



Biomimicry Design for Sustainability Skills in VET

KA220-VET-00620D4B

**KA220-VET - Cooperation Partnerships in Vocational Education and
Training**

WP2 Biomimicry Process Design for Sustainability Skills

Biomimicry Platform Design



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Document Info	
Project reference	2023-1-EL01-KA220-VET-000158477
Deliverable	D.2.3 Biomimicry Platform Design
Dissemination level	Public
Date	15/3/2024
Document version	1
Status	Final
Sharing	CC-BY-NC-ND
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1. Introduction

Biomimicry has emerged and been consolidated as a viable approach that could inspire creative minds and drive human innovation. Biomimicry designs are constructed considering both sustainability goals and cost-efficiency solutions. Equipping students with the skill sets that would enable them to draw on natural organisms and processes to fuel innovation effectively has become a priority in education.

The LET'S MIMIC Project invests in the development of skills that would enable future generations to create sustainable designs that mimic nature's efficient use of resources, reduce waste, and lower environmental impact. The LET'S MIMIC Collaborative Platform implements the biomimicry design process and enables VET learners to enhance their sustainability skills through gamified microlearning units, collaborative activities, and self-regulated learning experiences.

At a more granular level, the Platform will implement the Biomimicry Process Design methodology to allow VET learners to experience the six steps of the Biomimicry Design Process (DEFINE; BIOLOGIZE; DISCOVER; ABSTRACT; EMULATE and EVALUATE); provide a collaborative space to experiment Problem-based Learning methods such as constructivism and social learning via gamified, Self-Regulated Learning Paths (SRL-P); develop microlearning resources and provide stand-alone units of study that can be configured as SRL-P to support active, customised learning processes and better accommodate the learning needs of VET students; integrate gamification mechanics to boost engagement and motivation; provide mechanisms to evaluate achievements and monitor progress.

This deliverable reflects the work carried out under Work Package 2: Biomimicry Process Design for Sustainability Skills. It describes the key functionalities of the LET'S MIMIC Collaborative Platform, which implements the Biomimicry Design Process and can be experimented with through collaborative working areas and a self-regulated learning kit.



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The platform design specifications present the platform architecture diagram, the design specifications for the mentor and student interfaces, and the detailed functionalities for the frontend and backend modules: microlearning management, SRL-P, collaborative learning, gamification, and assessment.

The document includes the following sections:

- **Chapter 1** provides an overview of the role of this deliverable within the project workflow and the approach taken.
- **Chapter 2** describes the platform architecture and critical components.
- **Chapter 3** describes the register and Login interface.
- **Chapter 4** presents the key screens of the prototype related to the mentor experience.
- **Chapter 5** presents the key screens of the prototype related to the student experience.
- **Chapter 6** presents the conclusions.



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2. LET'S MIMIC Platform Architecture Development

The Biomimicry Collaborative Platform implements the Biomimicry Process Design methodology and integrates the following components:

- **The Microlearning module** manages bite-sized units of content that promote the development of Sustainability Skills of VET students, with focused and specific learning outcomes. The module manages the development and allocation of the training units to students through the following components:
 - *My workspace – MENTORS (private)* – the module is dedicated to the management of the training units:
 - Mentors' private collections are created based on the 6 steps of the Biomimicry Design Process, which is implemented as a pipeline for controlling digital assets.
 - Mentors' private resources.
 - *Repository – MENTORS & STUDENTS (public)* – the module is dedicated to public Collections and Resources (bite-sized units).
- **The Self-Regulated Learning module** enables students to opt for the learning units they want to study. It allows VET students to control their learning, take responsibility and complete their training at a time and place of their choice. The content is delivered as SRL-P, constructed based on individual goals, self-evaluation, and gamified challenges.
 - *Microlessons – STUDENTS* – the module provides the option to list Collections and Resources from the Repository that users mark as favourites.
- **The Teamwork module** manages a collaborative space, enabling mentors to create digital spaces to share with VET students for collaborative work. The collaborative space can be constructed based on the collection pipeline, the six stages of the Biomimicry Design Process, or another micro-unit made available in the Repository of microunits.



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- *My classes - MENTORS & STUDENTS* - the module is dedicated to mentors and students for individual or collaborative work:
 - Mentors can create a private space designed as a class for collaborative work, which they can share with a group of students.
 - A student can enrol in a class for individual work based on a code provided by the mentor.
- **The Gamification module** for students provides features like a point system, badges, and leaderboards paired with SRL-P challenges and quizzes. The module is integrated within the pipeline of the six stages of the Biomimicry Design Process or within a micro-unit.
- **The Assessment module** manages the mentors and the student dashboards and provides feedback on student evolution, used to improve student performance.

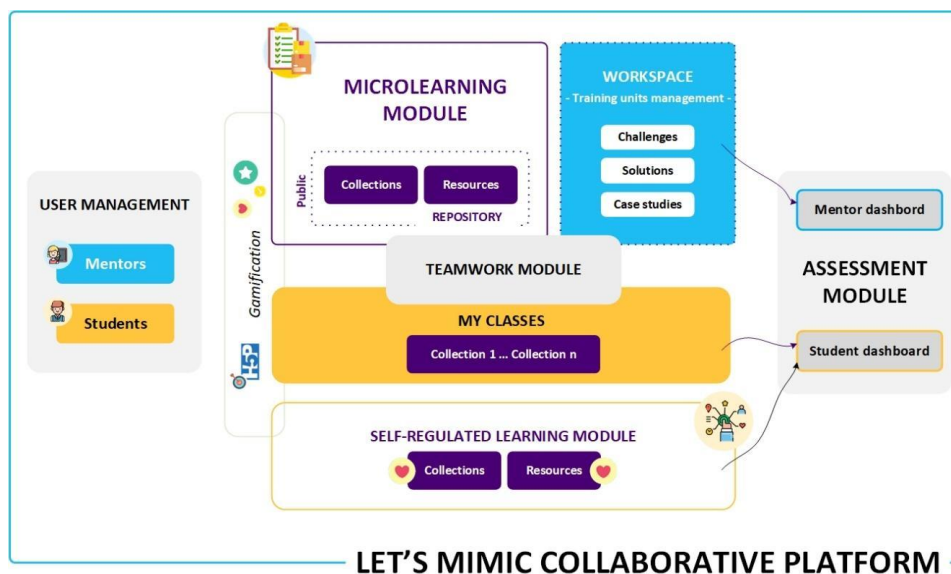


Figure 1. LET'S MIMIC collaborative platform architecture

3. Authentication: Register and Login

The Authentication module is standard for all types of users, namely Mentors and Students, and is divided into two components for Logging in and for Registering.



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- **The Register interface** allows Mentors and Students to create a new account. The register is divided into two steps. In the first step, the user is requested to choose the type of user – Mentor or Student. In the second step, the user is requested to enter the First and Last name (optional but strongly recommended), the username (mandatory), the password to confirm it (mandatory), and to accept the Privacy Policy. No email address will be required, nor will it be stored in the servers to comply with the general GDPR directives.

