Results for competency building – Living Lab eNaBlS 05.06.2025

Words: Elisavet Petridi and Tilemachos Kotronis

Proofread: Dora Psoma and Paschalis Valsamakis

Keywords: eNaBlS project, Living Labs, Nature Based Solutions (NBS), GreenComp Framework, Interdisciplinary Research, Transdisciplinary Research, Competences, Skills

Abstract

The article explores the implementation and results of the Greek Living Lab, which took place on June 5, 2025, at the Technical Camber of Greece in Thessaloniki. The lab was organized in collaboration with the Institute of Bio-Economy and Agro-Technology of the Centre for Research and Technology (CERTH), in the framework of the eNaBlS project.

The aim of the action was to strengthen the competencies related to Nature-Based Solutions (NBS), through an interactive lab that combined theoretical presentations with participatory activities focused on the design of an urban water collection system. The main target group was engineers, but people from other sectors also participated, forming a diverse group of 30 participants.

After the final activity, participants were asked to answer a self-reflection questionnaire, which was designed by the IDEA Training team in collaboration with 3s Research & Consulting. Although it was distributed at the end, it was considered an integral part of the lab. The questionnaire was based on the GreenComp framework and assessed four core competencies through a Likert scale: promoting nature, critical thinking, future literacy and collective action.

Analysis of the responses showed moderate to high levels of perceived competency building, with particularly positive results for the competency Promoting Nature. Although no significant differences were found in relation to demographic characteristics, responses to the open-ended question highlighted the lab as a highly educational and transformative experience and emphasised the importance of integrating Nature-Based Solutions (NBS) into education programs.

Overall, the findings confirm the effectiveness of Living Labs as an inclusive strategy for cultivating sustainability competencies and interdisciplinary

collaboration. This approach can be applied more broadly in educational and professional contexts.

Introduction

The Greek Living Lab for Nature-Based Solutions (NBS), in the framework of the eNaBlS project, took place on Thursday 5 June at the Technical Chamber of Greece in Thessaloniki, with the participation of the Institute of Bio-Economy and Agro-Technology of the Centre for Research and Technology (CERTH). The lab was attended by 30 people from different demographic and educational backgrounds, with the main target group being engineering trainees.

The main objectives of the workshop were:

- to familiarize the participants with the concept of NBS
- to raise awareness of the contribution of nature in addressing environmental challenges
- and developing relevant competences, in line with the EU GreenComp framework for sustainability (Bianchi et al., 2022).

To achieve these objectives, the workshop combined presentations of basic theory with a practical and participatory approach, emphasizing interactive learning.

In practice, participants engaged in group activities designed around the creation of an urban water collection system in a block near the Makedonia Palace Hotel in Thessaloniki. The three activities were designed and facilitated by Smaro Katsagelou, an architect and engineer, PhD candidate at Florida Atlantic University, specializing in Architecture, Artificial Intelligence and Robotics.

In detail:

- In the first activity, the participants wrote down on sticky notes (post-its) what they would like a park to include and what they would prefer to be avoided.
- In the second activity, they were given a printed layout of the block and asked to draw their vision for the space.
- In the third activity, they wrote a short fictional story about a day spent in this park.

The second activity is presented below as a typical example (see Figure 1) to visually illustrate the nature of the activities. Both the initial topographical layout (a) and the final result of one of the participants (b) are presented.

