single perspective taken by itself? Schematically referring to Figure 4: scientific research can contribute with the big ideas and methods coming from several different disciplines. Science education can contribute with hints about possible ways to reconstruct disciplinary ideas to make them more suitable to the widest dissemination of scientific culture. Society can contribute with all the forms of knowledge and experiences that citizens can bring into the debate.

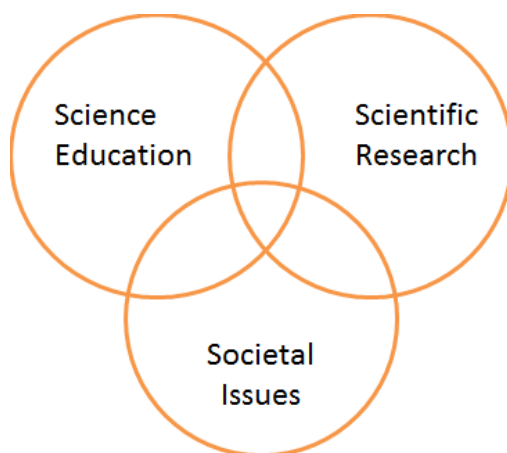


Figure 4. The issue of sustainable development can be tackled from many different perspectives.

Scientific research is often too far from citizens' actual views, perspectives and needs. It is no coincidence that H2020 Programme is very much focused on the idea of Responsible Research. Science education sometimes is not able to take into account the huge variety of contexts in which people actually learn and all the current lines in science education research are framed by the idea of Inquiry. Policies often fail to take into account social, economic and cultural issues but since the Rio Earth Conference in 1992 environmental issues started to be brought into a wide scenario which is centred on a general idea of Social Equity.

Starting from these keywords (Responsible Research, Inquiry, Social Equity), we state that environmental education cannot be simply the sum of contributions coming from traditional disciplines. Adding the adjective environmental to traditional disciplines hardly brings new knowledge. The environmental perspective can give us hints which help us looking at traditional disciplines in a more transversal, integrated and non-reductionist way.

If we consider both the developments of different scientific disciplines that evolve towards inevitable specialisms and the need to work towards a unified vision of the phenomena we see that it is necessary to rethink the structure of the subject contents. This can be done by reorganizing the contents in core ideas and crosscutting concepts (NSF,2012) as outlined in Figure 5.

Crosscutting Concepts	Disciplinary Core Ideas
Patterns	<i>Physical Sciences</i>
Cause and effect: Mechanism and explanation	Matter and its interactions
Scale, proportion, and quantity	Motion and stability: Forces and interactions
Systems and system models	Energy
Energy and matter: Flows, cycles, and conservation	Waves and their applications in technologies for information transfer
Structure and function	<i>Life Sciences</i>
Stability and change	From molecules to organisms: Structures and processes
	Ecosystems: Interactions, energy, and dynamics
	Heredity: Inheritance and variation of traits
	Biological evolution: Unity and diversity
	<i>Earth and Space Sciences</i>
	Earth's place in the universe
	Earth's systems
	Earth and human activity

Figure 5. Disciplinary Core Ideas and Crosscutting Concepts (
<http://www.nap.edu/catalog/13165/>)

Environmental education (and science education in general) must increasingly involve citizens (individuals and communities) to develop critical thinking aimed at facing complex problems. The study of complexity changes the way we think about science and its role in society. Complex systems are systems in which the separate behaviours of different parts can give rise to emerging collective behaviours of the system. Reductionist approach based on the possibility of studying separately the different parts of the system is no longer adequate: emerging behaviours can be explained only if we take into account the relationships between the different components of a system. The study of complex systems invests and is informed by a number of traditional disciplines including all scientific disciplines, maths, engineering, management, sociology and many others. Environmental education is not a generic tendency to develop educational programmes aimed at enhancing citizens' sensibility towards environmental issues but is a more general and well established framework although

researchers follow it with many different approaches (Ardoin, 2013, Krasny & Dillon, 2012, Sauvé, 2005), where environmental issues are brought into a wide scenario that involves social, economic and cultural issues and are linked to a general idea of social equity (UNESCO, 2010). From an educational point of view, moving to this perspective then means the implementation of programmes that are intrinsically interdisciplinary and are not based on a *didactic of the environment*. Special attention should be devoted at constructing brand new links between traditional scientific disciplines contents and the environmental education framework (NAAEE, 2014). People involved in environmental education programmes should be engaged in developing awareness of the huge complexity of environmental issues and link the knowledge they are developing to skills that make them able to make decisions that are informed and responsible from a socio-economical point of view (Bachiorri, Puglisi & Giombi, 2009). In figure 6 we present a conceptual map of the course we designed while in Figure 7 the organisation of the course in modules is outlined. Aim of the course is to develop transversal competencies in science, in economic and social sciences for an education that involves people as citizens. Learners are required to recognize the complexity of many phenomena with a critical integrating knowledge coming from different disciplines. Learning activities have to be focused on dealing with real problems and critically evaluating the consequences of different solutions. The course address students from different degree courses, school teachers and educators who work in local institutions and can be implemented in different contexts (universities, schools and museums) in order to target the general public.

