BIOTALENT – Talent in Biodiversity
Innovative education and new skills to increase engagement in Science

REPORT
INTELLECTUAL OUTPUT O5
ONLINE LEARNING COMPONENT

ACTIVITY LEADING ORGANISATION: HNHM
Authors:
Gergely Babocsay, PhD, Curator, Vertebrate Collections Mátra Museum, HNHM
Catherina Voreadou, PhD, Head of Education, NHMC
Tine Geunis, PGD, Educator, RBINS
Isabella Van de Velde, PhD, project coordinator, RBINS

Erasmus+ KA2 Strategic Partnerships for vocational education and training
Grant Agreement: 2016-1-BE02-KA202-017356
Start - End: 01/09/2016 - 31/08/2019
Document approved by BIOTALENT Consortium
Date: August 2019

TABLE OF CONTENTS

1. INTRODUCTION

The pilot course '**BIODIVERSITY IN A CHANGING CLIMATE: E-LEARN MORE'** targets biodiversity and climate change using climate sensitive model species in order to develop learners' competences in those key fields. The training programme is centred on two groups of model organisms on which best practices in blended educational programmes in biodiversity can be worked out and demonstrated. Learners gain insight into the problem of biodiversity loss and climate change and will learn about the model organisms that:
1. reflect the profound changes of the global environment, and
2. show painfully what we are losing.

The 80 learning hours blended training programme consists of two main learning components: (i) an online learning component with a general module and a case study module (40 learning hours) and (ii) an attended learning component with a training on-the-job module (40 learning hours).

In the general module '**Biodiversity and Climate Change**' learners study biodiversity, its importance to the planet, investigate the causes of climate change and its consequences for biodiversity. After successfully completing the general module, learners can choose either **Herpetofauna** or **Medicinal plants** as case study organisms to continue the BIOTALENT course.

2. COURSE OVERVIEW AND TIMING

The online part of the course started on 7 January 2019 and ended on 31 March 2019.

General module - BIODIVERSITY and CLIMATE CHANGE
6 weeks - 20 learning hours - 3-4 h weekly commitment

Text: Gergely Babocsay, HNHM & Petros Lymberakis, NHMC-UoC
Copy editor and lay-out: Isabella Van de Velde, RBINS
IBL methodology: Catherina Voreadou, NHMC-UoC & Tine Geunis, RBINS
E-learning course moodle: Carlos Rodrigues, EduFor

Theme 1. Introducing biodiversity
1.1 What is biodiversity? ♦ Gergely Babocsay - Readings
1.2 Origin of biodiversity ♦ Gergely Babocsay - Readings
1.3 Agrobiodiversity – Genetic diversity ♦ Gergely Babocsay - Readings
1.4 Biodiversity hotspots ♦ Gergely Babocsay - Readings

1.5 A short history of biodiversity ♦ Petros Lymberakis - Reading
Relicts of a past climate - Video
1.6 What is a species? ♦ Petros Lymberakis - Reading

Theme 2. Exploring biodiversity

2.1 Relationship of organisms in ecosystems, ecological niche ♦ Petros Lymberakis - Reading
2.2 Documenting biodiversity - scientific collation ♦ Gergely Babocsay - Readings
Keeping track of changes: monitoring the living world around us - Video
2.3 Biodiversity patterns and processes regulating species diversity ♦ Petros Lymberakis - Reading
2.4 Importance of biodiversity for humans ♦ Gergely Babocsay - Readings

Theme 3. Threats to biodiversity in a changing climate

3.1 Habitat loss, fragmentation and degradation ♦ Gergely Babocsay - Readings
Studying genetic diversity for species conservation - Video
3.2 Overexploitation of wildlife ♦ Gergely Babocsay - Readings
3.3 Invasive alien species ♦ Gergely Babocsay - Readings
3.4 Climate change ♦ Gergely Babocsay - Readings

After successfully completing the general module, learners choose one of the case studies Herpetofauna or Medicinal Plants.

Case study module – HERPETOFAUNA

6 weeks - 20 learning hours - 3-4 h weekly commitment

Text: Gergely Babocsay, HNHM, Judit Vörös, HNHM & Petros Lymberakis, NHMC-UoC
Copy editor and lay-out: Isabella Van de Velde, RBINS
IBL methodology: Catherina Voreadou, NHMC-UoC & Tine Geunis, RBINS
E-learning course moodle: Carlos Rodrigues, EduFor

Theme 1. Origin of the herpetofauna

1.1 Origin of the amphibians ♦ Judit Vörös - Reading
1.2 What is a reptile? ♦ Petros Lymberakis - Reading

Theme 2. Diversity of the herpetofauna

2.1 Diversity of amphibians ♦ Judit Vörös - Reading
2.2 Climate change in Europe ♦ Petros Lymberakis - Reading
2.3 Studying diversity of amphibians and reptiles ♦ Petros Lymberakis & Judit Vörös - Readings
Diversity of amphibians and reptiles: Herpetological collections - Video

Theme 3. Physiology and ecology of the herpetofauna

3.1 Physiology of amphibians ♦ Judit Vörös - Reading
3.2 Ecological adaptations of amphibians ♦ Judit Vörös - Reading
3.3 Physiology of reptiles ♦ Petros Lymberakis - Reading
3.4 Ecological adaptations of reptiles ♦ Petros Lymberakis - Reading

Theme 4. Threats to the herpetofauna

4.1 Habitat loss, degradation and fragmentation ♦ Gergely Babocsay - Readings
Threats to Herpetofauna: Snake in the city - Video
4.2 Invasive alien species ♦ Gergely Babocsay - Readings
4.3 Diseases ♦ Gergely Babocsay - Readings
4.4 Overexploitation ♦ Gergely Babocsay - Readings
4.5 Climate change ♦ Gergely Babocsay - Readings

Theme 5. Herpetofauna and humans

5.1 Herpetofauna as source of scientific disciplines ♦ Judit Vörös - Reading
Conservation and evolutionary ecology of Amphibians - Video
5.2 Herpetofauna as source for future human welfare ♦ Gergely Babocsay - Readings
5.3 Effect of herpetofauna on human life ♦ Gergely Babocsay - Readings
5.4 Conservation of herpetofauna, organisations, citizen science ♦ Petros Lymberakis - Reading