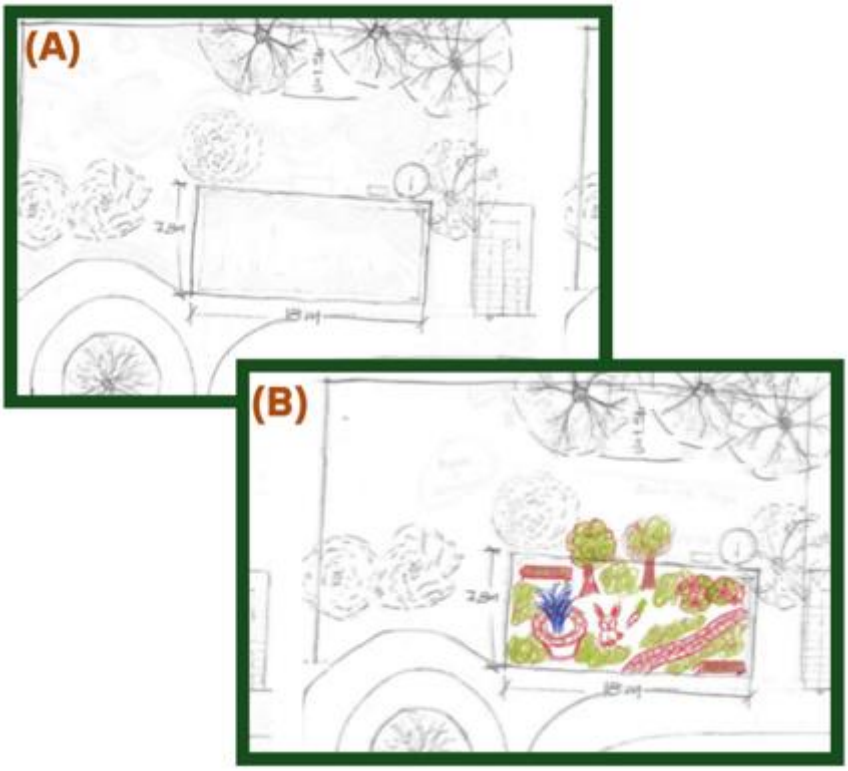

Figure 1: Second Activity of the Greek Living Lab

Based on the ideas and perspectives expressed, a visual representation of the envisioned park was created using artificial intelligence. In particular, the Midjourney platform was used where different tests were carried out until the desired and most representative result was obtained.

Key principles of Living Labs

The approach applied in the Greek Living Lab reflects basic principles of the Living Lab methodology, as described in the paper "A Living Lab Day of Working" by Steen and Van Bueren (2017).

One of the key principles of a living lab is that the initiative should take place in a real environment. Although the Greek lab took place in a closed auditorium, due to the particular weather conditions (high temperature and humidity), the choice of a real urban site as a design field - the plot near the Makedonia Palace Hotel - fulfils this principle to a significant extent.

In addition, the lab incorporated other important principles of Living Labs:

- Multi-stakeholder participation

- co-creation

- and user-centered innovation

Another key characteristic of the Living Labs is the need for a flexible institutional framework, which was indeed found in the Greek example, giving room for experimentation and adaptation.

Finally, the main objectives pursued by Living Labs include:

- the promotion of innovation

- the production of knowledge that can be replicated

- and improving urban sustainability

(Steen & Van Bueren, 2017; Rogers et al., 2023; van der Wee et al., 2024).

Interdisciplinary and transdisciplinary approaches in Living Labs

Living Labs usually adopt interdisciplinary and/or transdisciplinary research approaches.

The interdisciplinary approach involves collaboration between different academic disciplines. The common problem is thus addressed in a holistic and therefore more effective way (Tress et al. 2003; Lyall et al., 2011).

The transdisciplinary approach goes one step further as it is even more inclusive by including non-academic stakeholders in the knowledge creation process.

These practices differ significantly from multidisciplinary research, where scientific disciplines work side by side but do not interact closely with each other and knowledge is not exchanged (Tress et al. 2003; Lyall et al., 2011).

The integration of interdisciplinary and transdisciplinary elements makes Living Labs particularly well suited to address complex sustainability challenges.

Attitudes and behaviours

The success of interdisciplinary and transdisciplinary research depends not only on methodological integration but also on the attitudes and behaviours of those involved. According to the DELTA framework, a certain attitude is among the essential preconditions for interdisciplinary and transdisciplinary collaboration (Tress et al., 2003).

- Attitude is defined as the general tendency to react favourably or unfavourably to something (Ajzen, 1991).

- Behavior refers to the observable action that results from one's intention, as predicted by attitudes, subjective norms, and perceived behavioral control (Ajzen, 1991).

In interdisciplinary research, certain attitudes are considered essential for effective collaboration. These include an interest in learning from other disciplines, respect for stakeholders' perspectives, curiosity about unfamiliar approaches, and creativity (Tress et al., 2003). Such attitudes enable researchers to engage meaningfully with people from different backgrounds and promote mutual learning.

However, individual attitudes alone are not enough. The structure and management of a project also play a key role in supporting these behaviours. Successful interdisciplinary work requires project management that encourages communication and understanding across different knowledge cultures. When these affective aspects are overlooked such as openness, respect, and collaboration, it becomes more difficult to build trust and work effectively as a team.

Reflection tool (Questionnaire)

For the evaluation of the learning outcomes of the Greek Living Lab, a self-reflection questionnaire was used, which was distributed to the participants via QR code immediately after the completion of the last activity.

The questionnaire was designed by the IDEA Training team in collaboration with 3s Research & Consulting. The tool was inspired by the EU GreenComp framework that defines sustainability competences for education (Bianchi et al., 2022).

Initially, the questionnaire collected some demographic data in order to get a general picture of their background. These demographics included age, gender, educational level and most importantly previous knowledge of NBS.