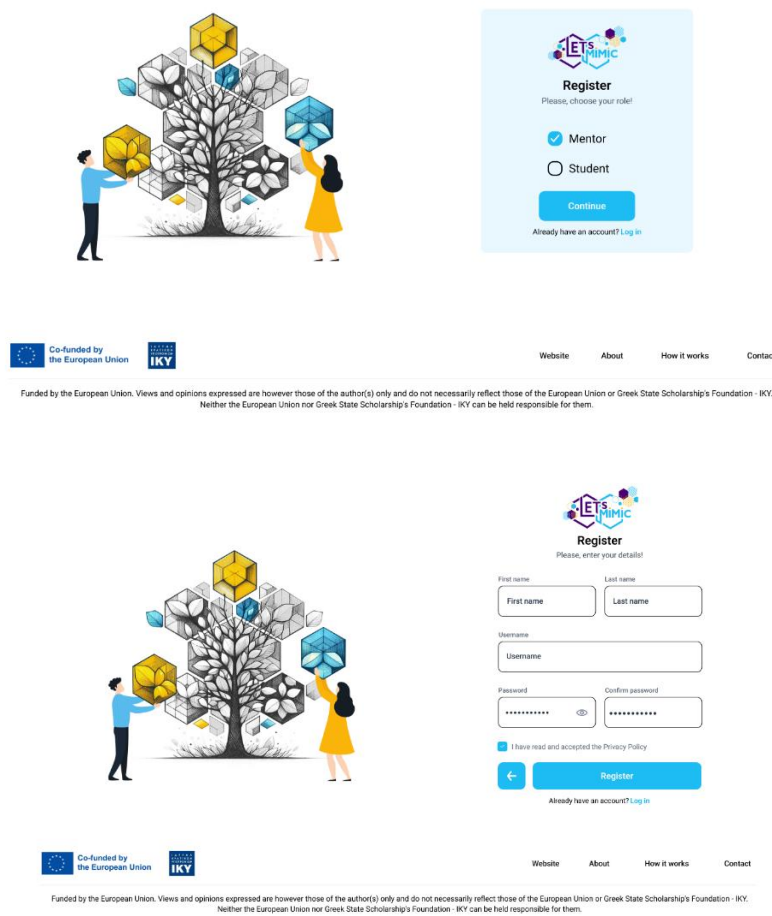


Figure 2. Register interface

- **The Login interface** allows Mentors and Students to log in to the platform by providing the username and password, with the possibility of recovering the password if the user does not remember it. The interface includes an additional

functionality: "Remember Me," which allows users to access all the data from the same machine even after the session expires.

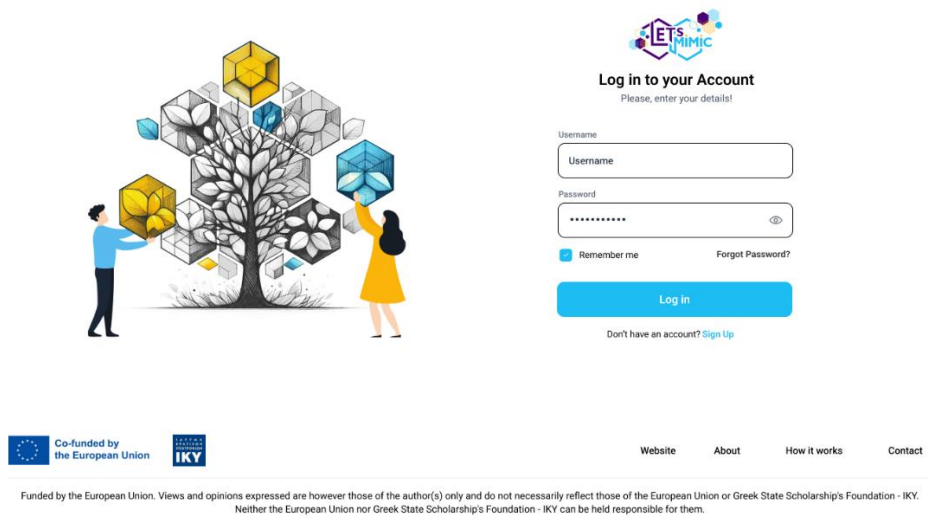


Figure 3. Log in interface

4. Interface Design Specifications: Mentors

The Mentor User Interface follows an aesthetic layout. It provides a seamless and user-friendly experience by offering firsthand an overview of all the critical components of the platform. The interface is divided into four sections:

- **The menu:** The menu is configured according to the access level:
 - *Level 1 – before login:* includes the options to log into the platform or create an account to access the platform.
 - *Level 2 – after login:* includes all the critical components of the LET'S MIMIC Platform: Repository, My Workspace, My Classes, Profile, Chat and Language. The main menu is displayed at each level of interaction with the platform.
- **The main section:** This section briefly describes the LET'S MIMIC Platform, the options for accessing the project website, and the platform manual.
- **The content section:** This section includes the latest collections or resources on the platform. These can be accessed only after logging in.
- **The footer and disclaimer:** They include the logo of the EU and Greek National Agency (IKY), a quick menu for accessing relevant information about the project and the acknowledgement. This section is displayed at each level of interaction with the platform.



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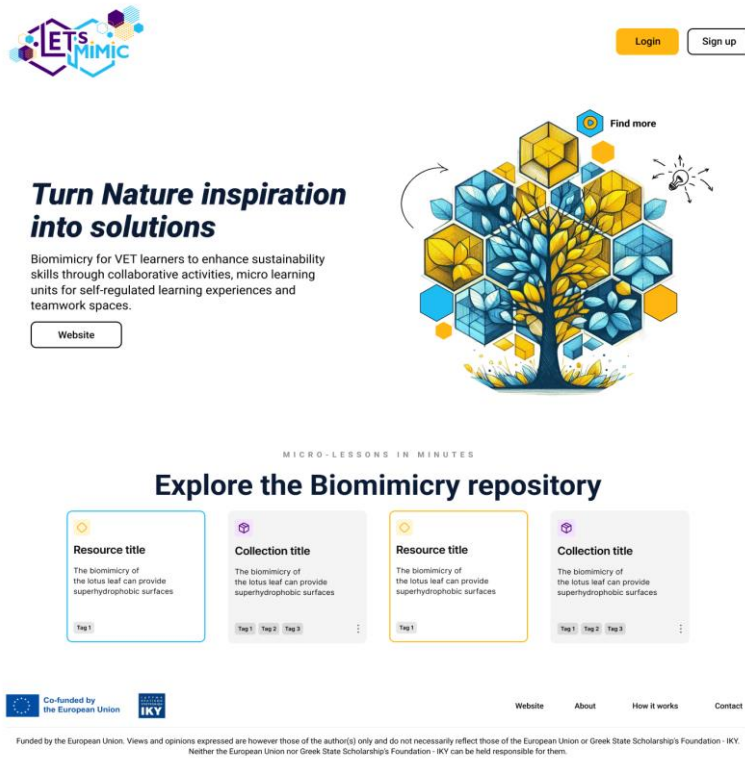


