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# Deliverable D4.1 – IoT-ECO hub

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## 1. Introduction

The deliverable D4.1 entitled "IoT-ECO hub" reports the activities pertaining to the general design of the IoT-hub (as part of the work planned in the frame of WP4). The concept that is adopted for designing the hub relies on the principles of modularity to allow each partner to develop and deploy their respective module (i.e., educational, and experimental) as they see fit and then focus on defining and implementing efficient and effective interactions among the modules.

In the following, first, the general design of the IoT-ECO hub will be described including its mission, its educational and experimental parts, as well as their interactions. Then, an outline of the next steps towards the final deployment and usage of the hub will be provided.
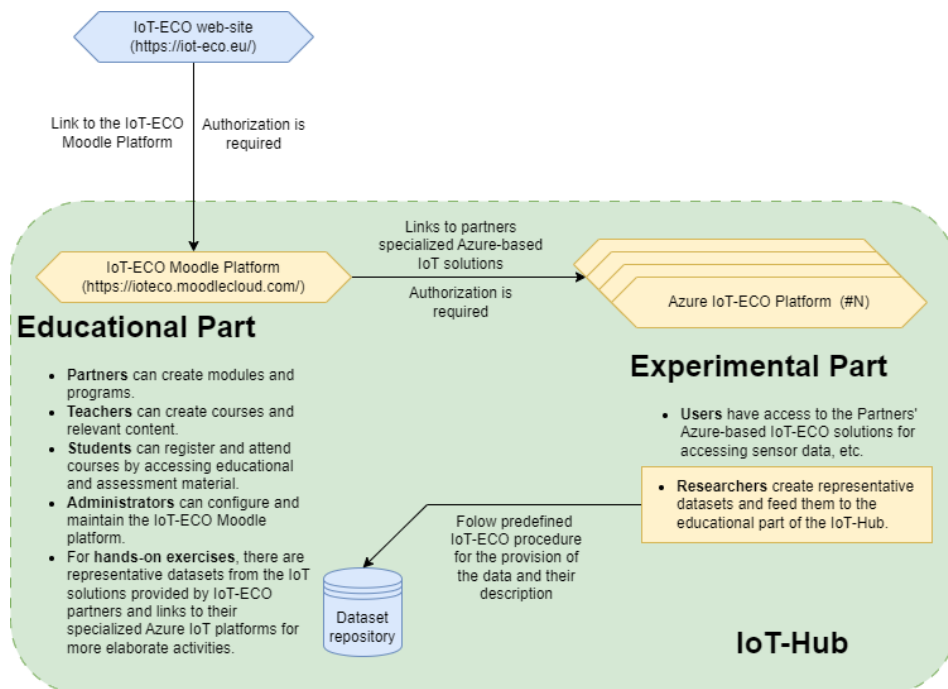


*Figure 1: The general concept of the IoT-ECO hub.*

## 2. General design of the IoT-ECO hub

The general concept and high-level design of the IoT-ECO hub is depicted in Figure 1. The IoT-ECO hub will be accessed via the IoT-ECO project web page using the web link https://iot-eco.eu. In the IoT-ECO project web page, an informative description of the IoT-ECO hub will be provided including its mission, goals, and provided services (with a special focus on the educational and experimental parts). Finally, a web link to the IoT-ECO hub will be given in order the interested user to be redirected to the IoT-ECO hub and, particularly, to its education part using, currently, the web link https://ioteco.moodlecloud.com. In the educational part, the users will have access to the educational content produced in the frame of the IoT-ECO project and they will, also, be able to have access to the Azure-based IoT solutions provided by the IoT-ECO partners. In the following, we will outline the general mission of the hub and describe, in more detail, the educational and experimental parts.

## 2.1. Mission

The IoT-ECO hub is established to provide the IoT-ECO partners and other interested users with:

- A common space for teachers to collect and share teaching and assessment materials, videos, presentations, data, software resources, simulators, tutorials, guidelines, practical assignments pertaining to the main theme of the IoT ECO project, namely, "IoT and Green transformation."

- An electronic classroom for enabling students to study IoT and Green transformation material, get hands-on experience, familiarize themselves with Azure-based IoT solutions provided by the partners and engage in discussion forums and project and idea sharing and exchanges.

- Access to existing, external, or newly developed IoT prototypes for data collection, thus, providing representative datasets for further experimentation and data analysis.

## 2.2. Educational part

The educational part of the IoT-ECO hub will be built using the open-source learning platform Moodle LMS (found in https://moodle.org/). This platform can support multiple user roles including teachers, students, and site administrators. Moreover, the platform can support the creation of modules (each consisting of multiple courses) and programs (e.g., at the under-graduate and post-graduate levels).