Subsequently, to measure and quantify the acquired competences, the questionnaire was structured in four thematic sections. Each of them corresponded to one of the competences identified for analysis: promoting nature, critical thinking, future literacy, collective action. In each section, participants were asked to respond to four reflection statements. A 4-point Likert scale ranging from strongly disagree (1) to strongly agree (4) was used for the response. There was also an additional option, Not Applicable (N/A).

The questionnaire concluded with an optional open question “What is your opinion on the application of NBS competences in education? How has your own NBS competency been affected through your participation in the Greek Living Lab”, allowing participants to express their views and experiences more authentically and holistically.

Statistical Analysis Results

Of the 30 participants of the Greek Living Lab, 21 persons responded to the self-reflection questionnaire. Statistical analysis of the responses was performed using IBM SPSS Statistics 30.0.

First, we carried out a descriptive statistical analysis of the demographic characteristics of the participants. This analysis revealed that in terms of gender, men outnumbered women with percentages of 57.1% and 42.9% respectively. In terms of age, most participants, 52.4%, were aged 26-45 years, followed by those aged 46-65 years with 28.6% and those aged 18-25 years with 19%. In terms of educational background, the majority were postgraduate degree holders, 57.1%, followed by those with a postdoctoral degree with 22.4%, while 14.3% held a BSc degree and only 4.8%, a PhD. Based on preexisting NBS knowledge, slightly more than half, 52.4% reported that they possessed.

The results, including the dominant groups within each socio-demographic category, are presented in the graphs below (Figure 2)

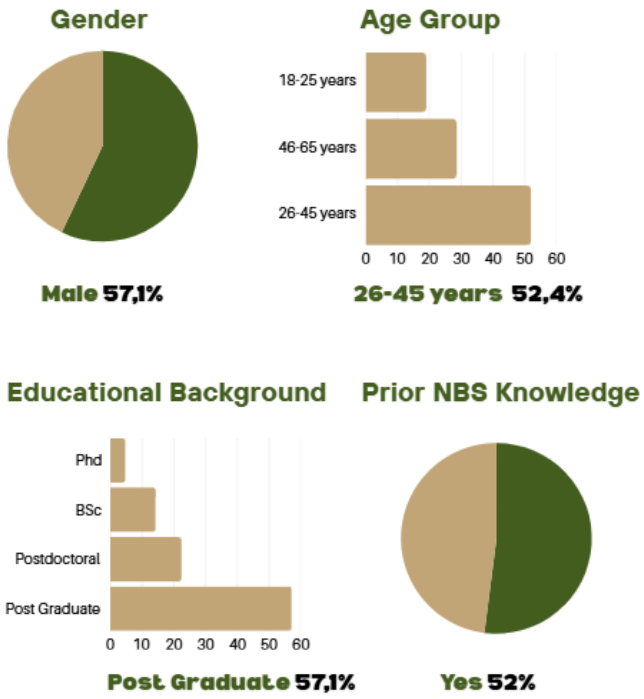

Figure 2: Descriptive statistical analysis results

Then, descriptive statistics were also applied for each of the four targeted competencies: C1 – Promoting Nature, C2 – Critical Thinking, C3 – Futures Literacy, and C4 – Collective Action. Each competency, as explained previously, was assessed via four Likert scale items, with N/A defined as a missing value for statistical purposes. New composite variables were created with the aim of deriving an average measure of the acquisition of each individual competence. Each new variable consisted of the average of the four individual statements (a, b, c, d) per competency.

The resulting mean scores indicated generally moderate to high levels of perceived learning: C1 (M = 3.37, SD = 0.49), C2 (M = 3.33, SD = 0.35), C3 (M = 3.16, SD = 0.50), and C4 (M = 3.10, SD = 0.55). These scores, on a scale where 4 represents the highest level of agreement, suggest that participants felt they had acquired relevant competencies. The strongest agreement was observed for Promoting Nature (C1), while slightly lower levels were reported for Collective Action (C4), as can be seen in the following graph (Figure 3).