Figure 4. Mentor UI before login

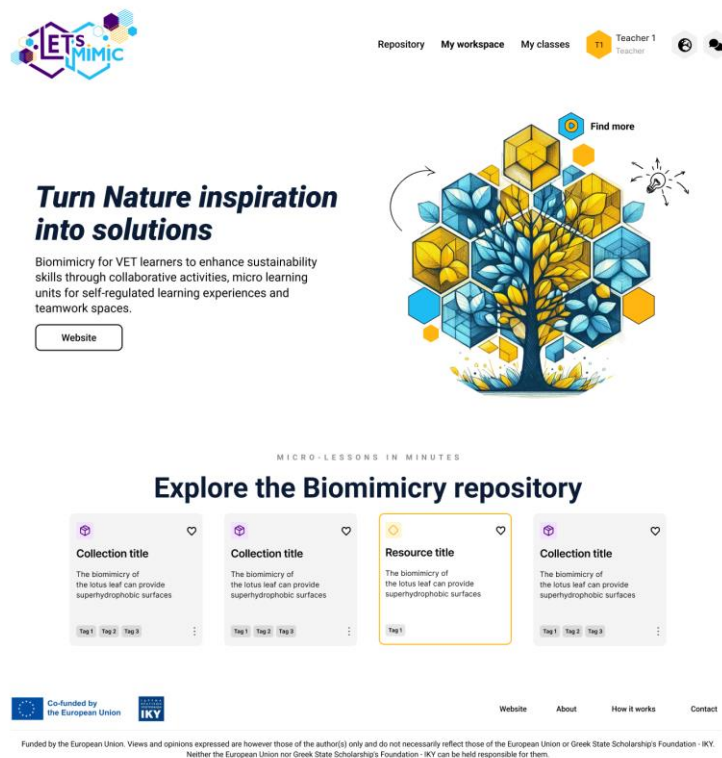


Figure 5. Mentor UI after login

4.1. Repository (Content Bank)

The Repository provides mentors access to a list of all Collections and Resources made public and created via the **Microlearning module**. The interface allows mentors to:

- Search the content, including Collections or Resources, by title.
- Filter the content by type, namely Collections or Resources.
- Edit/delete own Collections or Resources.
- Share Collections or Resources with other mentors and students.

The screenshot displays the 'Repository' interface. At the top left is the 'ETS MIMIC' logo. The navigation bar includes 'Repository', 'My workspace', and 'My classes', along with a user profile for 'Teacher 1' and icons for search and notifications. Below the navigation is a search bar with the text 'Search' and a search icon. The main content area is titled 'Repository' and features two tabs: 'Collections' (selected) and 'Resources'. The 'Collections' tab shows a grid of 10 collection cards. Each card has a purple cube icon, a title, a description, and three tags. The description for all cards is 'The biomimicry of the lotus leaf can provide superhydrophobic surfaces'. At the bottom right of the grid is a pagination control showing '1' of 2 pages. The footer contains logos for the European Union and IKY, and links for 'Website', 'About', 'How it works', and 'Contact'.

Figure 6. Repository for Collections



Repository

Collections Resources

Grid of 10 resource cards. Each card contains a title, a description, a tag, and a 'Go explore' link.



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Figure 7. Repository for Resources

4.2. My Workspace

The My Workspace section manages the mentors' private collections and/or resources created using the 6 steps of the Biomimicry Design Process.

The interface is designed as blocks of content filtered by type of content, namely Collection or Resource. It allows mentors to control various digital assets: text, documents, images, videos, H5P, and collaborative spaces as canvas, embedded in each of the stages of the Biomimicry Design Process.



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4.2.1. Collections

The Collections section is autogenerated and is designed as a pipeline, allowing mentors to define, edit, delete and make public a collection.

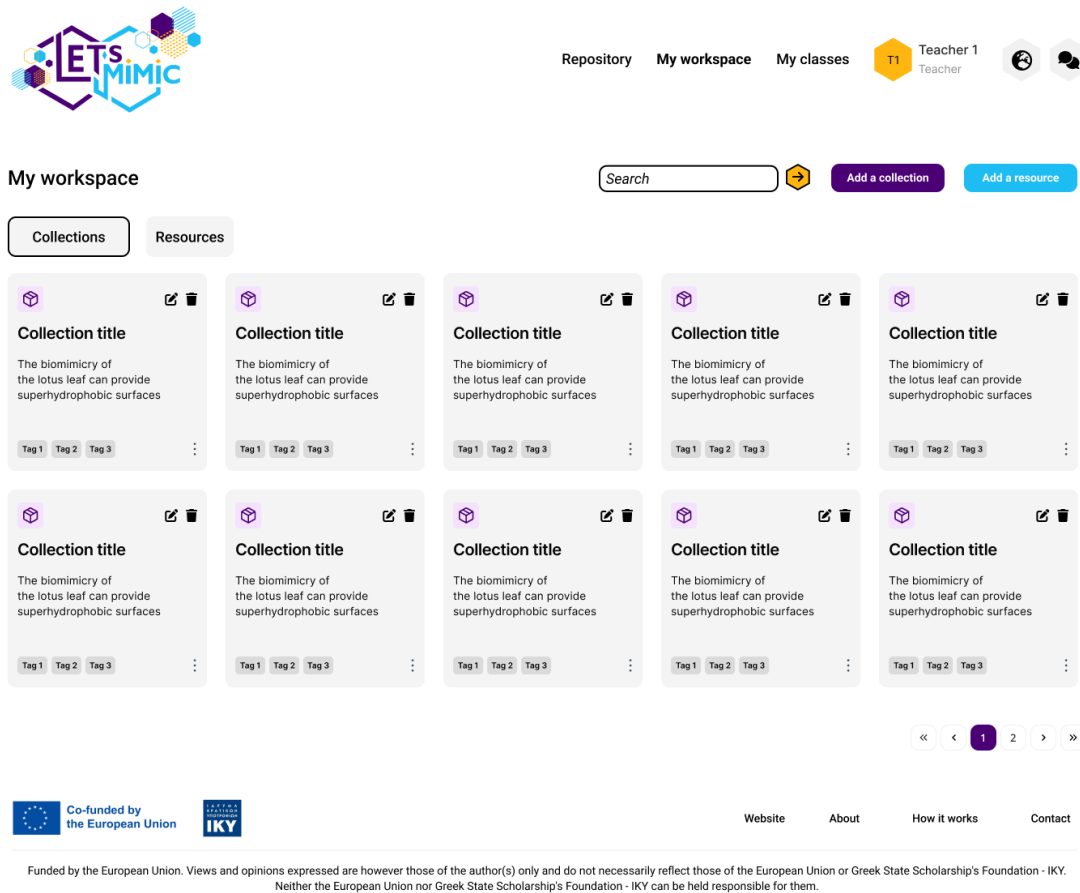


Figure 8. List of private Collections

A collection is structured based on the six steps of the Biomimicry Design Process and their respective resources:

- **Step 1—Define:** This step allows you to clearly articulate the impact the design must have on the world (i.e., the challenge you want to solve) and the criteria and constraints that will determine success.