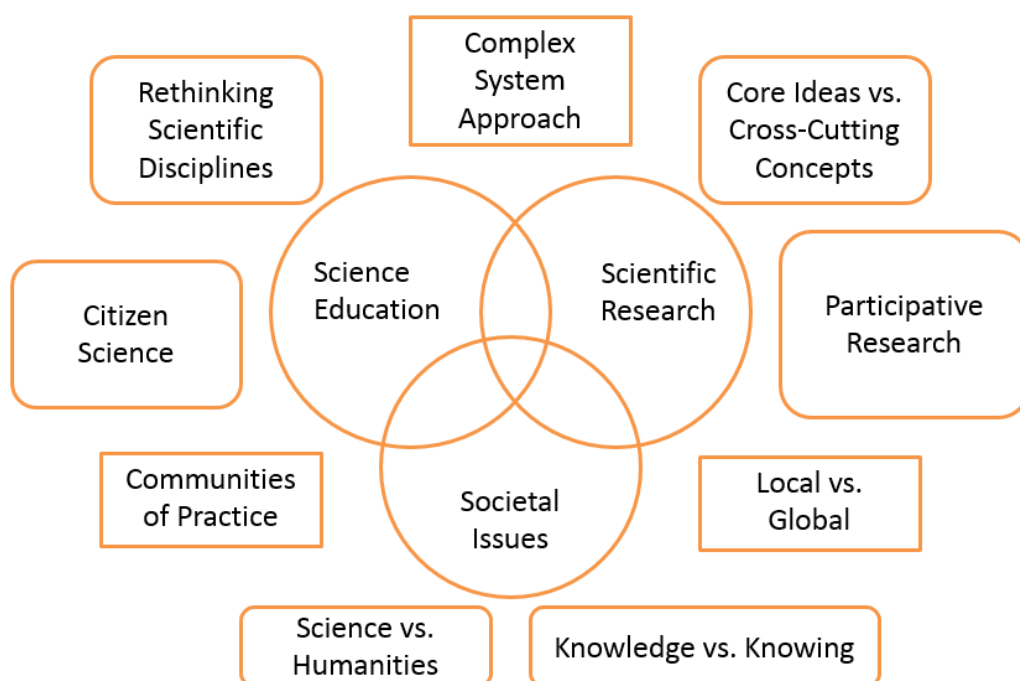


Figure 6. Conceptual map of the course.

COURSE	ECTS	CONTENT	METHOD/TOOL
Module 1	3	Topic 1: Action research, reflexivity and participatory methods Topic 2: Case study analysis	Face to face / Laboratories
Module 2	3	Topic 1: Transversal competencies in environmental education Topic 2: Complexity of biodiversity and impacts on local communities	Face to face / Laboratories
Module 3	3	Topic 5: Core ideas and crosscutting concepts in science education Topic 6: Complex system	Face to face/ Laboratories
Case study	6	Recycling and sustainable management of natural resources	Face to face/ Laboratories/ Fieldwork

Figure 7. Organisation of the course into modules.

Local Initiatives and Proposal for Future Research

The understanding of the relationship between local and global process is crucial for the sustainability. The interconnectedness of human-made systems and communities, and the understanding of how local experiences mediate the global ones are the main elements that characterize the Case study of the course (the fourth module in figure 7).