Case study module - MEDICINAL PLANTS

6 weeks - 20 learning hours - 3-4 h weekly commitment

Text: Zoltán Barina, HNHM & Manolis Avramakis, NHMC-UoC
Copy editor and lay-out: Isabella Van de Velde, RBINS
IBL methodology: Catherina Voreadou, NHMC-UoC & Tine Geunis, RBINS
E-learning course moodle: Carlos Rodrigues, EduFor

Theme 1. Plant diversity

1.1 How many plant species are there? ♦ Zoltán Barina - Readings
Botanical collections - Video
1.2 Plant and habitat diversity ♦ Zoltán Barina - Readings

Theme 2. Complexity of plant biogeography

2.1 Environmental adaptation and tolerance of plants ♦ Zoltán Barina - Readings
2.2 Dynamics in plant distribution and dispersal ♦ Zoltán Barina - Readings
Unique habitats, isolated hotspots - Video
2.3 Complexity of biogeography ♦ Zoltán Barina - Readings

Theme 3. Plants and climate change

3.1 Climate changes and postglacial migration of plants ♦ Manolis Avramakis - Reading
3.2 Plant responses to climate change ♦ Zoltán Barina - Readings

Theme 4. Plants as source for the future

4.1 Everyday uses of plants ♦ Manolis Avramakis - Reading
4.2 Fuel from plants ♦ Manolis Avramakis - Reading
4.3 Food from plants ♦ Manolis Avramakis - Reading
4.4 Industrial uses of plants ♦ Manolis Avramakis - Reading
4.5 Medicinal plants. Past, present and future ♦ Manolis Avramakis - Reading

Theme 5. Threatening factors of plant diversity

5.1 Plants in the Anthropocene ♦ Zoltán Barina - Reading
5.2 Threats to plant diversity ♦ Zoltán Barina - Readings
The importance of botanical gardens. The Füvészkert in Budapest. - Video
5.3 Herbs vs nature conservation ♦ Manolis Avramakis - Reading

Appendix: Annotated checklist of medicinal plants.
Medicinal plants in the lessons and their medicinal use.
♦ Zoltán Barina, HNHM & Isabella Van de Velde, RBINS - Reading

3. PARTICIPANTS

The online part of the course aimed at unlimited participation and provided open access to anyone interested to join the course. Given the training topic there is a huge potential audience to reach. To enable a good follow-up and analysis of the pilot course in the present project, it was initially decided to limit the number of participants to 400.

In order to have an idea about learners' interest to follow the course topic, a pre-registration was announced and 614 people pre-registered. At the course start, 497 people enrolled to the course, exceeding the expectations. A diverse group of learners from across Europe and beyond participated in the on-line part of the course.

4. COURSE PEDAGOGICAL APPROACH

The entire course is based on the Inquiry Based Learning (IBL) methodology, which is a constructivist approach where the overall goal is for learners to build knowledge by themselves. Inquiry Based Learning incorporates many current learning approaches such as project-based learning, problem-based learning, design thinking, etc. Equal emphasis is given on content and in the process of learning, learners are actively involved in constructing understandings through research and several consolidation activities, many of which bring them outside of their learning settings.

Each course theme includes different steps through which learners build knowledge by themselves. In Step 1, learner's prior knowledge is ascertained through a quiz or problem-based activity. In Step 2, after going through carefully selected resources, learners retake the quiz or confirm their answer of the problem-based activity. In Step 3 they work out assignments in the consolidation activities. All learners' work is uploaded on their workspace (padlet) and posted to a wall (lino). Through a procedure of 'Meet and Share' in Step 4, learners have the possibility to share their understanding and findings with their co-learners, learning thus from and with each other. They can comment, compare and evaluate their co-learners work. The course structure and different IBL steps are illustrated in Fig. 1-9.