- **Step 2—Biologize:** This step allows one to analyse the essential functions and context the design solutions must address. In this step, the solutions can be reframed in biological terms so that students can “ask nature” for advice.
- **Step 3—Discover:** This step allows one to Look for natural models (organisms and ecosystems) that need to address the same functions and context as the design solution. In this step, the strategies used to support their survival and success can be identified.
- **Step 4—Abstract:** This step allows the students to carefully study the essential features or mechanisms that make biological strategies successful. In this step, the students can State them in non-biological terms as “design strategies.”
- **Step 5—Emulate:** This step allows the student to look for patterns and relationships among the strategies found and focus on the key lessons that should inform the solution. The students can then develop design concepts based on these elements.
- **Step 6—Evaluate:** This step allows students to assess the design concept(s) for how well they meet the criteria and constraints of the design challenge and fit into Earth’s systems. Students can consider technical and business model feasibility. Refine and revisit previous steps as needed to produce a viable solution.

The Collection interface contains the following components:

- **Step 2—The Beginnings:** This is the interface with collection details. Mentors can define and view the title, description, and tags for the collection.



The Beginnings
Design Worksheet

How to

- Step 1 - Define
- Step 2 - Biologize
- Step 3 - Discover
- Step 4 - Abstract
- Step 5 - Emulate
- Step 6 - Evaluate

+ Add resource

Type the title of the collection

Type the description of the collection

Type the subject of the collection

+ Tag 1 Tag 2

Save



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Figure 9. Add collection



The Beginnings
Design Worksheet

How to

- Step 1 - Define
- Step 2 - Biologize
- Step 3 - Discover
- Step 4 - Abstract
- Step 5 - Emulate
- Step 6 - Evaluate

+ Add resource

Lotus-leaf superhydrophobic surfaces

Description

Among them, the most well-known example is the lotus leaf, which could make water droplets roll off the leaf surface quickly to achieve surface cleaning. Lotus leaves exhibit a contact angle $> 150^\circ$ and a small sliding angle $< 2^\circ$. The high surface tension of water will assemble the droplets into spheres that drive the droplets to roll off the surface together with embedded dirt from the surface.

Subject: Architecture Tag 1 Tag 2



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Figure 10. View description of Collection



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- **How to (Help):** This auto-generated interface displays relevant information for mentors on how to construct the collection.

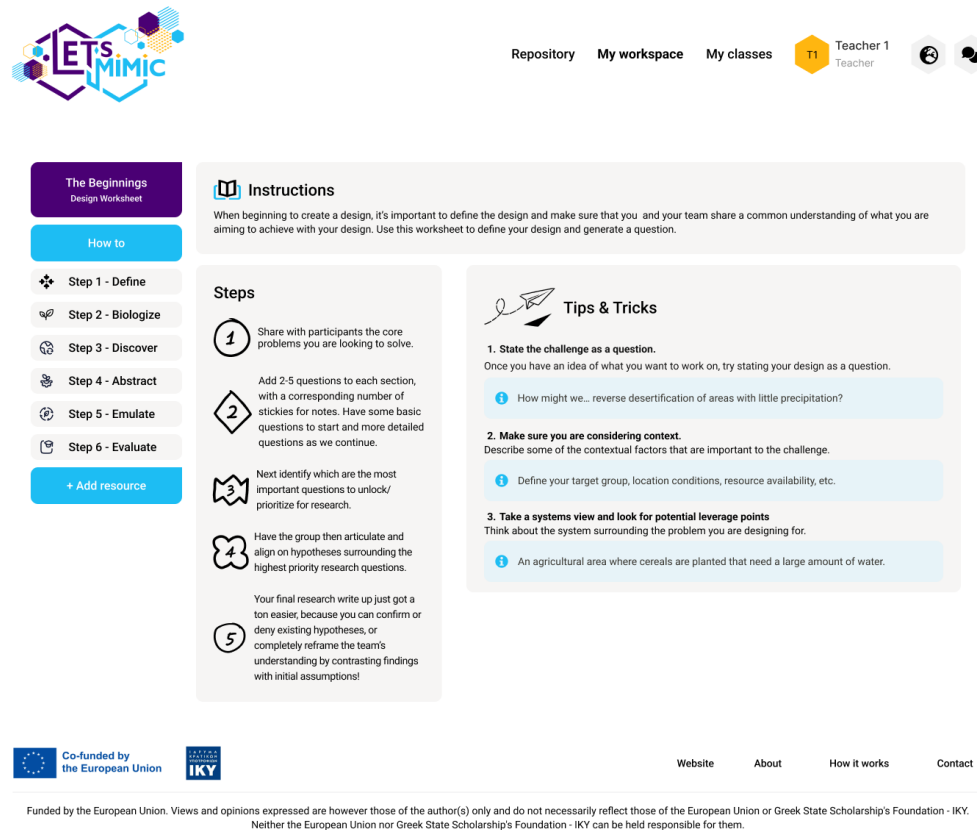


Figure 11. View instructions

- **Stages of the Biomimicry Design Process:** This is a predefined interface with information related to each step of the Biomimicry Design Process. Mentors can view specific information related to each stage.

The Beginnings
Design Worksheet

How to

❖ Step 1 - Define

Document

🔍 Step 2 - Biologize

Document

Video

🌐 Step 3 - Discover

Document

📄 Step 4 - Abstract

Document

Video

🔄 Step 5 - Emulate

Video

📊 Step 6 - Evaluate

Quiz

+ Add resource

Define

When beginning to create a design, it's important to define the design and make sure that you and your team share a common understanding of what you are aiming to achieve with your design. Use this worksheet to define your design and generate a question.

The goal of this step is not to decide what you will make or design but to understand what your design needs to do, for whom, and in what context. It can be tempting to rush this step but doing so can mean jumping to conclusions prematurely.

If you are working on a very complex issue, now is the time to learn all you can about it. Do your research. Talk with experts and stakeholders. Once you have a good understanding of the issues involved, select a discrete and specific challenge to focus on – ideally one that you feel has a good probability of success given your resources and abilities.

Guidelines

- 1. State the challenge as a question.**
Once you have an idea of what you want to work on, try stating your design as a question.
- 2. Make sure you are considering context.**
Describe some of the contextual factors that are important to the challenge.
- 3. Take a systems view and look for potential leverage points**
Think about the system surrounding the problem you are designing for.

Figure 12. View information on a step of the Biomimicry Design Process

- Content addition to the Biomimicry Design Process:** The platform allows inserting different types of resources, which can be allocated by drag-and-drop action in each of the Biomimicry Design Process. The resources can be documents, images, videos, H5P, and collaborative spaces. The documents, images, videos, and H5P units are integrated into the platform via a URL.



The Beginnings
Design Worksheet

How to

Step 1 - Define

Document

Step 2 - Biologize

Document

Video

Step 3 - Discover

Document

Step 4 - Abstract

Document

Video

Step 5 - Emulate

Video

Step 6 - Evaluate

Quiz

+ Add resource

Type the title of the resource

Type the description of the resource

Insert URL

Save



Figure 13. Add resource - Document type



The Beginnings
Design Worksheet

How to

Step 1 - Define
Document

Step 2 - Biologize
Document
Video

Step 3 - Discover
Document

Step 4 - Abstract
Document
Video

Step 5 - Emulate
Video

Step 6 - Evaluate
Quiz

+ Add resource

Title of the resource

Description

In this document you will find all the information needed to ...