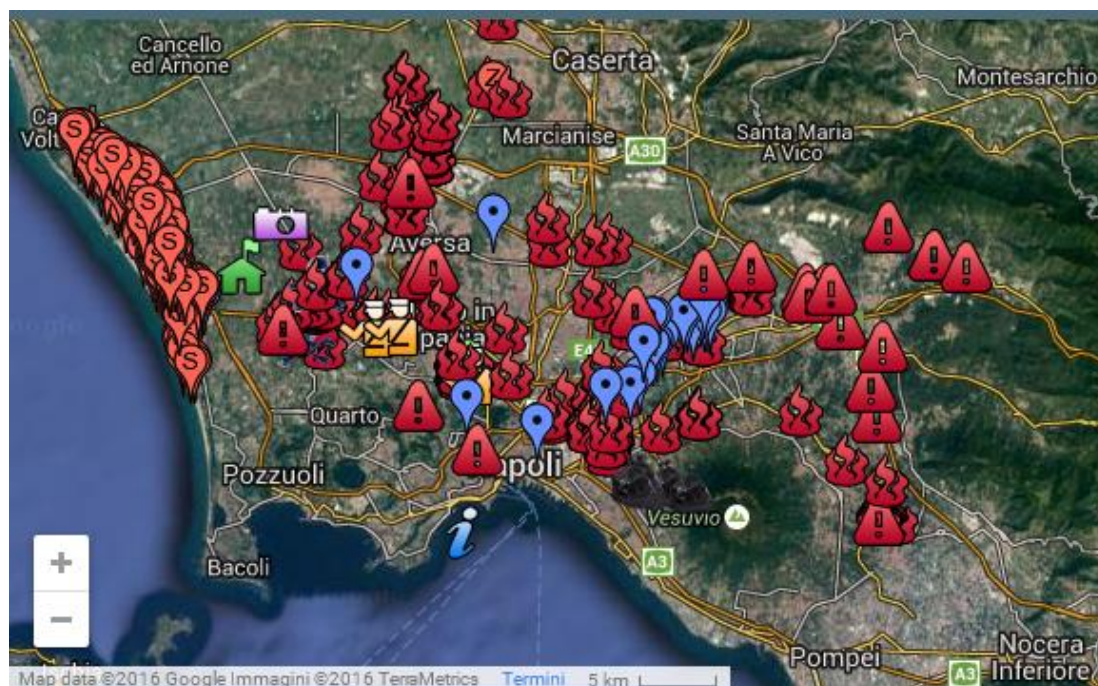


Figure 8. Interactive Map, census of illegal fires and sites of toxic waste incineration (<http://www.laterradeifuochi.it/>)

The analysis of the case study becomes an opportunity for us to engage future educators in the participatory research with the creation of a community of researchers, activists and citizens able to involve policy makers to solve issues of mutual interest. Although

waste management is often considered to be mainly a technical issue, in the discussion of our Case study we argue that it cannot be addressed without taking into account, at the same time, the local and the global dimension and the way in which citizens are involved. Just as in 2008 the waste crisis in the Campania region and the consequent environmental problems of contamination of soil, water and air caused, as indirect effect, the rise of a new general awareness among the local inhabitants on the social and environmental damage impacts. In the past 20 years, a large area in Campania has become known as the “Land of fires” (Fig. 8), a place where black pillars of smoke from burning garbage dumps have exposed local populations to increased risk of lung carcinoma. In response civil society has mobilised in local grassroots committees and associations and many protests and clashes with authorities have taken place.

The recent financial crisis (and consequent cuts to the social services, even at a local level) have had a double and contrasting impact on the life of the inhabitants of the city of Naples. On the one side, the inhabitants’ living conditions - in particular, among low-income and/or marginalized individuals, families and groups in the popular neighbourhoods of the city - have worsened as social services and public services have been reduced. On the other side, a lack of or poor public intervention caused the rise of social movements aimed at developing innovative forms of grassroots economies. For example, many different kind of civil society organizations in the past few years have occupied, recovered and reused abandoned buildings (in most of cases, historical buildings owned by the Municipality of Naples) implementing brand-new spatial practices within the urban space with relevant environmental as well as social implications. Furthermore, the city of Naples is a complex social context of great interest for educational issues: since the seventies, many experimental pedagogical projects addressing deprived neighbours’ children and young people have been arisen, what makes Naples a context with a long tradition in grass-roots pedagogies, even if this kind of experiences have been not so often taken up in “normal” school. The strategic relevance of the schools is established, first, by their capacity of activating local community networks and get them involved in the activities of research. Second, since the schools are spaces of exchange and confrontation between parents, teachers, students, researchers and educators, they represent an inherent space of mediation between the scientific culture (in particular, between its school version) and the different specific “funds of knowledge” of the students and their families. Third, exactly for their role in the local community life, the school can be utilized within an action-research approach to make not only the students but the whole community involved in science education projects in order to make them familiar with practices and concepts that are usually used by environmental scientists or technicians – such as ICT devices (sensors and apps) for the acquisition and representation of data together with the knowledge of scientific concepts in order to describe complex systems and environmental phenomena that are by their nature complex – or by social scientists – theories and methodologies of ethnographic research and participative inquiry. In particular, such projects should privilege the involvement of schools with the following characteristics: 1) an educational approach aimed at promoting cooperation with other schools and universities; enhancing the contribution of training and learning opportunities coming from the territory; developing and exploiting the use of innovative learning methodologies, approaches and tools and strengthen the scientific-technological field; 2) pupils coming from low-income families and disadvantaged social groups; 3) located in an area particularly affected by environmental problems or likely to be interested in activities promoting sustainability.

Discussion and Conclusion

Introducing elements of environmental education in the available university courses or specific courses devoted to environmental education could be a good way to bring some

change in the perceptions of all students who are building a professional profile that has to do with environmental issues. Such a process could however be difficult to implement for a number of reasons. Elsewhere in Europe, environmental education is becoming part of widespread culture and is part of the school curricula from the earliest grades of education. This is not the case for Italy especially because of a lack of structural initiatives by the institutions. In order to improve the situation there should be a strategic interest by the Institutions in developing a widespread culture of environmental issues.

This change of perspective should be based on interventions that are in line with the internationally established principles that underlie environmental education. It would be important to revisit the subject content of traditional scientific disciplines in the specific perspective of environmental education, but this revision must be deep and cannot just mean adding the word "environment" to anything. Different disciplines should be contaminated with each other in order to construct a brand new discipline. This also means changing the general idea of what science is and is meant for, going in the direction of including expectations that come from citizens. In many countries, citizens' associations, non-governmental organizations involve teachers in learning paths at school. It has formed an invisible infrastructure of educators acting in formal and informal contexts which effectively supports teachers and citizens (in adult education programs) in the development of issues related to environmental education. Education for sustainability requires the development of participatory actions in which scientists and humanists are working with citizens and politicians sharing and negotiating solutions. Environmental education (and science education in general) must increasingly involve citizens (individuals and communities) to develop critical thinking aimed at facing complex problems. Many human behaviours are difficult to evaluate. Efforts are needed to share with educators and teachers indicators and new assessment methods for evaluating the effectiveness of educational activities on sustainability.