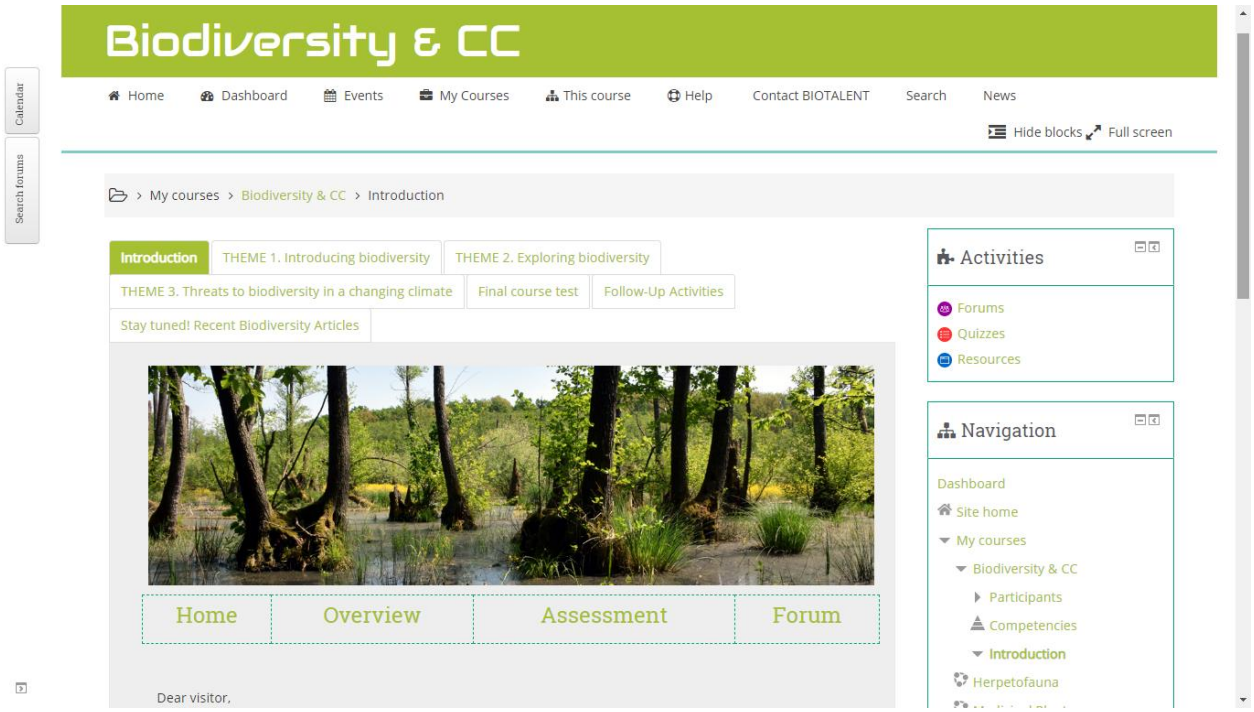

Fig. 1 General course module, introduction page

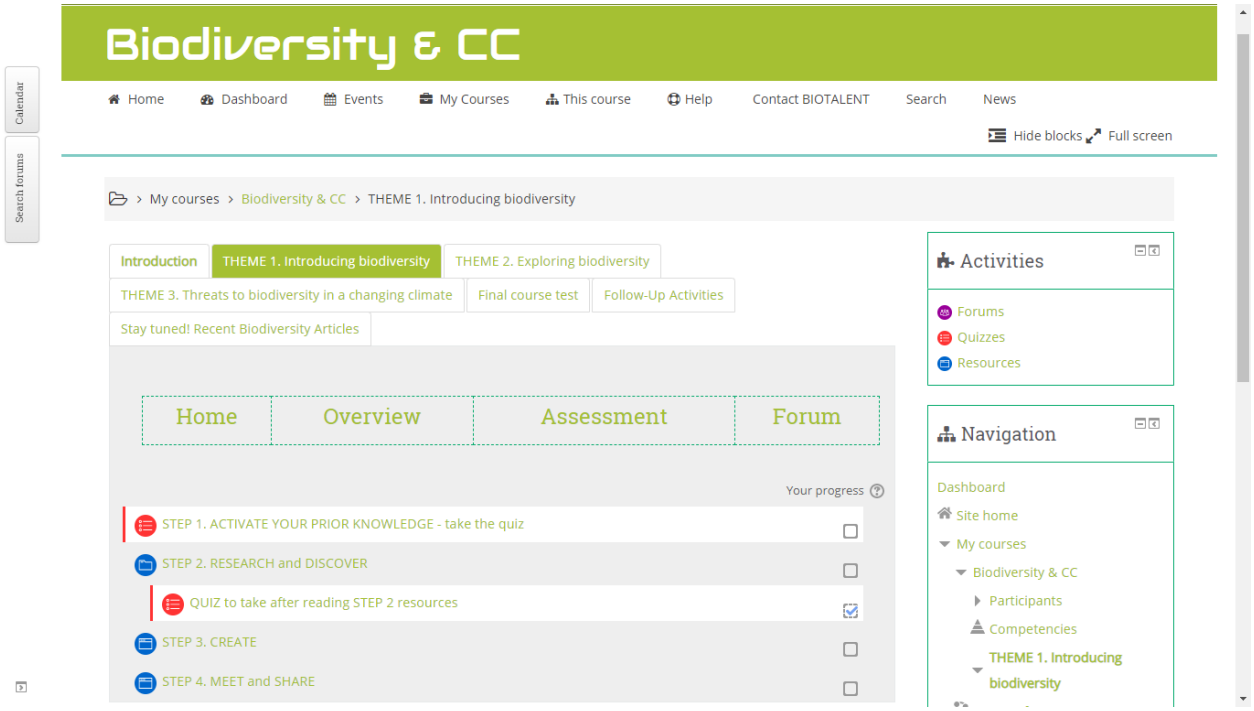

Fig. 2 General module – IBL methodology learning steps