In more detail, a user will need to be registered at the educational part of the IoT-ECO hub and be assigned a specific role. This can be achieved via several ways including (a) per-case registration by an existing site administrator or a teacher and (b) via a self-contained way using, e.g., their personal emails. In any case, users can log in to the educational part of the hub using their credentials via a webpage as depicted in Figure 2.
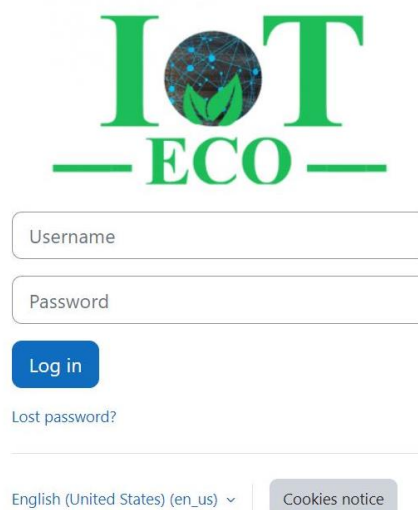
*Figure 2: Logging in to the educational part of the IoT-ECO hub.*

The site administrators are responsible for the configuration of the site and its maintenance (see Figure 3). Some examples of what can be configured are the following:

- General attributes related, e.g., to the registration approach provided by the site,
- Managing site users,
- Configuring the general attributes of courses,
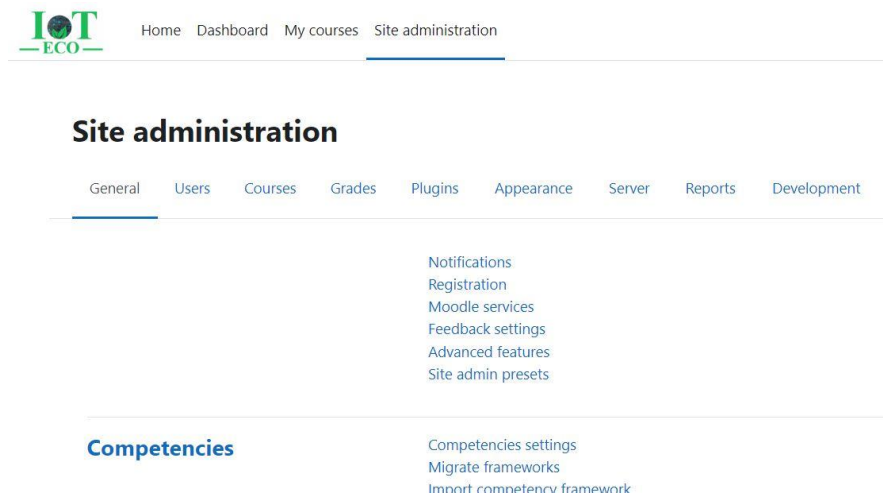- Site appearance, etc.



*Figure 3: Some functionalities controlled by the site administrator.*

The teachers are responsible for creating courses (defining their structure and content), and interacting with the students enrolled in the course. In Figure 4, there is an example of the webpage for creating and structuring a course, while, in Figure 5, examples of activities and resources that can be incorporated into a course, are depicted (e.g., forum, textbooks, assignments, etc.).
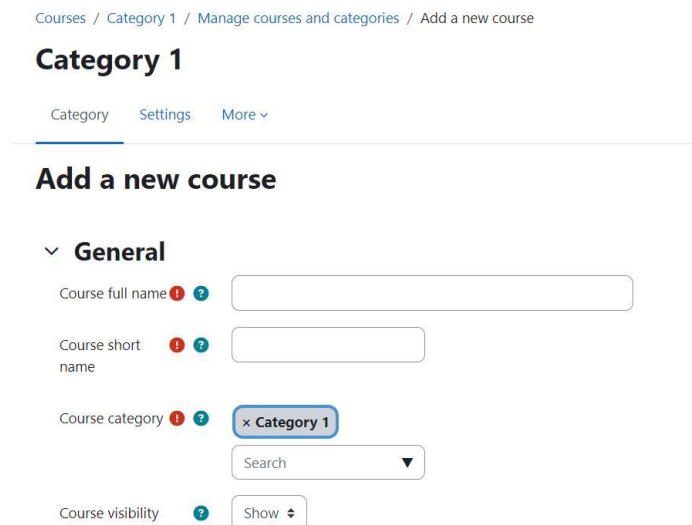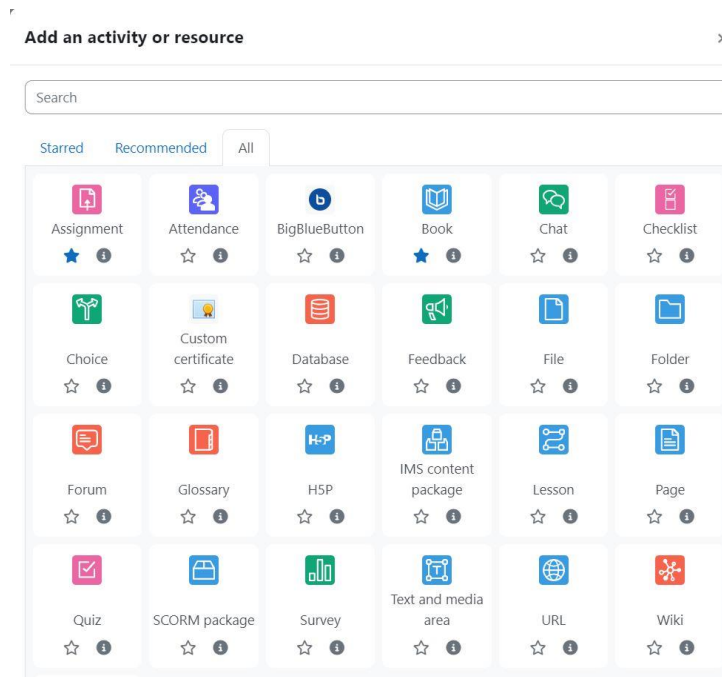