References

- Ardoin, N. M., Clark, C., & Kelsey, E. (2013). An exploration of future trends in environmental education research, *Environmental Education Research*, 19 (4), 499–520.
- Bachiorri, A., Puglisi, A. & Giombi, G. (2009). Environment, our common future: Exploring students' perceptions in an environmental education framework, In *Abstract book of the 5th World Environmental Education Congress*, Montreal.
- Balzano E., D'Onofrio A., Gialanella L., Giberti G., Pugliese M., Roca V., Romano M., Sabbarese C. & Venoso G. (2006). Education in the radioactivity field: a project for the Italian schools. *Second European IRPA Congress on Radiation Protection*, Paris.
- Funtowicz, S.O. & Ravetz J. R. (1991). A New Scientific Methodology for Global Environmental Issues. In R. Costanza (Ed.) *Ecological Economics: The Science and Management of Sustainability* (pp. 137–152). New York: Columbia University Press.
- Funtowicz, S. O. & Ravetz J. R. (1992). Three types of risk assessment and the emergence of post-normal science. In S. Krimsky & D. Golding (Eds.), *Social theories of risk*, (pp. 251–274). Westport, CT: Praeger.
- Gibson R, Fox M. (2013). Simple, Complex and Wicked Problems. Available from <http://mofox.com/pdf/simple,complex,wicked.pdf>.
- Krasny, M. & Dillon, J. (2012). *Trading zones in environmental education: Creating transdisciplinary dialogue*. New York, NY: Peter Lang.
- Kuhn, T.S. (1962). *The Structure of Scientific Revolutions*. Chicago: University of Chicago Press.
- NAAEE (2014). *Linking environmental literacy and the next generation science standards, a tool for mapping an integrated curriculum*. Washington, DC: North American Association for Environmental Education.

- National Research Council (2012), *A Framework for K-12 Science Education*. Washington DC: The National Academies Press.
- Ravetz J. R. (2006). Post-Normal Science and the complexity of transitions towards sustainability *Ecological Complexity*, 3(4), 265–382.
- Sauvé, L. (2005). Currents in environmental education: Mapping a complex and evolving pedagogical field, *Canadian Journal of environmental education*, 10(1), 11–37.
- UNESCO (2010). Teaching and learning for a sustainable future, a multimedia teacher education programme. Retrieved from <http://www.unesco.org/education/tlsf/>
- Wals, A.E.J (2016). Beyond unreasonable doubt. Education and learning for socio-ecological-sustainability in the anthropocene. Retrieved from https://arjenwals.files.wordpress.com/2016/02/8412100972_rvb_inauguratie_wals_oratieboekje_v02.pdf

Citation

Balzano, E., Miele, C., Serpico, M. (2016). Citizen Science and Environmental Education in Italy. Possible Developments and the Role of Universities. *Science Education: Research and Praxis, Special Issue*, 58: 31-42. ISSN:1792-3166 (www.lib.uoi.gr/serp).



Environmental Portfolio for Quality in University Education

2014-1-EL01-KA200-001373

Intellectual Output (O6)

Hellenic Open University



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 EPOQUE. Η ανάδραση που λάβαμε είναι πολύ ενθαρρυντική, ενώ αποκάλυψε

¹ Hellenic Open University, Greece.

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

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.

