

Teaching Environmental Awareness with Smart IoT Planters in Learning Spaces [TEASPILS]

Intellectual Output 3

Extended report

Visualisation dashboard to show sensor data - mobile and web-based app



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Project information

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Consortium Partners	Doukas school (DOU) Hochschule für Agrar und Umweltpädagogik (HAUP) Open University of Cyprus (OUC) Pädagogische Hochschule Wien (PHW) Universidad Pompeu Fabra (UPF)
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Visualisation dashboard to show sensor data - mobile and web-based app

To enable experienced-based environmental awareness learning activities, in TEASPILS we have developed a dashboard that visualizes data captured by sensors located in plants (smartIoT planters, IO2) available in learning spaces. The design and development have been led by UPF, and all partners have participated in co-design work sessions and have provided reviews and feedback on design proposals.

UPF has also conducted co-design workshops with teachers and external experts to inform the final design and the prioritization of features developed. To achieve its aims, the formulation of the co-design workshops included brainstorming about learning activities that could be supported by the dashboard. The possibilities for learning activities using smart planters can be diverse (plant care, ambient or emotional implications, data analysis, etc.) and its design can influence the shape of desirable dashboard features. The approach followed has offered an answer for such a type of dashboard design based on a human-centered methodology that involves stakeholders (experts and practitioners) in its co-design.

The design of the dashboard is described in the following article [[Human-centred design of a dashboard](#)] and it is currently (as of August 2023) under review in an international journal.

The results show insights related to what are the types of learning activities supported by smart planters that can be especially valuable to educators (in alignment with the SDGs) and what design principles should be considered in the creation of the supporting dashboard. Resulting representative proposals for activities include plant monitoring, correlation of sensed data and observations, and collaborative tasks. Key values perceived by participants include expected high levels of student engagement, critical thinking, and familiarity with the scientific method. The results of the conducted workshops led to an identification of design principles and features for a supporting dashboard that included the use of a traffic light metaphor or the enabling of data collection that could serve for contrasting variables and observations at a moment in time and across time.

TEASPILS Dashboard

The TEASPILS dashboard was developed as a responsive web application (<http://teaspils.upf.edu/teaspils/>) including these features. Figure 1 shows how data is visualized, enabling possibilities for comparing the variables over time and between each other. Data is presented using a time-based shared axis plot to easiness the tracking of the interaction between variables. The dashboard enables users to monitor the most common plant variables of interest such as environment temperature, soil temperature, soil humidity, light, and Co2. It also has an interface to perform a bi-variate analysis among the measures.



Figure 1- Data visualization tool.

A snapshot of the status of the plant at a given time could be displayed (Figure 2) by navigating through the points in the timeline. This screen also shows if the plant requirements are being addressed properly or not. Colors act as alerts and their thresholds can be configured.

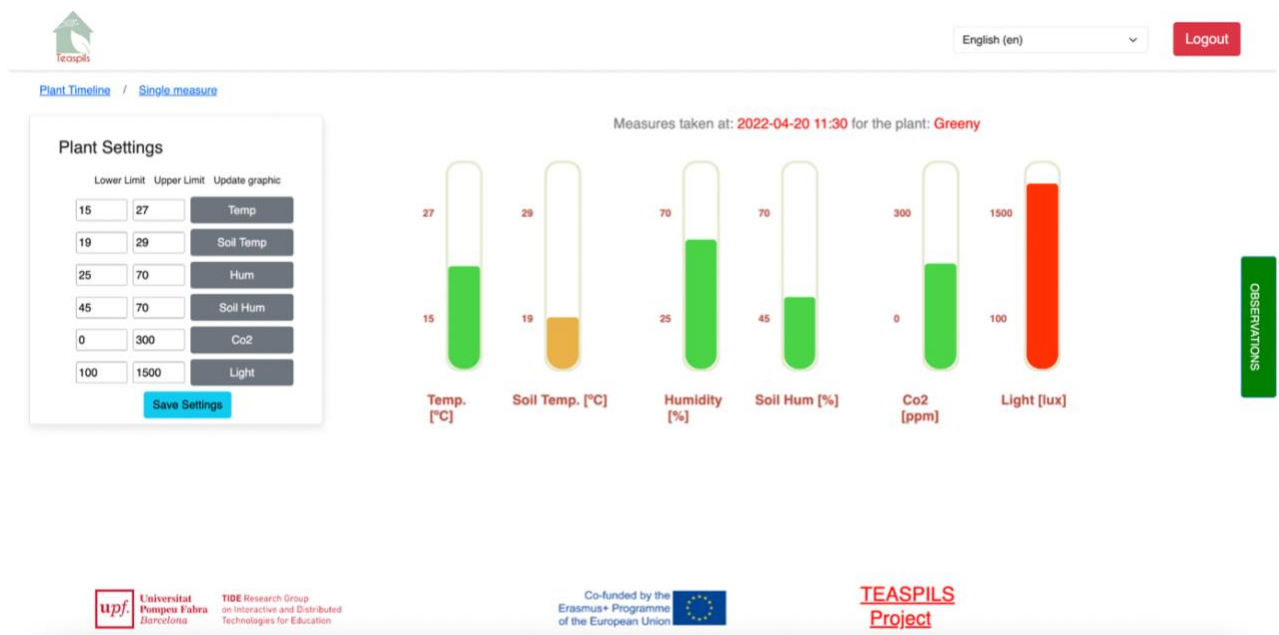


Figure 2- Instant snapshot of the status of the plant.