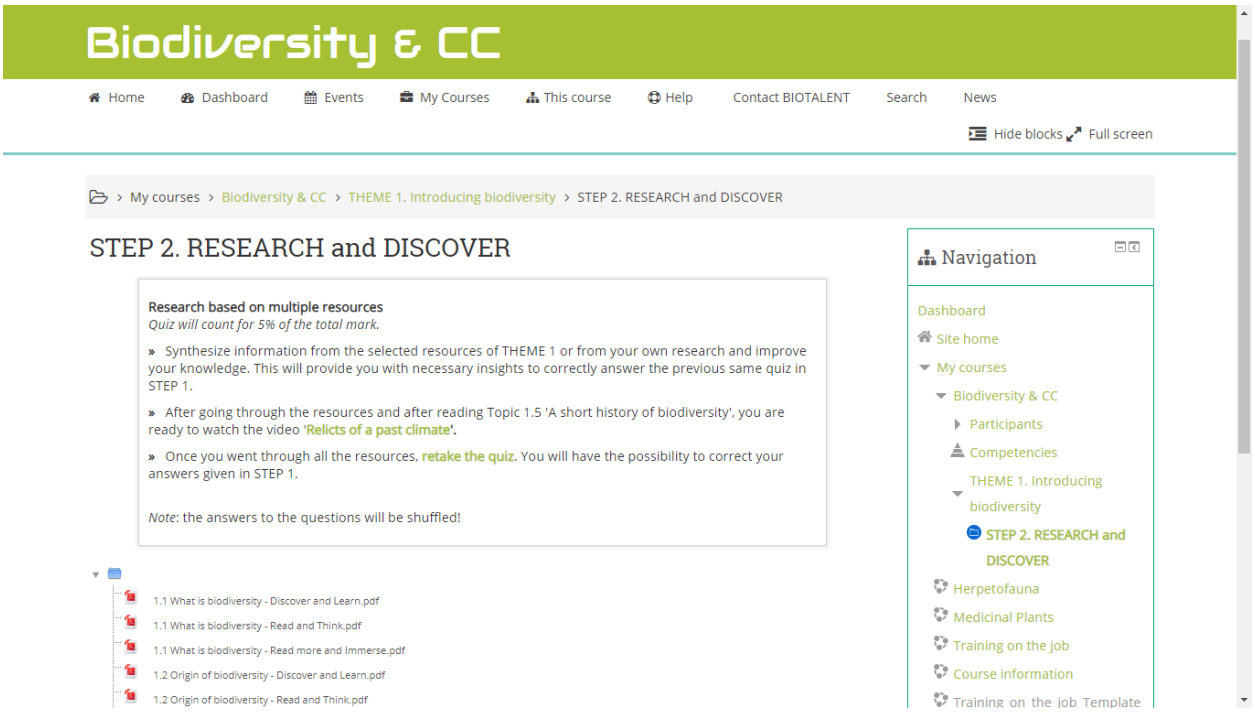

Fig. 3 General module - IBL Step 2

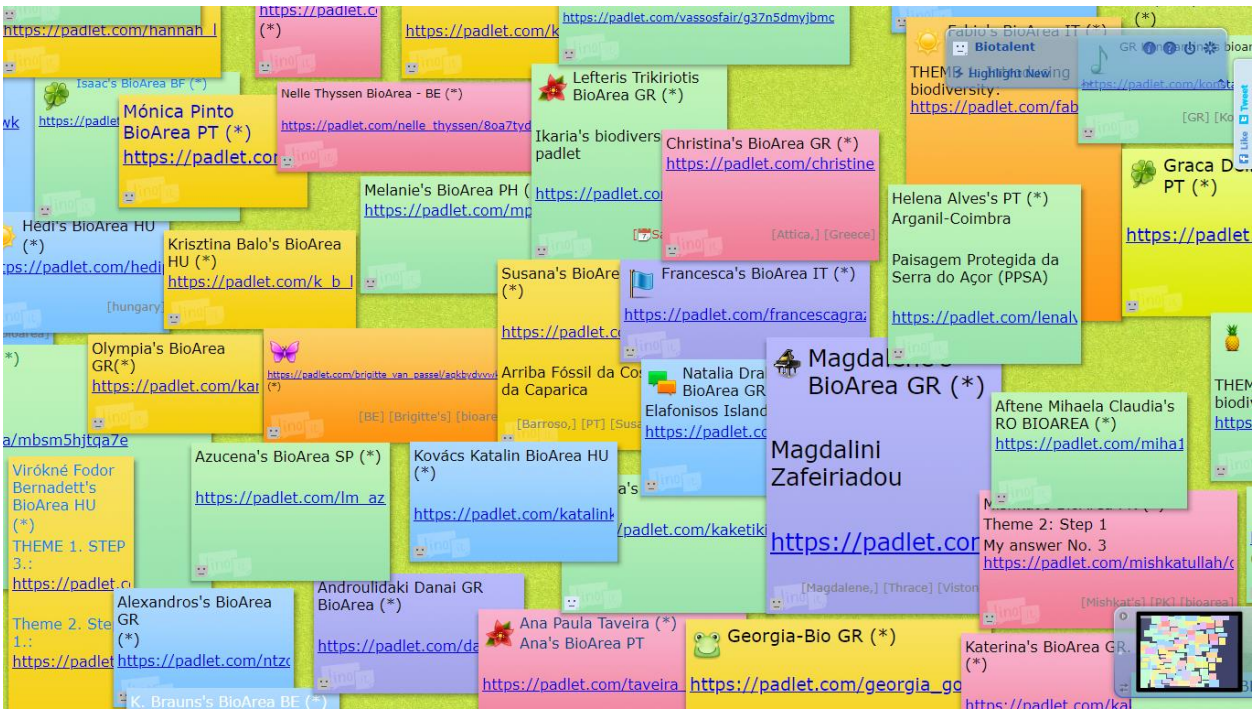

Fig. 4 General module - IBL Step 3 – 4: posted links of learners' padlet on the wall (lino)