Mammal Biomimicry 1 / 2 100%

Mammal Biomimicry

Grade Range: Grade IX - X

Lesson Time: 20 minutes

Key Terms

Biomimicry
Invention
Mammal
Mimic
Scientist

Materials and Resources

Comparing Mammals Picture
Materials for models (see Closing)

Activity Overview

There are currently over 4000 species of mammals around the world! Mammals are warm-blooded, vertebrate animals that have hair and produce milk to feed their young. Mammals also help inspire scientists to create inventions to help solve human problems. This is the basic idea of biomimicry, an approach to innovation that looks to nature for sustainable solutions to human problems. In this activity, students will take a closer look at a variety of mammals and explore some inventions that mimic mammals' external structures.

Essential Questions

1. How do organisms live, grow, respond to their environment, and reproduce?
2. How do the structures of organisms enable life's functions?

Objectives

- Use materials to design a solution to a human problem by mimicking how mammals use their external parts to help them survive, grow, and meet their needs
- Mimic the way an external structure of a mammal captures and conveys information
- Mimic the way a mammal responds to information from the environment

Introduction

Prior to this activity, display photos of different mammals (e.g., the Comparing Mammals Picture). Ask students to identify and describe where they have seen each type of mammal. Then have students compare the similar parts that these mammals have. Allow students to share their ideas. Explain to the students that they will now take a journey to learn how mammals help inspire scientists to create inventions to help solve human problems.

Figure 14. View resource in Define stage - Document type

4.2.2. Resources

Mentors can create microlearning units and save them as individual resources that can be private or public at the platform level. Resources follow the same structure as a Collection, but they can be tagged and associated with one of the steps of the Biomimicry Design Process to be identified more easily.

Platform users can mark resources as favourites to support the self-regulated learning approach.

My workspace



Add a collection

Add a resource

Collections

Resources

<p>Resource title</p> <p>The biomimicry of the lotus leaf can provide superhydrophobic surfaces</p> <p>Go explore →</p> <p>Tag 1</p>	<p>Resource title</p> <p>The biomimicry of the lotus leaf can provide superhydrophobic surfaces</p> <p>Go explore →</p> <p>Tag 1</p>	<p>Resource title</p> <p>The biomimicry of the lotus leaf can provide superhydrophobic surfaces</p> <p>Go explore →</p> <p>Tag 1</p>	<p>Resource title</p> <p>The biomimicry of the lotus leaf can provide superhydrophobic surfaces</p> <p>Go explore →</p> <p>Tag 1</p>	<p>Resource title</p> <p>The biomimicry of the lotus leaf can provide superhydrophobic surfaces</p> <p>Go explore →</p> <p>Tag 1</p>
<p>Resource title</p> <p>The biomimicry of the lotus leaf can provide superhydrophobic surfaces</p> <p>Go explore →</p> <p>Tag 1</p>	<p>Resource title</p> <p>The biomimicry of the lotus leaf can provide superhydrophobic surfaces</p> <p>Go explore →</p> <p>Tag 1</p>	<p>Resource title</p> <p>The biomimicry of the lotus leaf can provide superhydrophobic surfaces</p> <p>Go explore →</p> <p>Tag 1</p>	<p>Resource title</p> <p>The biomimicry of the lotus leaf can provide superhydrophobic surfaces</p> <p>Go explore →</p> <p>Tag 1</p>	<p>Resource title</p> <p>The biomimicry of the lotus leaf can provide superhydrophobic surfaces</p> <p>Go explore →</p> <p>Tag 1</p>

<< < 1 2 > >>

Figure 15. List of Private Resources

4.3. My Classes

The My Classes interface is dedicated to mentors' private classes, which can include one or more Micro learning units (Collections or Resources). The interface allows mentors to:

The interface will enable mentors:

- To search a class by title.
- To add a new class.
- To edit/delete existing classes.
- To share a Class with a student or to a group of students.

My classes

Search



Add a class






 Lotus-leaf The biomimicry of the lotus leaf can provide superhydrophobic surfaces Go explore →	 Mamal biomimicry students will take a closer look at a variety of mammals and explore Go explore →	 Whale & wind turbines Testing by fish revealed that serrated-edge wind turbines Go explore →	 Velcro A simple design of tiny hooks at the end of the burr's spines Go explore →	 Water collection A simple design of tiny hooks at the end of the burr's spines Go explore →
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Figure 16. List of classes created by a mentor

A class has a double purpose, as follows:

- It can include one or more Micro learning units and be shared with one student for individual work to promote self-regulated learning, in which the enrolment is made via a unique code.
- It can include one or more Micro learning units and be shared with a group of students to promote collaborative work, in which the enrolment is made via a unique code.