Furthermore, an observation module is available to register additional comments and insights made by users about their interactions and to contextualize what's happening with the plant. These observations could be made at two different levels, at the plant level, registering the overall progress of the plant experiment, and at a given point in time, enabling users to register their ideas over punctual events and moments in the experiment.



Figure 3. Observations module (at plant level)

Site administration

AUTHENTICATION AND AUTHORIZATION	
Groups	+ Add Change
Users	+ Add Change

TEASPILS_BACKEND	
Centers	+ Add Change
Courses	+ Add Change
Measure observations	+ Add Change
Measurements	+ Add Change
Observations	+ Add Change
Plant settings	+ Add Change
Plants	+ Add Change
Students	+ Add Change

Recent actions

My actions

- + LTT WIEN Center
- Greeny Plant
- Greeny Plant
- + PlantSettings object (1) Plant settings
- + Greeny Plant
- + 2022-1 @ JTELSS Course
- + JTELSS Center

Figure 4. Administration module.

The platform has available an administration module to configure and explore the data from the dashboard as seen in Figure 3. The administration module serves as a powerful tool for managing various aspects of the platform. Users can create, edit, and delete plants through this module, allowing them to customize their experiments according to specific needs. Additionally, the administration module enables users to explore plant- and measure-level observations, providing valuable insights into the data collected from the smart IoT planters. To configure a new plant, users must create a new Experiment (associated with a center) or use existing ones. The module also allows users to explore data, such as plant-level observations made by users and user groups associated with individual plants. Overall, the administration module offers comprehensive tools to effectively manage and oversee the TEASPILS system, promoting a seamless and efficient learning experience for all involved.

A User Manual was designed as part of the deliverables of the project. It provides an extensive guide on how to utilize the TEASPILS system for environmental education purposes. The manual covers an introduction to the administration module and includes instructions on accessing the user module for the visualization of the sensor data, as well as the instruction for custom dataset loading. Furthermore, the manual offers guidance on navigating the single-measure view, single-measure observation, and displaying plant observations, enabling users to easily interact with the platform.

Workshops and Multiplier events for IO3

To collect feedback and disseminate the project, including practical activities with TEASPILS dashboard, a series of workshops and multiplier events for teachers and learners were made during the project. The events included.

JTELSS Summer school: Project results were presented in a workshop co-located with the JTELSS Summer school (educational technology researchers)

CACAO international visits: UPF hosted a visit of international researchers and educational practitioners (field of biology education). As part of their visit, UPF organised an event devoted to

the presentation of the TEASPILS project and the developed ecosystem. After the presentation, participants and project members discussed the intersection of environmental awareness in learning spaces, technologies (such as the dashboard, the ILDE+ platform, and the sensors spike) music, and arts.

Lego League: The project was presented to kids, their teachers, and families attending the Barcelona's First Lego League. The project was presented in a series of talks and participants were encouraged to think about the relationship between technologies and environmental awareness. (<https://www.firstlegoleague.soy/eventos-locales-superpowered/>)

Oracle4Girls: A practical workshop for girls between 11 to 16 years old was developed based on the TEASPILS technologies. The girls were asked to propose a plant-based solution for some of their day-by-day problems in their learning spaces. (<https://oracle4girls.x-ternalmarketing.es/eventos-anteriores/?evento=talleres-presenciales-barcelona-22-de-abril>)

STEAMConf: On October 13 to 15, STEAMConf Barcelona counted on its 8th edition with a TEASPILS workshop oriented to teachers and educators. The workshop aimed to incentivize Barcelona's teachers to include learning activities based on the TEASPILS ecosystem. (<https://steam.soko.tech/es/steamconf22/>)

Makers Faire: On July 1st and 2nd, the Maker Faire 2022 in Barcelona hosted a panel on Sensors, IoT for STEAM learning, and environmental awareness, focusing on real experiences using TEASPILS tools in classrooms. The event included two workshops for teachers and kids. Technical advancements included moving the dashboard platform to a new domain, beginning preparations for pilot tests, and releasing a draft user manual for educators to discuss and improve. (<https://makerfairebarcelona.soko.tech>)