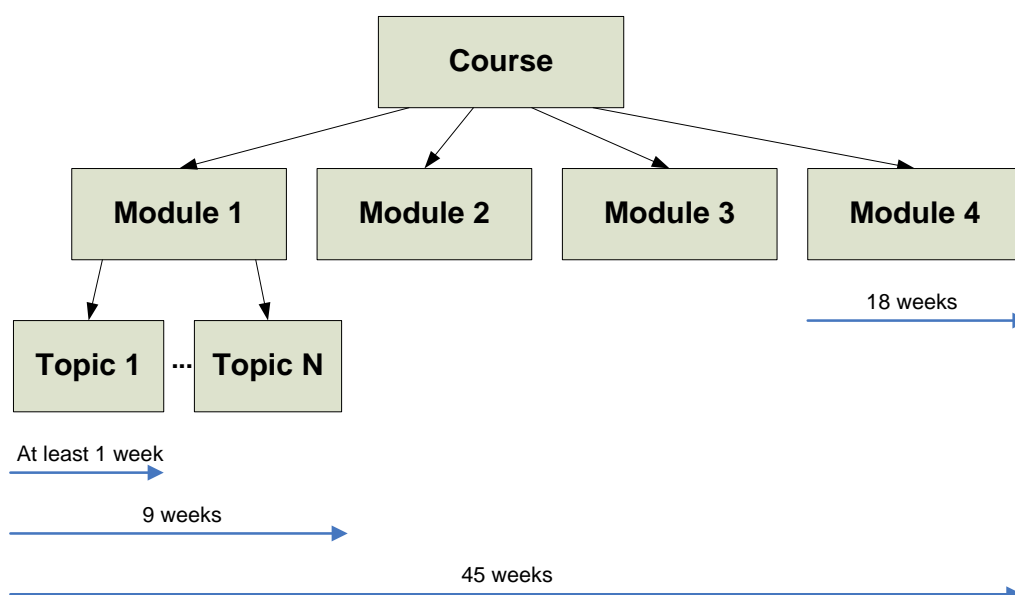


Figure 1: Graphical representation of the e-learning framework

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 LObs; 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 thee-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, discusses 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.

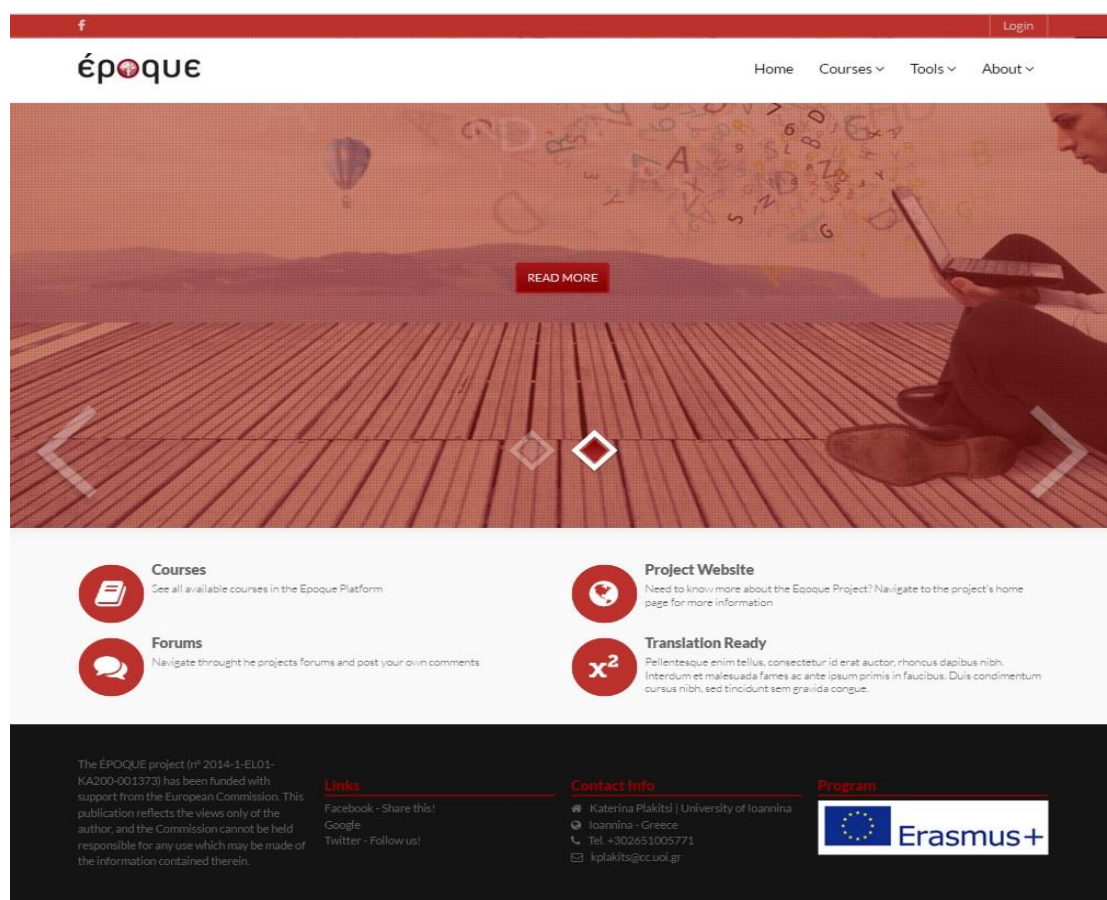


Figure 2: Home page of the EPOQUE e-learning platform

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.