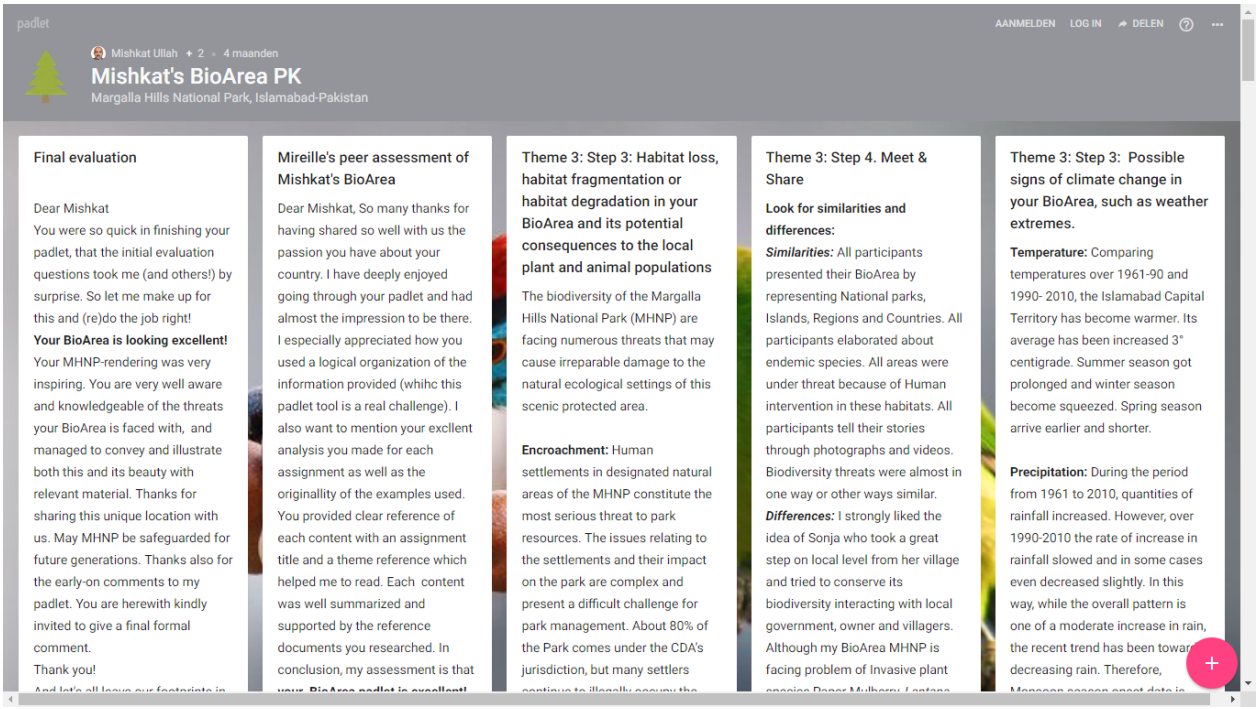

Fig. 5 Course module IBL Step 3-4: example of a learner's padlet

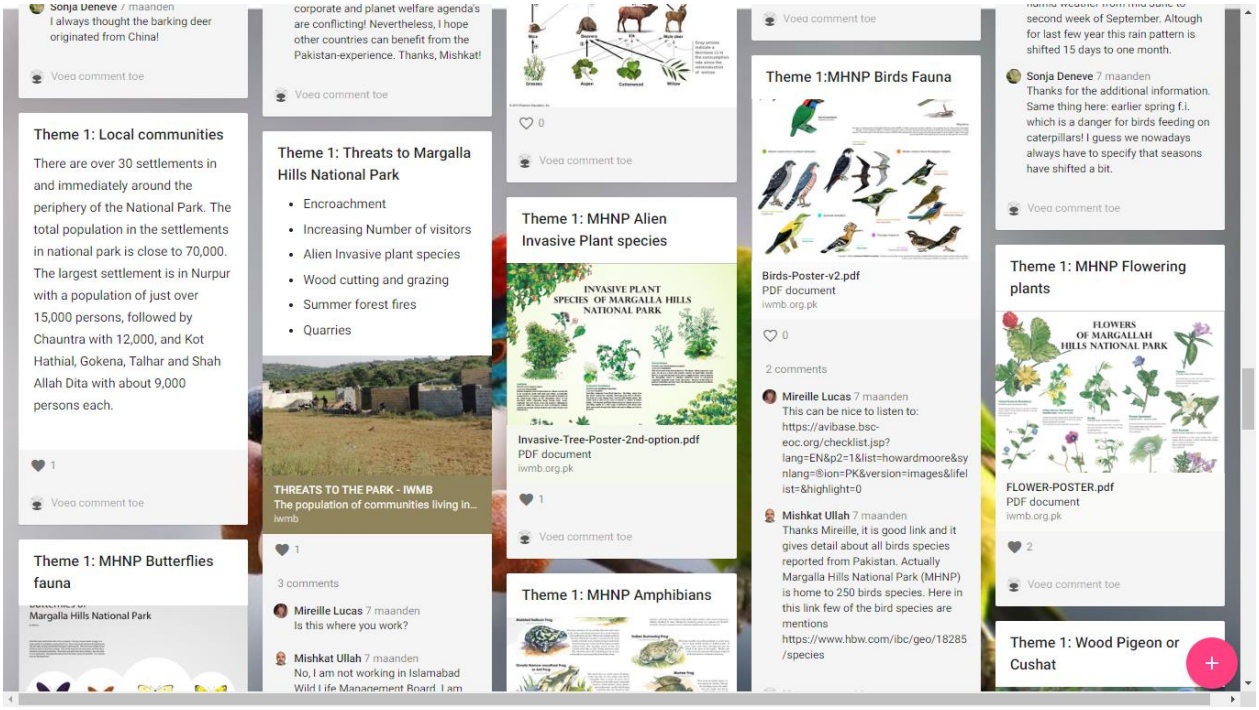

Fig. 6 Course module IBL Step 3-4: example of a learner's padlet

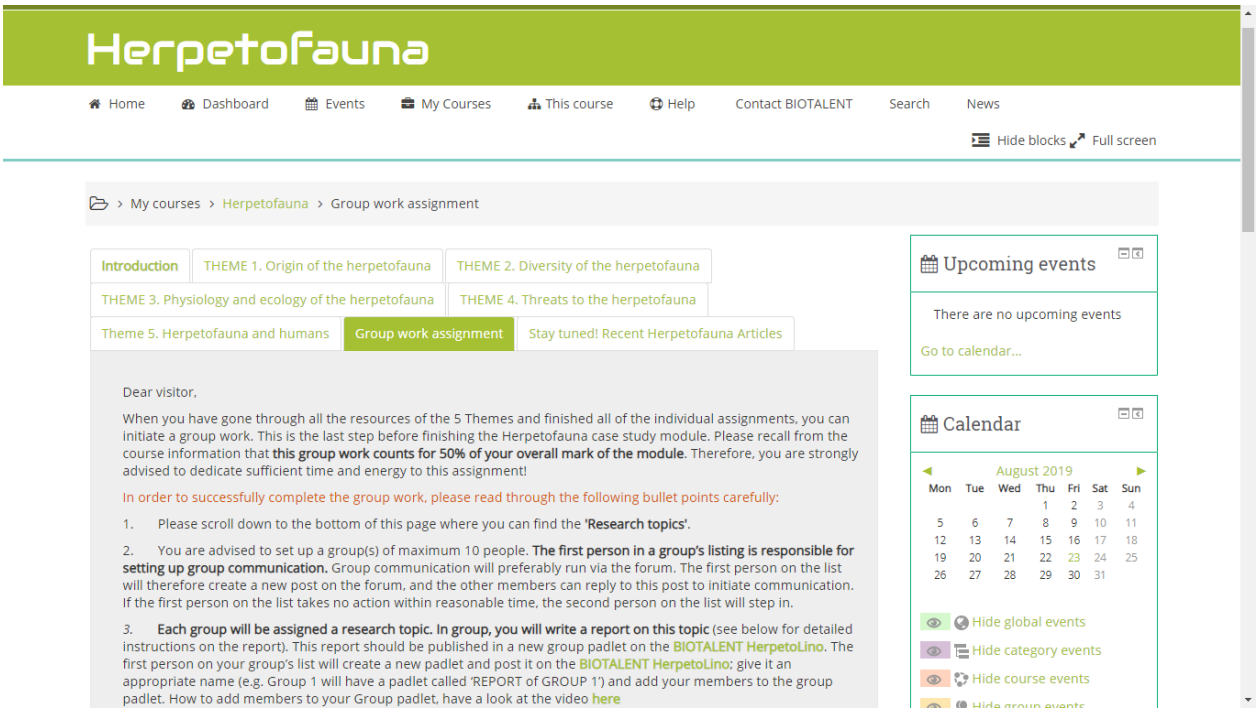

Fig. 7 Case study module: group work

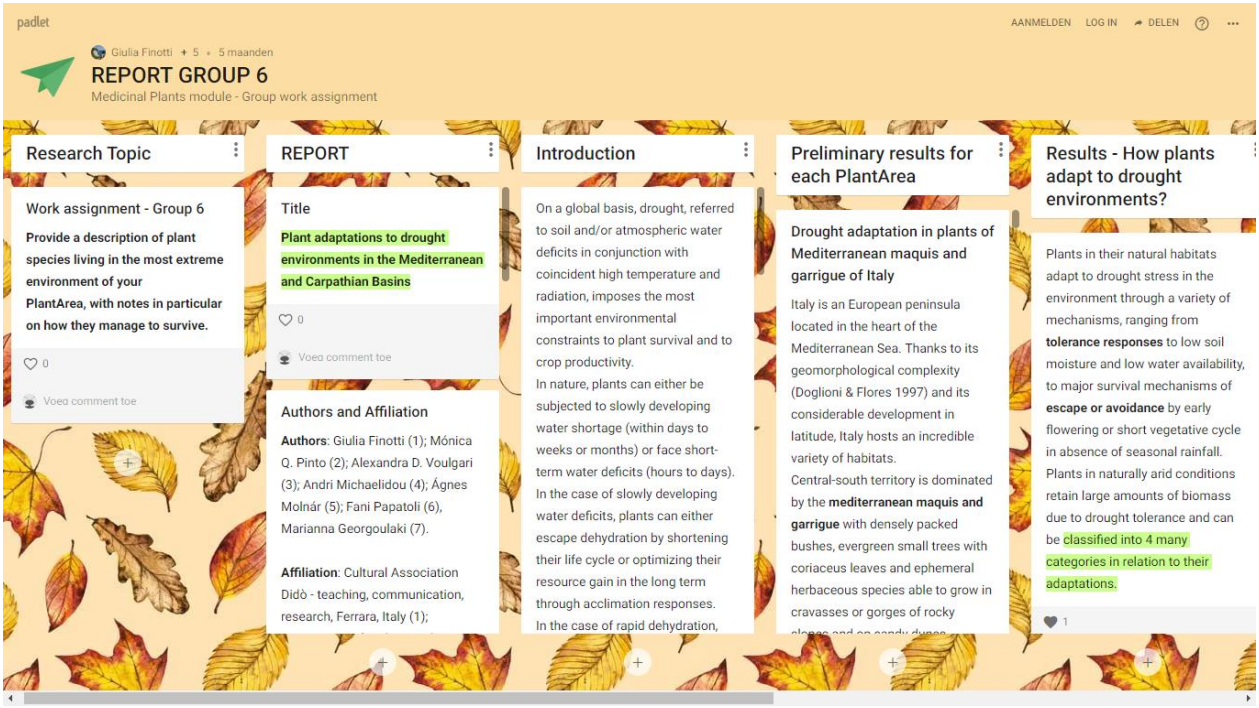

Fig. 8 Case study module: example of group work

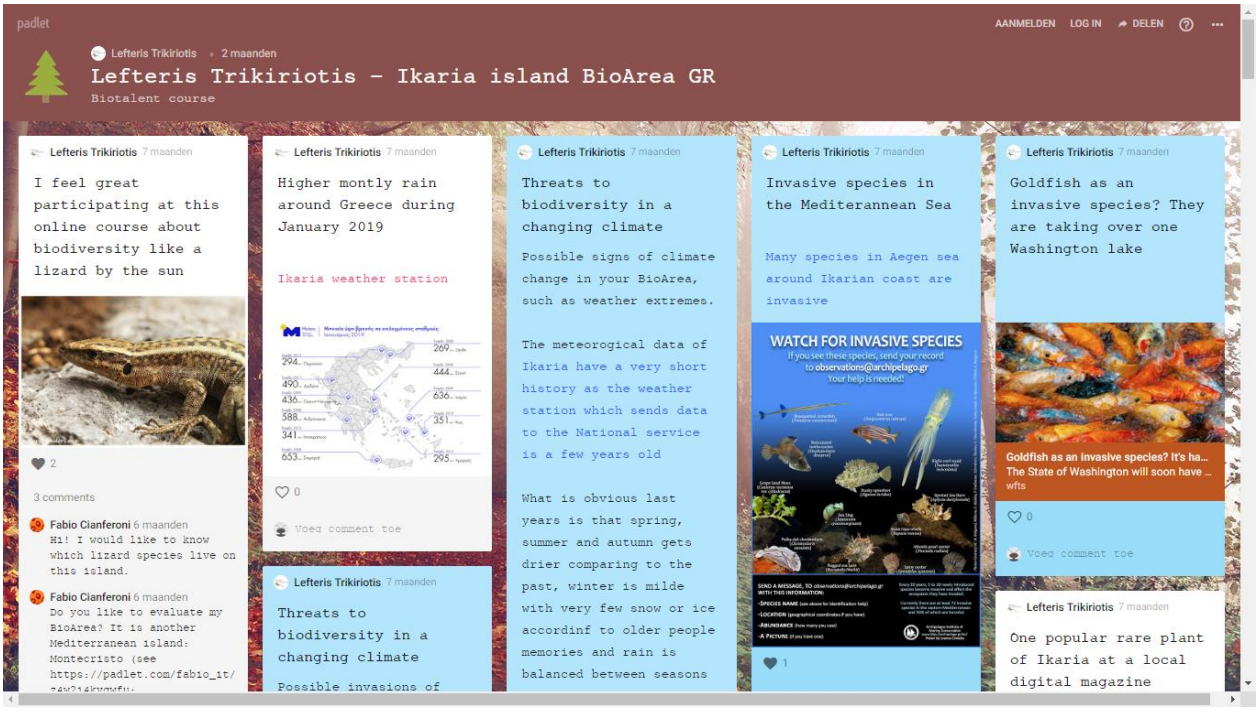

Fig. 9 Case study module: example of group work

5. ONLINE LEARNING MATERIAL

The course material was developed by our BIOTALENT experts exclusively for the needs of the 'Biodiversity in a changing climate: e-learn more' course. There are three main types of learning materials: Power Point Presentations (ppts), texts and videos. The layout of ppts is colourful, well illustrated with photos and texts are easy to go through. Relevant literature accompanies all resources. A glossary is included and can be consulted here.