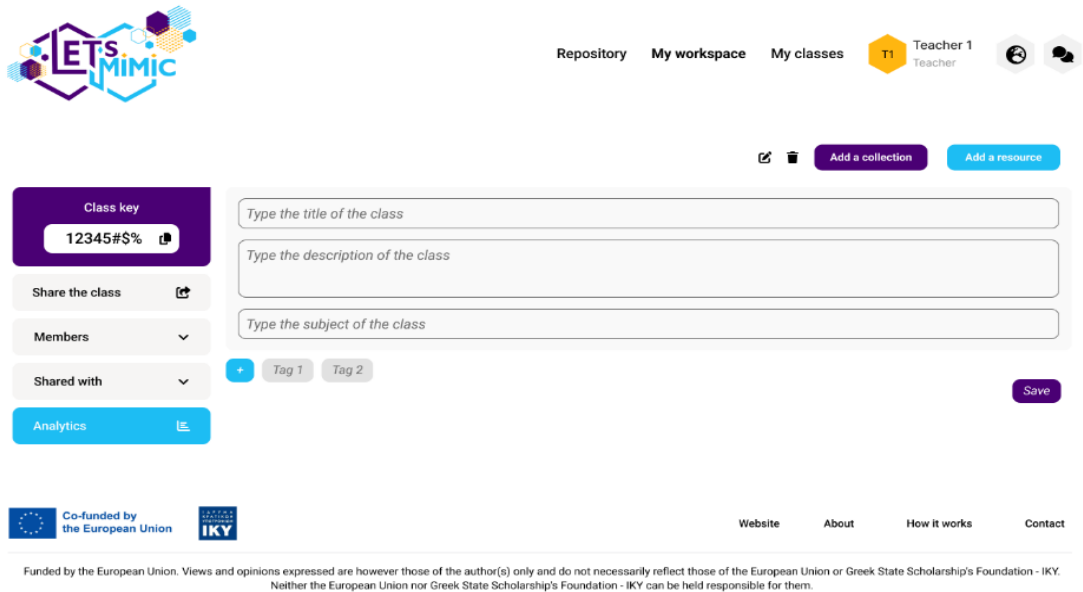


Figure 17. Form for adding a class

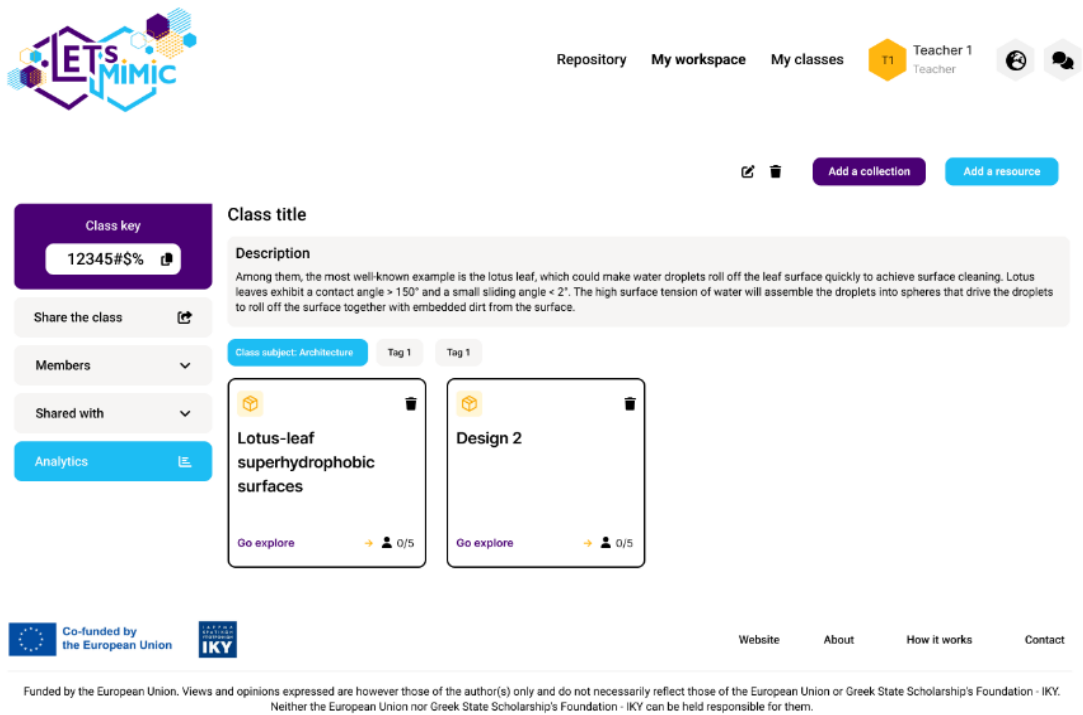


Figure 18. Class with Micro lessons included

4.4. Assessment Module

The module provides feedback on student evolution, which is used to improve students' performance. It manages the mentor and the student dashboards.

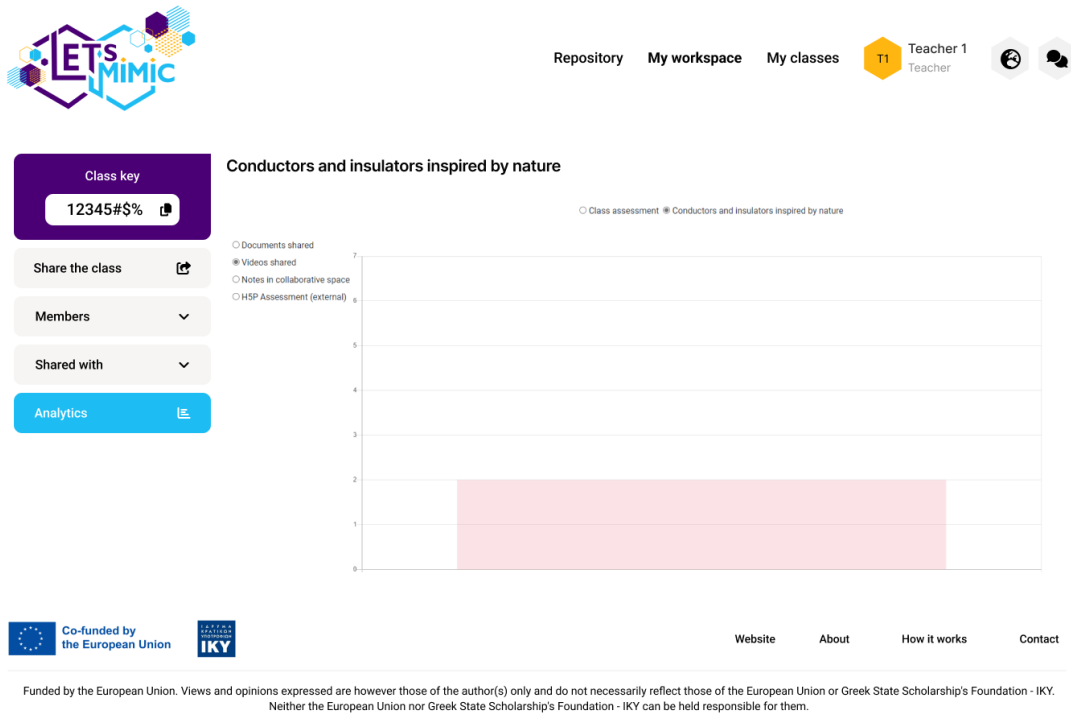


Figure 19. Assessment of a Collection in a class

5. Interface Design Specifications: Students

The Student User Interface follows an aesthetic layout. It provides a seamless and user-friendly experience by offering firsthand an overview of all the critical components of the platform. The interface is divided into four sections:

- **The menu:** The menu is configured according to the access level:
 - *Level 1* – before login: includes the options to log into the platform or create an account to access the platform.
 - *Level 2* – after login: includes all the critical components of the LET'S MIMIC Platform: Repository, Micro lessons, My Classes, Profile, Chat and Language. The main menu is displayed at each level of interaction with the platform.
- **The main section:** This section offers a short description of the LET'S MIMIC platform and options to access the project website, join a class, and access the platform's manual.
- **The content section:** This section includes the latest collections or resources on the platform. They can be accessed only after logging in.
- **The footer and disclaimer:** The footer includes the logo of the EU and Greek National Agency (IKY), a quick menu for accessing relevant information about the project and the acknowledgement. This section is displayed at each level of interaction with the platform.