*Figure 4: Creating a course*

*Figure 5: Examples of activities / resources to be added in a course.*

Finally, students can register to a course and study the relevant content based on the activities determined by the corresponding teacher / instructor. In Figure 6, there is an example of the webpage depicting the courses that one student has already enrolled to.
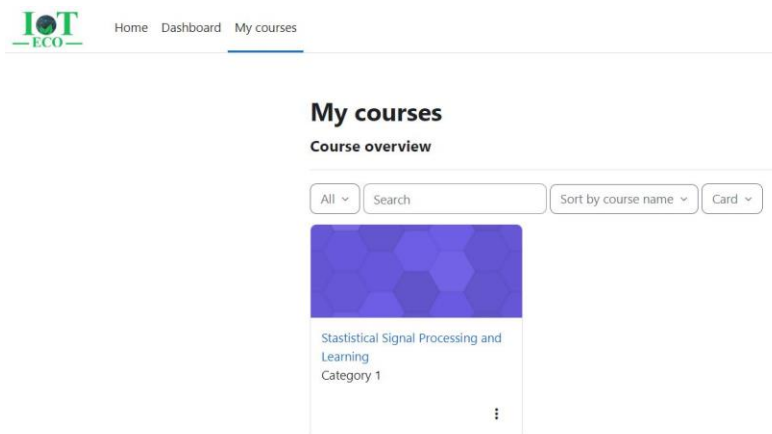


*Figure 6: The courses that a student has already enrolled to.*

Via the educational part of the IoT-ECO hub, teachers will have access to representative datasets (stored in a data repository) which can be utilized in the frame of laboratory courses. These datasets will be provided by the Azure-based IoT solutions developed by IoT-ECO partners. Each dataset should be accompanied with a documentation file where all necessary information regarding the included will be provided. Moreover, apart from those datasets, teachers will have the option to also provide web links to these solutions to enable students to elaborate further in

data collection and analysis depending on their interests. For this latter capability, an additional authorization procedure should be followed which will be determined by the corresponding partner that provides the IoT solution.

## 2.3. Experimental part

The experimental part of the IoT-ECO hub will comprise the virtual prototypes of green transformation ecosystem models of (a) the port of Durres, (b) the university campus of UBT, Pristina and, (c) the university campus of UM, Podgorica.

As an indicative example, concerning the port of Durres, a 3D model of the port is being created based on terrain maps and information regarding the available infrastructure, layout, area, features of the port warehouses, cranes, containers and other structures within the port (see an example in Figure 7). For the port, a digital twin for monitoring and simulations will be created and data, e.g., on energy consumption and levels of $CO_2$ will be captured and provided.



*Figure 7: An example of a 3D model of a small terminal in the port.*

## 3. Next steps

In the following period of the IoT-ECO project, focusing especially on WP4 activities, the general design that has been presented in the previous sections, will be further elaborated, developed, and deployed in appropriate infrastructure.

In more detail, the following options will be investigated for deploying the educational part of the IoT-ECO hub:

- Employ a cloud-service provided, e.g., by moodle.com for deploying the Moodle platform (currently, this is the option that is followed for getting familiar with the platform). This option requires a per-year license agreement, the cost of which depends on the number of expected users and the storage space that will be required for providing the course material as well as the representative datasets.
- Employ infrastructure and IT support provided by an IoT-ECO partner. This option is expected to be a suitable one as it will enhance the sustainability of the educational part beyond the end of the project.

Concerning the virtual prototypes that will be part of the experimental part, the option that is currently adopted is to allow each responsible partner to develop their prototype using the toolset that they are more familiar with including, for example, appropriate Microsoft Azure services. For these prototypes, access to IoT-ECO hub users will be granted by responsible partners per request for enabling the study of, e.g., more advanced aspects of the provided digital twins as well as the data capturing mechanisms.

Finally, in the frame of WP4, the administration and the regulations of the IoT-ECO hub will be determined. Moreover, guidelines and online training will be provided to teachers and staff of the IoT-ECO hub for creating, uploading, and sharing the required content of the targeted courses.