Fig. 10 Examples of course reading resources

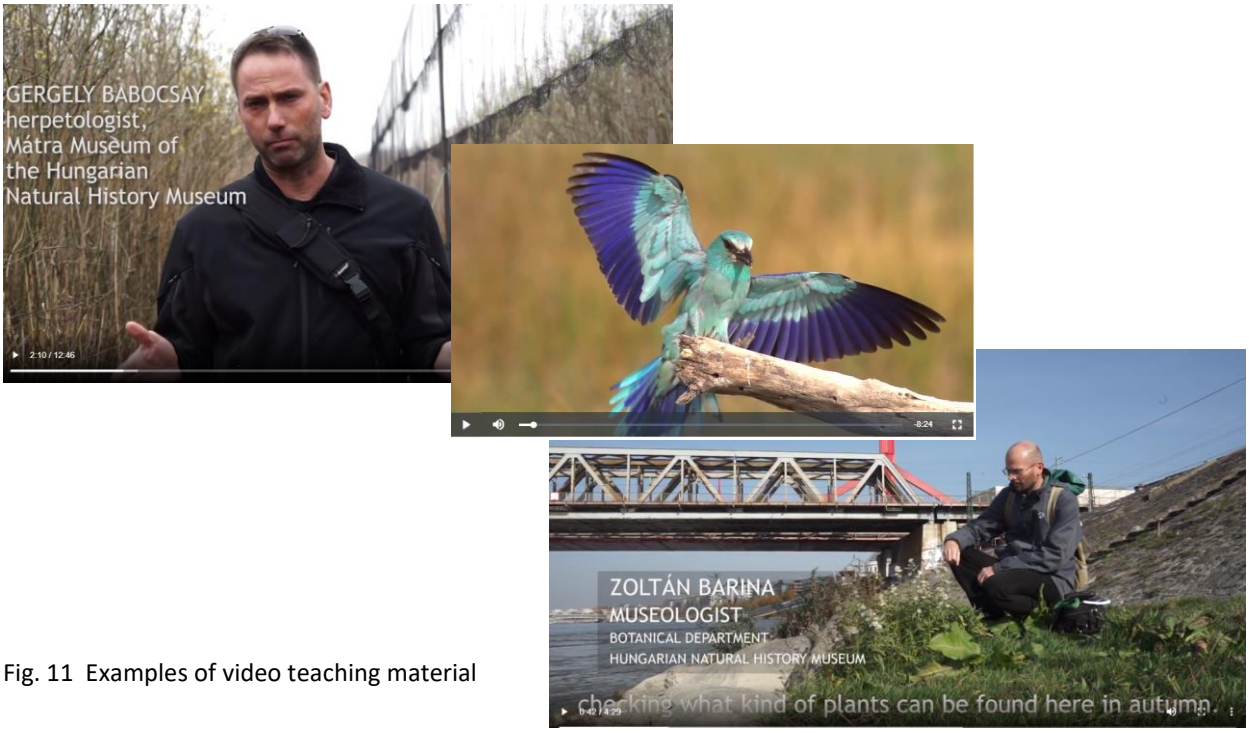

Fig. 11 Examples of video teaching material

Open educational resources

6. LEARNING OUTCOMES

General module - BIODIVERSITY and CLIMATE CHANGE

By the end of this course, learners will have the knowledge, skills and competences in order to:

Learning area

Theme 1. Introducing biodiversity

Define the concept of biodiversity.
List and explain the key elements of biodiversity.
Use the most widely applied diversity indices.
List the main factors driving evolution.
Explain how the Darwinian algorithm works, and how the changing environment (especially climate) drives evolution.
Define the concept of agrobiodiversity.

Compare agrobiodiversity to natural diversity and identify the differences and similarities between them.
List some examples of highly diverse cultivated organisms.
Explain why loss of agrobiodiversity is detrimental to societies.
Identify natural sources that improve agrobiodiversity.
Explain which factors determine the distribution of biodiversity.
Identify biodiversity hotspots, summarise their criteria, and demonstrate their global distribution.
Compare biodiversity hotspots to hotspots of particular taxa (e.g. mammals or birds).
Compare the diversity of organisms among different areas.
Describe some hotspots and include characteristic species.
Illustrate the appearance and history of the main organismal groups.
List the factors shaping biodiversity.
Define species concept.
Differentiate the principle methods of taxonomy and systematics.
Interpret phylogenetic trees and cladograms.
Summarise the main species concepts.

Learning area
Theme 2. Exploring biodiversity
Explain the concept of an ecological niche, and how it relates to adaptation and competition.
List the different possible relationships between organisms.
Explain trophic pyramids and food webs.
Identify how they contribute to constitution ecosystems.
Explain how large scaled and/or local ecological processes maintain diversity.
Illustrate how diversity creates more diversity.
Argue for the importance of scientific collections.
Explain how they are built and help taxonomy and other aspects of science.
Relate to scientific collections as sources of biodiversity related data.
Explain patterns of biodiversity, and identify factors and processes regulating biodiversity.
Explain speciation and extinction.
Explain how organisms may affect human health.
Explain bioprospecting and the way it investigates natural compounds as sources for biodiversity.
Contrast natural-selection tested properties of organisms with artificial compounds, and their relative values as targets for pharmaceutical research.
Present scientific collections as important resources for solving epidemiological problems.
Link biodiversity to economy: potential new crops, industrial raw material, pests, etc.
Evaluate how ecosystem services contribute to all levels of the economy.

Learning area
Theme 3. Threats to biodiversity in a changing climate
Identify the main causes of biodiversity loss.
Explain, by using examples, how habitat loss and degradation impedes evolutionary and ecological processes resulting in decline of biodiversity.
Explain how humans, by over harvesting species, drive them to (near) extinction.
Evaluate which activities put the highest pressure on populations.
List the key characteristics of an invasive alien species (IAS).
Differentiate between the characteristics of IAS and non-invasive species to demonstrate how non-invasive species become invasive.
Explain how IAS drive habitat degradation, habitat loss and extinctions.
Define climate change and list the factors causing it.
Explain how climate change drives range shifts of organisms, causes extinctions or recolonisations.
Summarise why the present climate change drives large scale extinctions as organisms are captured in small natural islands called nature reserves and large scale evolutionary and ecological processes are hampered.
Summarise the large climate changes in the history of Earth and their effect on evolution.
Illustrate the ways biota reacts to climate change, using the Pleistocene glaciations and the subsequent Holocene warming and climatic stability as an example.
Explain the climate change driven movement of biota: retreat, recolonisation, adaptive colonisation.