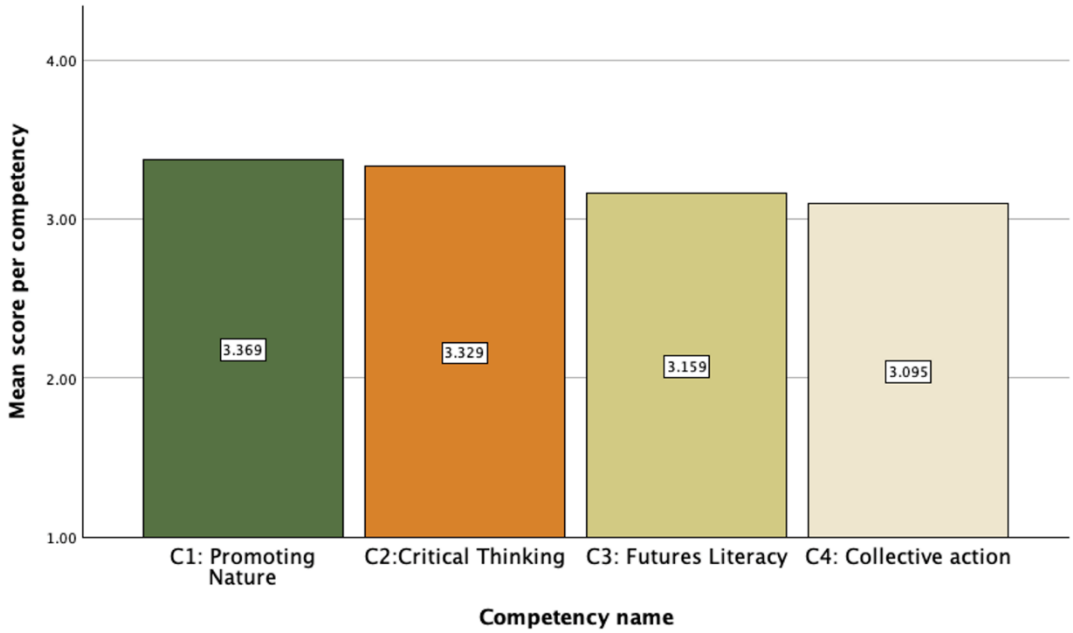

Figure 3: Mean Scores for Perceived Competency Acquisition Across Four Targeted Areas (1 = low, 4 = high)

More specifically, examining the individual statements of the 4 competences, it was observed that they received high Likert scale scores. In many cases, the combined percentage of “Agree” and “Strongly Agree” responses approached or exceeded 90%. However, two statements showed a wider range of responses with the negative responses, Disagree and Strongly Disagree, also being selected but in smaller percentages. The first was the statement relating to testing technologies related to the 4th industrial revolution (AI, VR, AM) in the context of

future literacy (C3). The second was the statement about negotiating with people with different opinions, in the context of collective action competency (C4). These findings suggest potential areas for improvement in the design of future living lab activities.

Moving a step further, to investigate whether demographics affected competence acquisition, inferential statistical methods were utilized. These included an independent T test in order to examine the difference in mean competence scores based on gender and prior NBS knowledge. As the T- test applies to binary variables, the educational background variable was also grouped into lower and higher education. The analysis found no statistically significant differences between groups for any of the four competencies.

Additionally, we used a Kruskal–Wallis H test to assess variations in competency mean scores across three age categories (18–25, 26–45, and 46–65). This method was chosen instead of ANOVA due to the relatively small sample size, only 21 responders, and the uneven distribution of participants across groups. The Kruskal–Wallis H test revealed no significant differences, suggesting that age did not systematically influence perceptions of learning.

Regarding the open-ended question, out of 21 participants only 8 responded, a response rate of 38%. Respondents represented a wide age range from 18 to 65 years and included men and women in equal percentages. Participants were mostly highly educated with 7 out of 8 holding a postgraduate degree. However, five of them had no prior knowledge of NBS.

A recurring theme that emerged was the recognition of Nature-Based Solutions (NBS) as a crucial element that should be formally integrated into education curricula. As Participant 22 noted, “NBS now need to be integrated into study programmes in order to cultivate environmentally conscious citizens, as the issue of the climate crisis has become critical. Through the Living Lab, I was introduced to environmental competences I didn’t even know existed.”

Similarly, Participant No 13 highlighted that their NBS-related competencies improved, especially regarding the application of NBS in wastewater treatment and their potential to offer cost-effective solutions that support biodiversity and sustainable resource management. They added that "a broader demonstration of their potential would perhaps be necessary."

Moreover, the Living Lab was widely characterised as a highly effective pedagogical method. Nevertheless, one participant expressed a critical perspective. According to Participant No 14, “This is not something new, as we were told. It is simply a re-packaging of existing practices, aimed at appealing to researchers and justifying research funding.”

While qualitative data is limited by the low response rate and possible self-selection bias, as those who felt more engaged may have been more likely to respond, the findings still offer valuable insights.

In summary, statistical analysis confirmed that participants across all demographic groups reported acquiring basic NBS competencies within a moderate to high degree despite some minor disagreements. The results indicate that the Living Lab approach was comprehensive and effective in promoting relevant knowledge, skills and attitudes to the public.