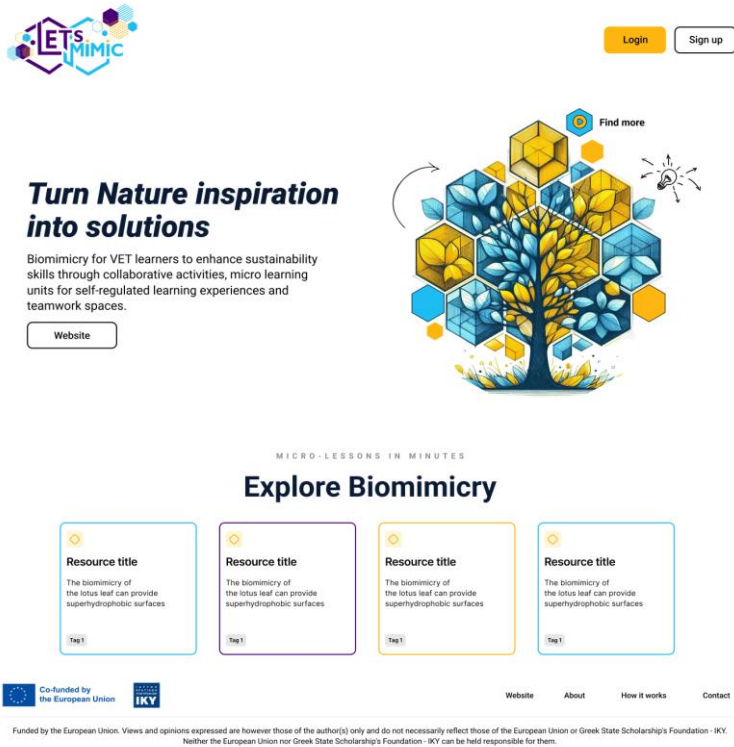


Figure 20. Students UI before login

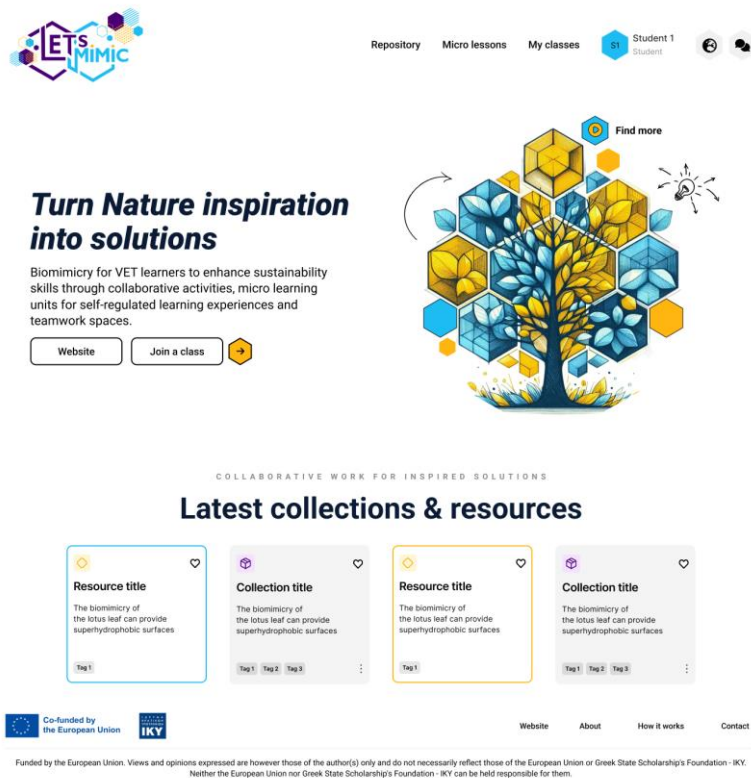


Figure 21. Students UI after login



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5.1. Repository

The Repository intersection face provides users with a list of all Collections and Resources made public by the mentors.

The interface allows users to:

- Search the content, including Collections or Resources, by title.
- Filter the content by type, namely Collections or Resources.
- Access a Collection or Resource.
- Mark as a favourite a Collection or Resource and transfer it to the Micro lesson component.

The screenshot displays the 'Repository' section of a web application. At the top left is the 'LET'S MIMIC' logo. The navigation bar includes 'Repository', 'Micro lessons', and 'My classes', along with a user profile for 'Student 1' and icons for search and communication. Below the navigation, the 'Repository' title is followed by a search bar and two filter tabs: 'Collections' (selected) and 'Resources'. The main content area features a grid of ten collection cards, each with a purple cube icon, a title, a description, and three tags. A pagination bar at the bottom shows page 1 of 2. The footer contains logos for the European Union and IKY, and navigation links for 'Website', 'About', 'How it works', and 'Contact'. A disclaimer at the bottom states: 'Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or Greek State Scholarship's Foundation - IKY. Neither the European Union nor Greek State Scholarship's Foundation - IKY can be held responsible for them.'

Figure 22. Repository of public Collections available for students



Repository

Collections

Resources

 Resource title The biomimicry of the lotus leaf can provide superhydrophobic surfaces Tag 1	 Resource title The biomimicry of the lotus leaf can provide superhydrophobic surfaces Tag 1	 Resource title The biomimicry of the lotus leaf can provide superhydrophobic surfaces Tag 1	 Resource title The biomimicry of the lotus leaf can provide superhydrophobic surfaces Tag 1	 Resource title The biomimicry of the lotus leaf can provide superhydrophobic surfaces Tag 1
 Resource title The biomimicry of the lotus leaf can provide superhydrophobic surfaces Tag 1	 Resource title The biomimicry of the lotus leaf can provide superhydrophobic surfaces Tag 1	 Resource title The biomimicry of the lotus leaf can provide superhydrophobic surfaces Tag 1	 Resource title The biomimicry of the lotus leaf can provide superhydrophobic surfaces Tag 1	 Resource title The biomimicry of the lotus leaf can provide superhydrophobic surfaces Tag 1



Figure 23. Repository of public Resources available for students

5.2. Microlessons

The Microlessons section allows students to mark a Collection or a Resource from the Repository as favourite and include it in the SRL-P.





Micro Lessons

Collections

Resources

<p>Collection title</p> <p>The biomimicry of the lotus leaf can provide superhydrophobic surfaces</p> <p>Tag 1 Tag 2 Tag 3</p>	<p>Collection title</p> <p>The biomimicry of the lotus leaf can provide superhydrophobic surfaces</p> <p>Tag 1 Tag 2 Tag 3</p>	<p>Collection title</p> <p>The biomimicry of the lotus leaf can provide superhydrophobic surfaces</p> <p>Tag 1 Tag 2 Tag 3</p>	<p>Collection title</p> <p>The biomimicry of the lotus leaf can provide superhydrophobic surfaces</p> <p>Tag 1 Tag 2 Tag 3</p>	<p>Collection title</p> <p>The biomimicry of the lotus leaf can provide superhydrophobic surfaces</p> <p>Tag 1 Tag 2 Tag 3</p>
<p>Collection title</p> <p>The biomimicry of the lotus leaf can provide superhydrophobic surfaces</p> <p>Tag 1 Tag 2 Tag 3</p>	<p>Collection title</p> <p>The biomimicry of the lotus leaf can provide superhydrophobic surfaces</p> <p>Tag 1 Tag 2 Tag 3</p>	<p>Collection title</p> <p>The biomimicry of the lotus leaf can provide superhydrophobic surfaces</p> <p>Tag 1 Tag 2 Tag 3</p>	<p>Collection title</p> <p>The biomimicry of the lotus leaf can provide superhydrophobic surfaces</p> <p>Tag 1 Tag 2 Tag 3</p>	<p>Collection title</p> <p>The biomimicry of the lotus leaf can provide superhydrophobic surfaces</p> <p>Tag 1 Tag 2 Tag 3</p>



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Figure 24. List of public Collection or Resources



Collection key

12345#\$%

Achievements

Collection title

The biomimicry of the lotus leaf can provide superhydrophobic surfaces...

Tag 1 Tag 2 Tag 3



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Figure 25. View Collection by self-enrolment



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5.3. My Classes

The My Classes section allows students to access a Class using a unique code based on the invitation received from a mentor.

