

The BotBid Project: Data Education at Work

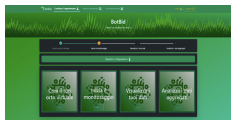
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Motivations and Goals

- The BotBid (From Botany to Big Data) project is an educational initiative that promotes data literacy, scientific and research methods, and participatory science practice
- The experiment involves setting up school gardens equipped with IoT kits for collecting and transmitting environmental data.
- The BotBid WebApp enables the collection of environmental parameters and plant growth data.
- The BotBid IoT infrastructure provides a dashboard to visualize, analyze and compare data collected by the different schools.



- Since July 2023, BotBid is part of the STACY community of Spoke 5 of the Robotic and AI for Socio-economic Empowerment (RAISE) Ecosystem of the Italian National Recovery and Resilience Plan (NRRP). The project was funded with 40,000 euros.
- The 2025 edition involved 10 different classes from five secondary schools from Liguria and one from Sardinia.
- The project also included 9 first-cycle classes in simplified version of the project .
- Including previous editions, the project has reached over 3,000 students and around 200 STEM teachers

Timeline and Goals (2025 edition)

Phase	Goal	Contents	Timing
Network formation	Creation of the network of schools, classes and teachers	Call for participation Online launch of the project	October-November
Training	Methodology	Introduction to the scientific method; biomonitoring best practices; setup of the experiment	December
	Data acquisition	Introduction to edge components and IoT platforms with a focus on biomonitoring case-study (e.g., environmental sensors)	January
	Data education	How to organize, prepare, and interpret data	February
	Data analysis	How to validate the experiment hypothesis	March
Monitoring	Data collection	Use the BotBid platform to collect data: for 12 weeks, once a week	March-May
Restitution	Data analysis	Use of statistical analysis to validate the experiment hypothesis, compare data and results of different nodes, comparisons and correlations	June

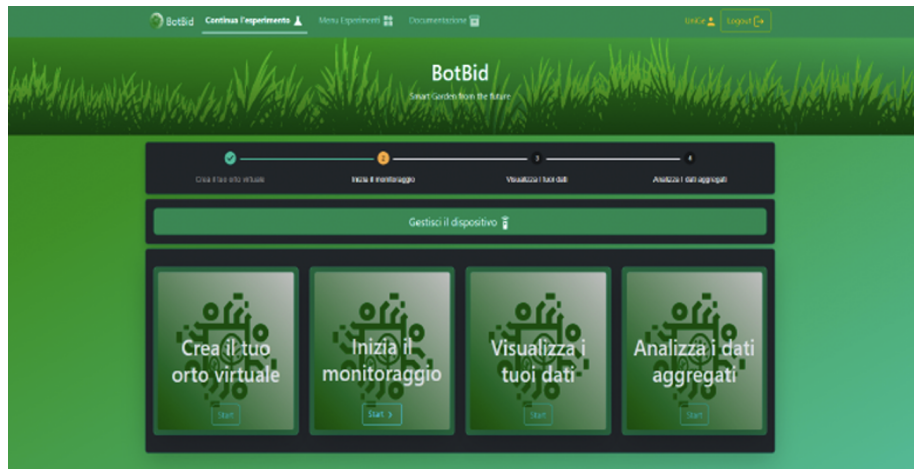
The Experiment

- Experiment set up: 30 control and 30 test lettuce plants
- The soil of test plants is polluted with small quantity of salt
- All plants are monitored for 12 weeks
- Hypothesis to validate: the growth rate of the control plants is higher than that of the test plants



BotBid Kit





BotBid WebApp: Digital Twin of the Garden

The screenshot displays the BotBid WebApp interface. At the top, a green navigation bar contains the BotBid logo, links for 'Continua l'esperimento', 'Menu Esperimenti', and 'Documentazione', along with user options 'Unige' and 'Logout'. Below this, a dark green header reads 'Gestisci le tue piante'. A dark grey panel titled 'Istruzioni' contains a 'Mappa' section with instructions on how to use the zoom controls and a 'Form e Dashboard' section. Below the instructions is a 'Seleziona la pianta' dropdown menu. The main area features a grid of 20 plant control buttons arranged in two rows of ten. Each button is labeled with either 'Ctrl' or 'Test' followed by a number (1-10). Each button also includes a magnifying glass icon and a small green or orange status indicator.

BotBid Continua l'esperimento Menu Esperimenti Documentazione Unige Logout

Gestisci le tue piante

Istruzioni

Mappa

In questa schermata puoi osservare il tuo esperimento. Clicca sulle lenti di ingrandimento per saperne di più sulla pianta o per eseguirne il monitoraggio. Una spunta vuol dire che si è già eseguito il biomonitoraggio parziale della pianta, due spunte vuol dire che il biomonitoraggio è completo.