Recommendations

The effectiveness of the Greek living lab gives us the impetus for the establishment of such participatory workshops as a way to effectively acquire basic NBS competencies. To further enhance the success of such initiatives in the near future, some targeted recommendations can be made, based on the relevant literature (Lupp et al., 2020; CARMINE Project, 2024).

It is important for a Living Lab as already mentioned to consistently implement a structured co-creation approach, even from the beginning of its design. Its objectives should be clear, and iterative feedback should be given throughout the process. Moreover, it should bring together a wide range of educators, researchers, students, NGOs, local authorities, etc., to build values such as trust, transparency, mutual understanding and ownership (Lupp et al., 2020; CARMINE Project, 2024).

Additionally, Living Labs should support educators with targeted training and use of sustainability competence frameworks like GreenComp to effectively integrate Nature-Based Solutions into both formal and informal learning. The use of simple digital tools, such as participatory mapping, citizen science platforms, can enhance student engagement and monitoring (Aniche, 2024). Finally, as demonstrated by the Greek Living Lab, partnerships with local and European networks (e.g., NBS EduWORLD, eNaBlS) can promote knowledge exchange and support the long-term sustainability and scalability of successful practices.

Conclusion

To conclude, the Greek Living Lab, despite its limitations, can be seen as a very effective way to actively involve people through specially tailored nature-based activities. The participants acquired NBS competences that they will use not only in their working environment but also in their daily life. Therefore, Living Labs should be seen as a bottom-up approach that is necessary to be integrated in education (Tercanli et al., 2022).

References

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, *50*(2), 179-211. DOI:10.1016/0749-5978(91)90020-T

Aniche, L. Q., Edelenbos, J., Gianoli, A., Enseñado, E. M., Makousiari, E., DeLosRíos-White, M. I., ... & Zalokar, S. (2024). Boosting co-creation of Nature-based Solutions within Living Labs: Interrelating enablers using Interpretive Structural Modelling. *Environmental Science & Policy*, *161*, 103873 DOI: https://doi.org/10.1016/j.envsci.2024.103873

Bianchi, G., Pisiotis, U. and Cabrera Giraldez, M., GreenComp The European sustainability competence framework, Punie, Y. and Bacigalupo, M. editor(s), EUR 30955 EN, Publications Office of the European Union, Luxembourg, 2022, ISBN 978-92-76-46485-3, doi:10.2760/13286, JRC128040 DOI: https://doi.org/10.2760/13286

CARMINE Project. (2024, August 3). *D1.7 Living Labs creation in case studies* (Version 01) [PDF]. Athena Research Center CARMINE_-D1.7-Living-Labs-Creation-in-Case-Studies-_v01_03082024_ATH-RC.pdf

ENABLS. (n.d.). *About overview*. Retrieved May 27, 2025, from https://enabls.eu/about-overview/

Lupp, G., Zingraff-Hamed, A., Huang, J. J., Oen, A., & Pauleit, S. (2020). Living labs—a concept for co-designing nature-based solutions. *Sustainability*, *13*(1), 188. DOI: https://doi.org/10.3390/su13010188

Lyall, C., Bruce, A., Tait, J., & Meagher, L. (2011). *Interdisciplinary Research: A guide for early career researchers*. Institute for Academic Development, University of Edinburgh

NBS EduWORLD | Home. (n.d.). https://nbseduworld.eu/

Rogers, S., Jeffery, A., Pringle, J., Law, A., Nobajas, A., Szkornik, K., ... & Hobson, L. (2023). Experiential and authentic learning in a Living Lab: the role of a campus-based Living Lab as a teaching and learning environment. *Journal of Learning Development in Higher Education*, (28) DOI: https://doi.org/10.47408/jldhe.vi28.1020

Steen, K., & Van Bueren, E. (2017). Urban Living Labs: A living lab way of working

Tercanli, H., & Jongbloed, B. (2022). A systematic review of the literature on living labs in higher education institutions: Potentials and constraints. *Sustainability*, *14*(19), 12234 DOI: https://doi.org/10.3390/ su141912234

Tress, B., Tress, G., van der Valk, A., & Fry, G. (2003). *Interdisciplinary and transdisciplinary landscape studies: potential and limitations* (pp. 182-191). Wageningen, The Netherlands: Delta Program. https://edepot.wur.nl/15144

van der Wee, M. L., Tassone, V. C., Wals, A. E., & Troxler, P. (2024). Characteristics and challenges of teaching and learning in sustainability-oriented Living Labs within higher education: a literature review. *International Journal of Sustainability in Higher Education*, *25*(9), 255-277 DOI: 10.1108/IJSHE-10-2023-0465