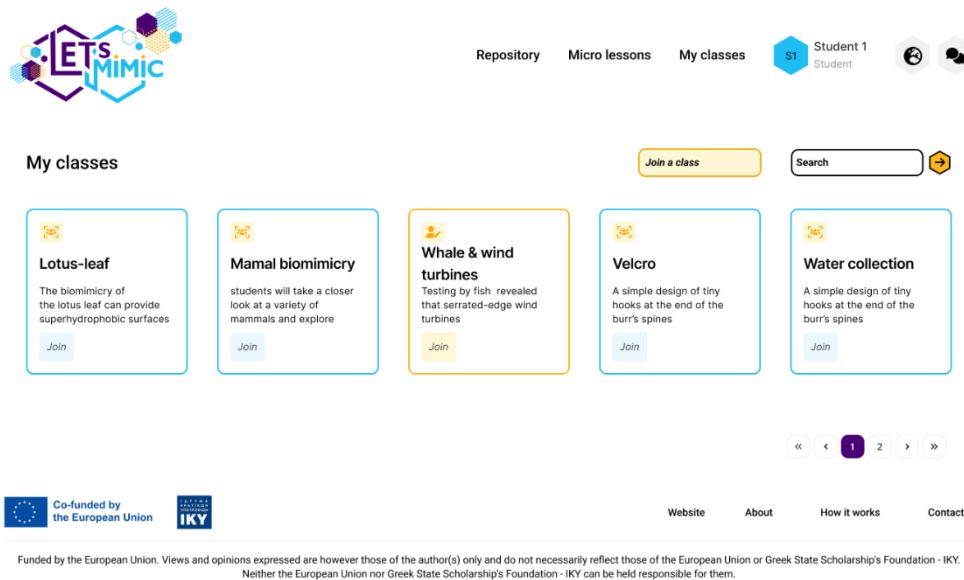


Figure 26. List of classes shared by mentor

A class has a double purpose, as follows:

- A student can work individually in a class shared by the mentor.
- A student can work collaboratively in a class shared by the mentor.

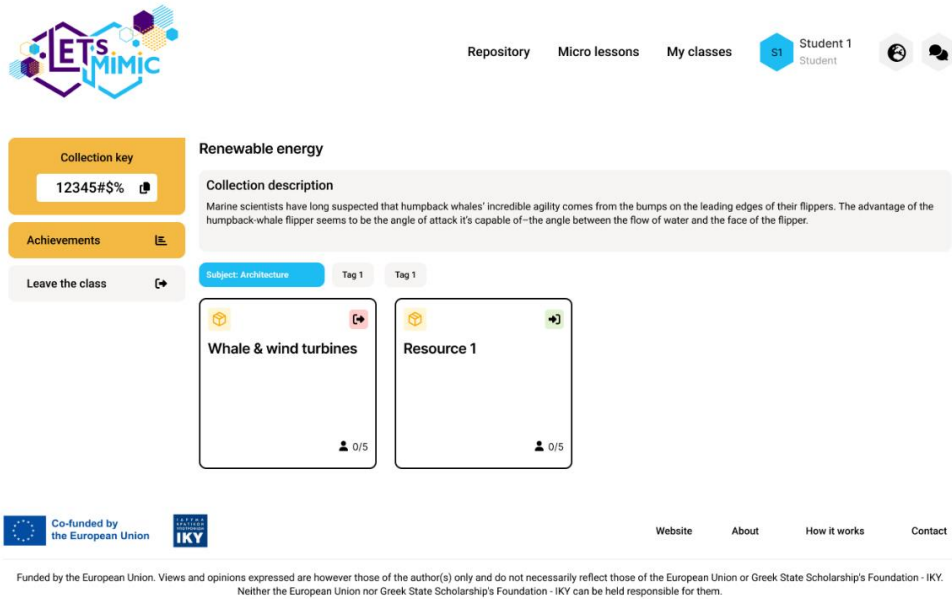


Figure 27. View class as individual work

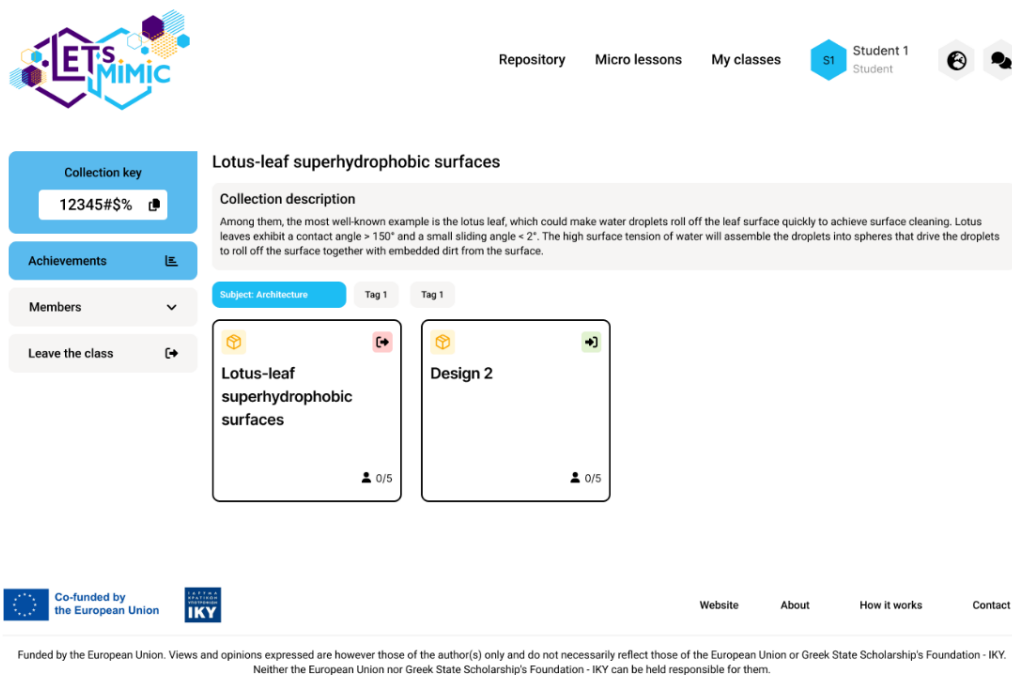


Figure 28. View class as collaborative work

5.4. Gamification Module

It provides features such as a point system, badges, and leaderboards paired with H5P resources, which can support gamification.



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The Beginnings
Design Worksheet

How to

- Step 1 - Define
Document
- Step 2 - Biologize
Document
Video
- Step 3 - Discover
Document
- Step 4 - Abstract
Document
Video
- Step 5 - Emulate
Video
- Step 6 - Evaluate
Quiz

Title of the resource

Description
In this document you will find all the information needed to ...

Conductors or insulators - Aluminium & Fabric

What are these? Drag & drop the correct answer.

2 / 2

Figure 29. Gamification of HSP unit

6. Conclusions

The Biomimicry Collaborative Platform was designed to enable mentors to create resources that enable students to experiment with the Biomimicry Design Process. This deliverable describes the main sections and features of the mentor and the student interfaces, focusing on presenting the key components of the platform and the users' experience, ensuring that the interfaces have elements that are easy to access, understand, and use to facilitate those actions.



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