Form e Dashboard

Seleziona la pianta

Ctrl 1	Test 1	Ctrl 2	Test 2	Ctrl 3	Test 3	Ctrl 4	Test 4	Ctrl 5	Test 5
Ctrl 6	Test 6	Ctrl 7	Test 7	Ctrl 8	Test 8	Ctrl 9	Test 9	Ctrl 10	Test 10

BotBid WebApp: Insertion Form

 BotBid [Continua l'esperimento](#)  [Menu Esperimenti](#)  [Documentazione](#)  [Unige](#)  [Logout](#) 

Pianta di controllo n. 1

Sul campo 

Esegui il biomonitoraggio misurando sia la pianta di controllo sia quella di test. Raccogli la lunghezza delle foglie e in un secondo momento, dopo averla pulita dalla terra, la lunghezza delle radici, la biomassa fresca e secca e il numero di foglie danneggiate. Segnati i valori per poi inserirli su BotBid.

Su BotBid 

Compila

Inserisci la lunghezza delle foglie 

Inserisci un nuovo campione per la lunghezza delle foglie

Inserisci gli altri dati 

Puoi compiere questa operazione una volta dissotterrata la pianta

Segna come morta

Torna alle tue piante 

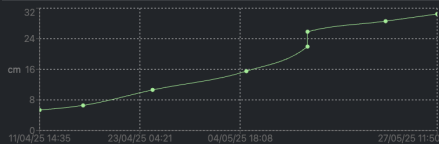
Foto

Scegli file Nessun file selezionato 

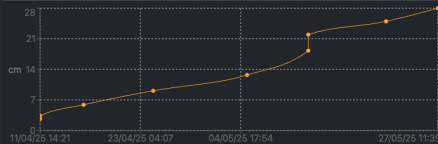
Carica la foto 

BotBid WebApp: Test and Control Plants

Lunghezza media foglie di Controllo



Lunghezza media foglie di Test



Variazioni percentuali tra i dati medi del test e del controllo

Lunghezza radici



-0.09%

Ctrl: 9.331 cm

Test: 9.323 cm

Biomassa



-17.82%

Ctrl: 10.531 g

Test: 8.654 g

Biomassa secca



-36.84%

Ctrl: 1.827 g

Test: 1.154 g

N foglie danneggiate

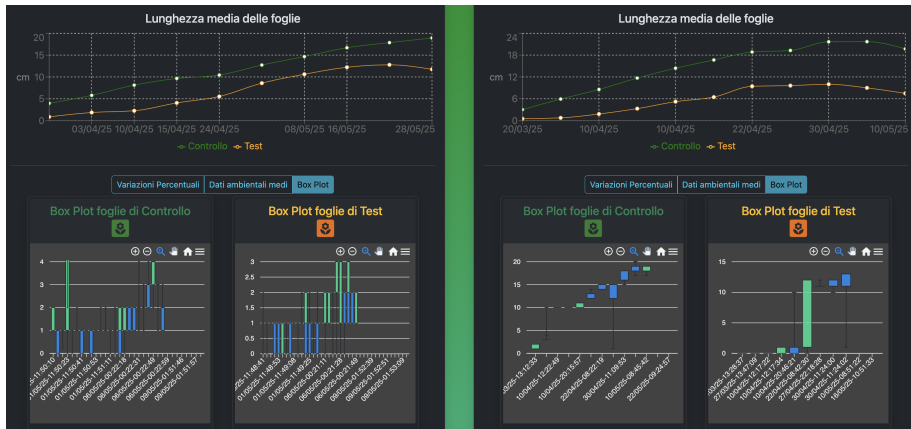


Non calcolabile

Ctrl: No data

Test: No data

BotBid WebApp: Comparisons



- The BotBid project combines data and scientific education, technological innovation, and active participation.
- Students and teachers are engaged from hypothesis formulation to data collection and analysis.
- Future developments include:
 - Expanding the network of schools;
 - Consider other scientific experiments/sensors;
 - AI applications (e.g. diagnosis from images, AI-assistants)
 - ...more fundings

BotBid "real" impact



Glossario

Questionario per parametri qualitativi generali utilizzati in tutti i Questionari

Comptel Digitali nelle Scuole
comptel@digitali.scuole.it

Parametro	Descrizione	Valore minimo	Valore massimo	Unità
1	...	...	...	...
2	...	...	...	...
3	...	...	...	...
4	...	...	...	...
5	...	...	...	...
6	...	...	...	...
7	...	...	...	...
8	...	...	...	...
9	...	...	...	...
10	...	...	...	...

10/01/2008

[illegible]

QUARTE
SCUOLA
PRIMARIA



Appendix: More on the Expected Outcomes

- Learning the fundamentals of environmental and applied botany.
- Acquiring a scientific method (experiment set up, formulation of hypothesis, observations and analysis) via a participatory science project.
- Learning how to use digital devices and applications (BotBid webapp/kit/dashboard)
- Learning how to collect, prepare, process, interpret, and graphically represent the data from their observations (data education)

Appendix: Statistical Tests (U-test)

ID	Mann-Whitney U	Z-Score	P-Value (One-Tailed)	P-Value (Two-Tailed)
Biomonitoraggio N1	99,5	-5,182	0,001	0,002
Biomonitoraggio N2	71,5	-5,596	0,007	0,014
Biomonitoraggio N3	64,5	-5,618	0,007	0,015
Biomonitoraggio N4	66,5	-5,587	0,007	0,013
Biomonitoraggio N5	53,5	-5,784	0,014	0,027