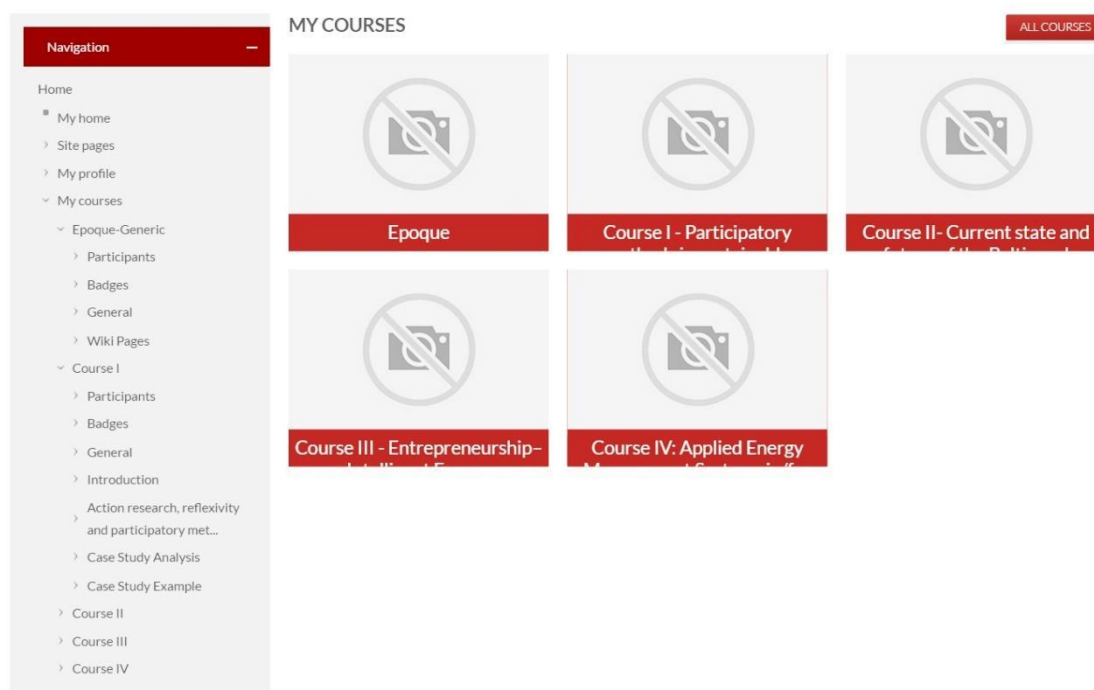


Figure 3: Course and user navigation

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

Question	Author	Replies	Latest
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.