Case study module - HERPETOFAUNA

By the end of this course, learners will have the knowledge, skills and competences in order to:

Learning area
Theme 1. Origin of the herpetofauna
Identify the main inventions developed in the course of amphibian evolution.
Describe the phylogenetic relationships among the main groups of amphibians.
Demonstrate the main differences among the main amphibian orders.
Define a reptile.
Indicate the main differences between amniotes and anamniotes.
Identify the main inventions developed in the course of evolution.

Learning area
Theme 2. Diversity of the herpetofauna
Recognise the past and present diversity and relationships of amphibians and reptiles.
Illustrate the richness of the amphibian and reptile fauna of the world.
List the factors that determine and influence the distribution of amphibians and reptiles across the globe.

Exemplify the distribution of species richness of amphibians and reptiles through selected reptile families.
List the main methods used in describing taxa of amphibians and reptiles.
Describe how glaciations affected the fauna and flora of Europe.
Illustrate how the fauna and the flora of Europe recolonised Europe in the Holocene.

Learning area
Theme 3. Physiology and ecology of the herpetofauna
Contrast the physiology of amphibians and reptiles in light of the environments they are capable to inhabit.
Give examples of adaptations of amphibians and reptiles that enables them to inhabit a wide range of environments.

Learning area
Theme 4. Threats to the herpetofauna
List the factors threatening the amphibians and reptiles of the world and describe the mechanism how these factors cause decline of the populations.
Illustrate how the various threatening factors cause decline of amphibian and reptile populations.
List the most important plagues threatening the world's herpetofauna and describe the way they compromise the health of frogs, salamanders and snakes.
Give examples on how climate change influences the survival of amphibians and reptiles.
Illustrate how the herpetofauna copes and coped with the environmental changes imposed by recent and today's climate changes.

Learning area
Theme 5. Herpetofauna and humans
Demonstrate the ways amphibians and reptiles are useful objects to study the theory of systematics, evolution, ecology and other realms of biology.
Give examples of traits of amphibians and reptiles that could prove useful for future development.
Illustrate how the herpetofauna may affect human life negatively.
List global and regional organisations dealing with the conservation of amphibians and reptiles.

Case study module - MEDICINAL PLANTS

By the end of this course, you will have the knowledge, skills and competences in order to:

Learning area
Theme 1. Plant diversity
List the characteristics of plant diversity.
Identify the plant diversity hotspots.
List the requirements and main methods of describing new plant taxa.

Describe the principles of naming plants and the history of plant naming.
Explain the reasons of scientific disagreements.
Discuss the problems encountered when describing plant diversity.
Illustrate the nature of financing scientific research and scientific publications.

Learning area
Theme 2. Complexity of plant biogeography
List and describe the different biogeographic regions.
Explain the occurrence of plants of the same species in different habitats.
Explain the importance of substrate types for the distribution of plant species.
Describe the characteristics of stationary life.
Illustrate the distribution ranges of plant species.
Compare (oceanic) islands with habitat islands.
Give examples of the phenology of individual plants.
Explain the history of recent plant biogeography.
Compare the ecological preferences of co-existing plant species.

Learning area
Theme 3. Plants and climate change
Explain why some plant species are “moving north”.
Relate reduced yields of crops with climate change.
Experience climate change outside of an air-conditioned room.
Distinguish between climate change and weather change.
Explain why it is difficult to study the impact of climate change.
Give examples of simultaneously interacting phenomena influencing climate change.
Illustrate the serious impact of plant introduction.
Define plant phenology.
Explain the link between speciation and climate change, taking into account the time factor.
Identify the spreading of invasive alien plant species.
Propose escape routes for plants in a changing climate.

Learning area
Theme 4. Plants as source for the future
Describe the decreasing dependence on wild plants for food once people started domesticating plants.
Propose a way plants can help us to reduce the use of plastic bags.
List the main biofuel crops.
Summarise the controversy and problems with biofuels.
Describe the worldwide importance of cereals for our need for proteins.
Compare the uses of different edible oils.
Explain which parts of plants are used as spices and give examples.
List the most important plants used in the fiber industry.

List the four major biochemical classes of medicinal compounds found in plants.
Explain why in a lot of places people still use herbs, instead of synthetic drugs.

Learning area
Theme 5. Threatening factors of plant diversity
Explain the irreversible consequences of species extinctions.
List some natural mechanisms that are disadvantageous in a fast changing environment.
Discuss the impact of fast and slow climatic changes on plants.
Explain the importance of invisible plant diversity.
Illustrate the disadvantages of decreasing biodiversity in horticulture.
Illustrate how spreading human populations causes decline of natural habitats.
Explain why human transport drastically transforms global biogeography.
Illustrate the spread of invasive alien species in time.
Name the inventories of threatened plant taxa.
Distinguish in situ from ex situ conservation of medicinal plants.
Explain why natural reserves and wild nurseries play an important role in medicinal plants conservation.

7. COURSE CERTIFICATES

In the framework of the ERASMUS+ programme, participants received upon successful completion of the course the **BIOTALENT ECVET* Certificate** and the **Europass Certificate Supplement,** confirming the knowledge, skills and competences they gained.

Online part: 4 ECVET points
Attended part: 4 ECVET points

* European Credit system for Vocational Education and Training

Pre-registrations via BIOTALENT website (21/12/2018)	614
General Module: Biodiversity and Climate Change (07/01/2019 – 11/02/2019)	
Total learners enrolled	497
Learners passed (score ≥60%)	176
Case study module: Medicinal Plants (18/02/2019 – 31/03/2019)	
Total learners enrolled	99
Learners passed (score ≥60%)	67
Case study module: Herpetofauna (18/02/2019 – 31/03/2019)	
Total learners enrolled	67
Learners passed (score ≥60%)	44

8. REFERENCES

BIOTALENT e-learning platform:
http://biotalent.ucdc.uoc.gr/

General course information

General course module 'Biodiversity and Climate Change'

Case study module 'Herpetofauna'

Case study module 'Medicinal Plants'

In order to have access to the course information and resources, please create an account on the e-learning platform.