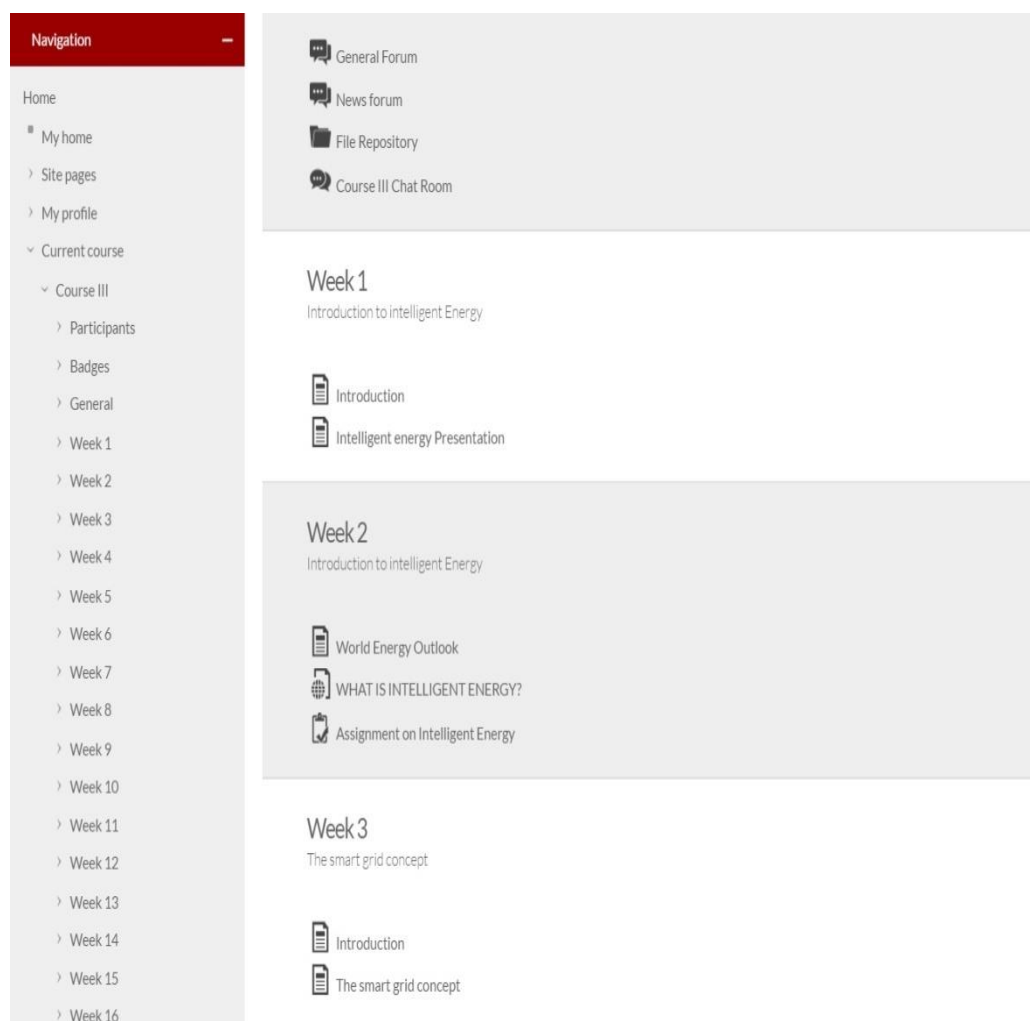


Figure 6: A segment of the EPOQUE's online Course III

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

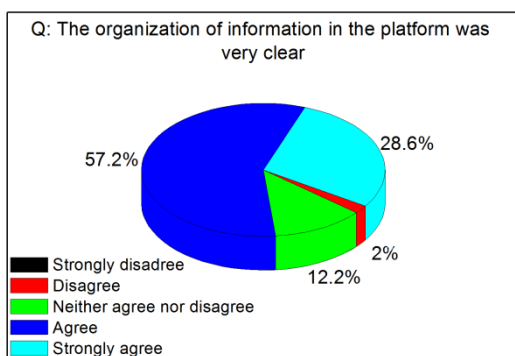
of primary education of the University of Ioannina, as well as teachers of primary and secondary education in Greece.

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.

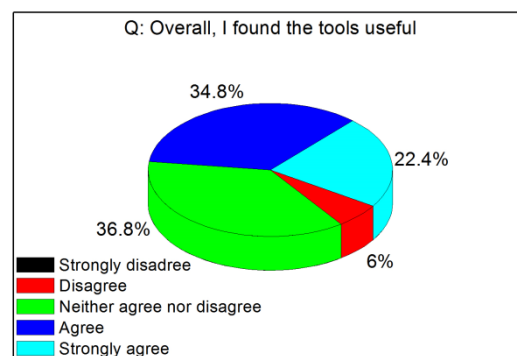
The sample comprised of 41 females (~86%) and 8 males (~16%). Approximately 67% of the attendants were students, 20% were teachers, 8% were out of and looking for work, while lower percentages corresponded to people out of and not looking for work or self-employed. Moreover, 61% of the attendants were 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

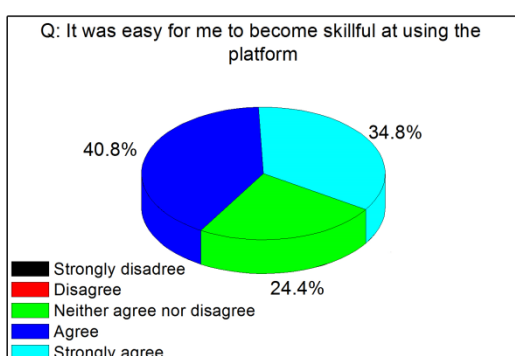
Table 2: Sections and indicative questions of the e-learning platform evaluation questionnaire



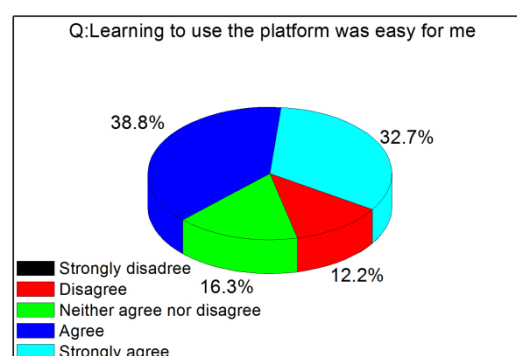
Platform in general



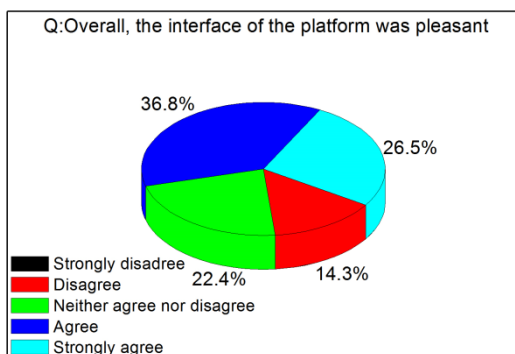
Tools



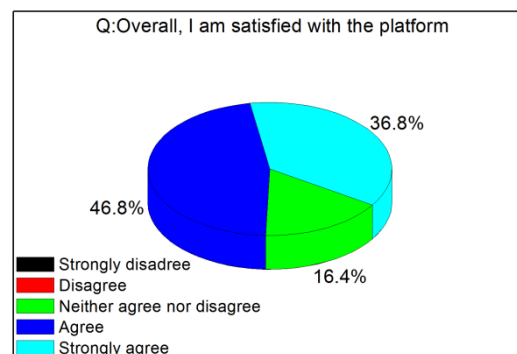
Ease of use



Learnability



Attractiveness



Satisfaction

Figure 7: Results of the answers to the questions of Table 2

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

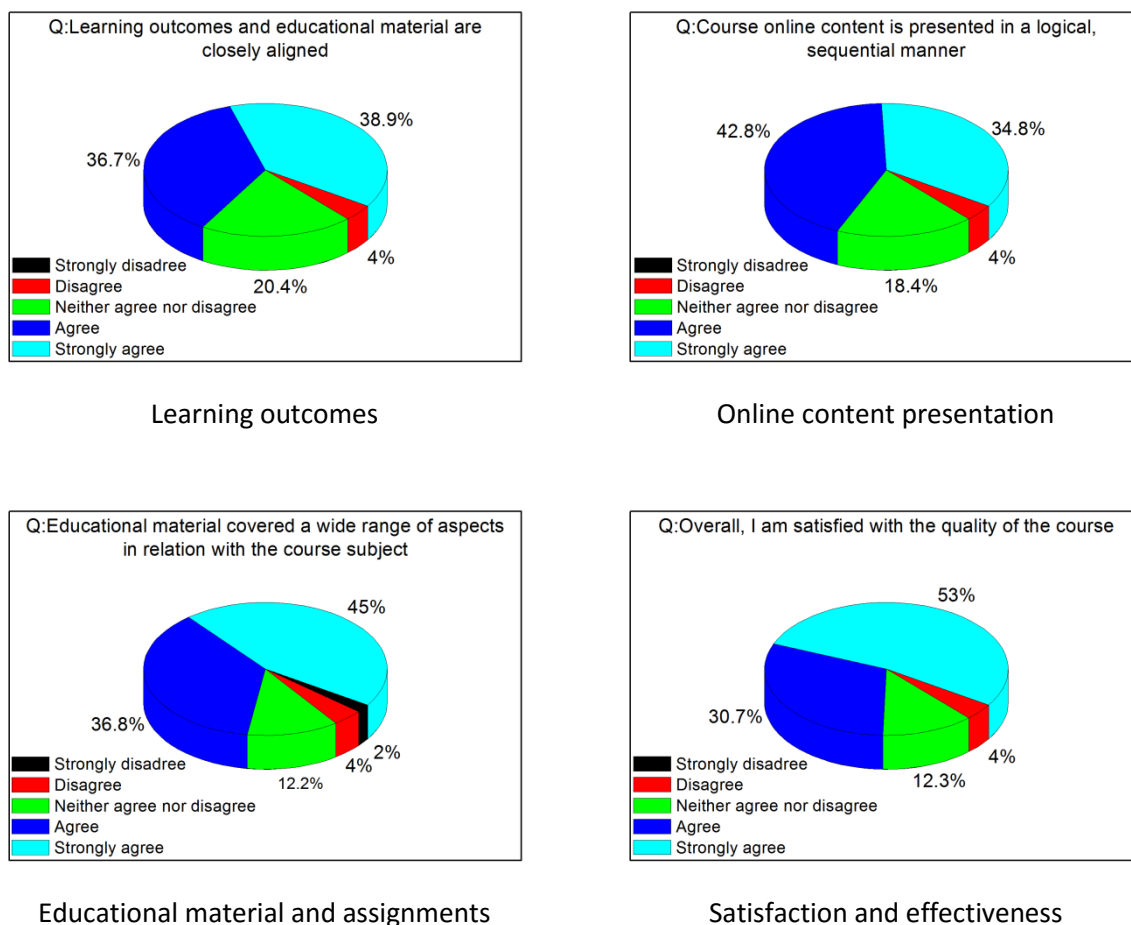


Figure 8. Results of the answers to the questions of Table 3

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.

References

- Adiyoso, W. & Kanegae, H. (2012). The effect of different disaster education programs on tsunami preparedness among schoolchildren in Aceh, Indonesia. *Disaster Mitigation of Cultural Heritage and Historic Cities*, 6(7), 25-35.
- Anderson, L.W., & Krathwohl, D. (2001). *A Taxonomy for Learning, Teaching and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives*. New York: Longman.
- Bloom, B. S., Engelhart, M., D., Furst, E. J, Hill, W. & Krathwohl, D. (1956). *Taxonomy of educational objectives. Volume I: The cognitive domain*, New York: McKay.
- Brown, A. & Green, T. D. (2011). *The essentials of instructional design: Connecting fundamental principles with process and practice*. Boston: Allyn & Bacon
- CEDEFOP (2008). Terminology of European Education and Training Policy A selection of 100 key terms. Retrieved from <http://www.cedefop.europa.eu/EN/publications/13125.aspx>
- European Commission (2015). ECTS Users' Guide 2015, Retrieved from http://ec.europa.eu/education/library/publications/2015/ects-users-guide_en.pdf
- Jarvis, P. (2012). *Towards a Comprehensive Theory of Human Learning, Lifelong Learning and the Learning Society*, London: Routledge,

Mager, R. F. (1984). *Preparing instructional objectives*. (2nd edition). Belmont, CA: Pitman Learning

U.S. Energy Information Administration (2013). International Energy Outlook 2013. Retrieved from [http://www.eia.gov/forecasts/ieo/pdf/0484\(2013\).pdf](http://www.eia.gov/forecasts/ieo/pdf/0484(2013).pdf)

Citation

Panagiotakopoulos, T., Kameas, A., Kalemis, I. (2016). Developing online courses for an environmental portfolio. *Science Education: Research and Praxis, Special Issue*, 58: 43-60. ISSN:1792-3166 (www.lib.uoi.gr/serp).