UNIVERSITAT POLITÈCNICA DE VALÈNCIA

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EcoThings: innovative environmental technology to improve learning outcomes among students at risk of social exclusion

(2021-1-ES01-KA220-SCH-000034349)

Quality evaluation of EcoThings:

a report of indicators, procedures and instruments

Ecothings

December 2024

UNIVERSITAT POLITÈCNICA DE VALÈNCIA

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Quality evaluation of EcoThings:

a report of indicators, procedures and instruments for IO1

UNIVERSITAT POLITÈCNICA DE VALÈNCIA

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

1 – Scope: This report integrates inputs from the EcoThing project stakeholders and aims to describe and systematize the quality evaluation process that took place during the project's implementation period (2022-2024). It was organized under the coordination of the UPV team and includes: the project framework; a general characterization of the project's participants involved partner institutions (including school teachers and students, higher education researchers, lecturers and students); the main evaluation dimensions, and indicators; the instruments and procedures for data collection, as well as the presentation of an analysis framework that systematizes the relationship between all the elements previously mentioned.

2 – Process: the project monitoring and evaluation follows plan based on the project´s objectives, competencies to be developed, activities and outputs, collaboratively designed by the UPV team in articulation with all the partners.

3 – Methodology: Data were collected at various stages of the project, mainly through 3 questionnaires submitted to the various stakeholders, which were mostly quantitative. These data encompass the evaluation/monitoring of the partnership and the project's activities developed; the student's competences before and after the participation in the project, and the quality of the outputs (results and products). Another type of data, of a more qualitative nature, was also collected within the activities carried out, such as photos, videos, teachers' reports, and students' progress, that allowed a more in-depth analysis, a closer perception of the various contexts of intervention and the making of adjustments, whenever necessary, to achieve the objectives in pursuit of the overall quality of the project.

4 – Indicators, procedures and instruments: The evaluation structure that guided the processes of the project quality evaluation was organised in the axes and dimensions involved in the EcoThing application (collaboration, effectiveness, innovative management of curricula, and impact and sustainability) and includes the main quality indicators, the procedures and instruments for data collection and refers the participants involved in each procedure. Facing the above, as envisaged in projects funded by the ERASMUS+ Programme (European Commission, 2021), the report's contents can be *tailored to the needs of other projects; transferred to new areas; sustained after the project has finished, or used to influence future evaluation practices*.

Introduction

EcoThings project is an international strategic partnership of cooperation for innovation and exchange of good practices that aims to improve the quality of education and develop students' skills towards cultural diversity, sustainable development, and citizenship through a transversal integration of technology in school education around a use case in house living. Therefore, it promotes learning skills, critical thinking, and prepares students for continuous change in the global world.

Transferring technological advances to our society and especially to schools is the base of this project in which universities and schools from all over Europe collaborate with public and private organizations with social concerns, environmental responsibility and sustainability. Our goal is to enhance the digital era with the mission of educating our young people and children in equality, sustainability and respect for the environment, with the essential support of technology. The transfer of knowledge, at the forefront of the technological development of universities, cannot be left out of the education of the youngest, future citizens and future students at our universities. The first step is taken now, through collaborative educational projects between schools and universities, transferring our knowledge towards fun, playful activities and, above all, with ethical and social value.

For education and innovative practices in a digital age, the project enabled innovative practices that connect the virtual and real world with the aim of motivating student learning. In addition, the project aimed to transfer to students the creation of a digital environment that would transform garden observation and work on data observation by:

- Developing knowledge in digital project-based learning around an inclusive programme which promotes equality of opportunities giving an individual education, fosters students' implication, solidarity and cooperation.

- Developing ICT tools and resources to promote children interaction with technology in schools through digital activities.

- Helping teachers and staff to make education in technology a sustainable tool.

- Transforming informal spaces into FabLabs promoting constructivism learning.

This report starts by presenting an overview of the projects' participants moving on, afterwards, to presenting the used data collection instruments and procedures in relation with the main axes, dimensions, and indicators that were established for quality evaluation purposes.

1. Overview of project's participants

In general, the project's participants involved partner institutions and their direct or indirect members. The table below introduces the partner institutions and the persons directly involved in each institution.

Country	Partner Organisation	Persons involved
Spain	Universitat Politecnica de Valencia (Coordinator)	● Leopoldo Armesto ● Sara Blanc ● Pedro Fuentes ● Larisa Dunai ● Ignacio Piqueras (technician) ● Ignacio Despujol (technician) ● Pablo Soler (technician) ● Óscar Bodoque (technician) ● Luís Taroncher (technician) ● María Calvo (student)
Spain	Colegio Santiago Apóstol	● Alessandro de Gregorio ● Roberto Martínez Rodríguez ● Samir Elzein Latorre
Turkey	Turan Erdogan Yilmaz Fen Lisesi	● Muhammet Merme ● Oymen Özbey ● Güldem Ersoy ● Gülsen Aşikli ● Fatih Aydoğdu
Romania	Wyliodrin SRL	● Cristian Rusu ● Ioana Culic-Radovici ● Amalia Simion ● Cristiana Andrei ● Alexandru Radovici
Cyprus	STANDO LTD	● Damla Kiral ● Thrasos Tilemachou ● Merve Buba ● Harris Evangelou

EcoThings set out to directly engage diverse profiles of participants, from which we highlight school's teachers and students; higher education institutions researchers, and experts from institutions outside the education system.

School teachers

Teachers from the participant schools were directly involved while actively participating in defining the methodology and developing the learning activities and dissemination events, as well as contributing to progress and quality evaluation and continuing feedback to partners. Teachers also developed and participated in exchange activities. Participant school's teachers also engaged other teachers from their schools through collaborative activities. The participant school's teachers were the ones from Colegio Santiago Apóstol (ES) and Turan Erdogan Yilmaz Fen Lisesi (TK).

School students

Students from the participant schools were directly involved through their daily learning, but particularly by experimenting with the learning activities proposed in the project involving the development of the smart house directly or indirectly. Furthermore, some students of Turkey participated in estimated mobilities between schools. The participant school students were the ones from Colegio Santiago Apóstol (ES) and Turan Erdogan Yilmaz Fen Lisesi (TK).

Higher Education Researchers and lecturers

Researchers from the partner HEI Universitat Politècnica de València (ES) gave support to the project learning activities, digital tools development, online contents creation, ebook support, quality plan and check, and dissemination events. Furthermore, the team from the UPV coordinated and put in place the project's quality and impact monitoring and evaluation procedures.

Researchers and experts from non-higher education institutions

These were members from the teams of Wyliodrin SRL (RO) who gave support to the project digital tools development, online contents creation, ebook support, and dissemination events. STANDO LTD (CY) who gave support to the ebook creation, and dissemination events.

Higher Education students

Students from the UPV participated under a "Service-Learning" approach. UPV students collaborated in the program with Colegio Santiago Apóstol in a 6 weeks session focus on children training in Arduino and Smart House sensors.

VET students

Moreover, two students of VET from Colegio La Purísima, Valencia, participated in this same training supporting Turan Erdogan Yilmaz Fen Lisesi students during their mobility to Valencia.

2. Main evaluation axes, dimensions, and indicators

The evaluation device followed the 360º approach as it intended to get information from all the participants and it was focused on four main axes of the project: **Collaboration, Effectiveness, innovative management of curricula and Impact and sustainability**.

Collaboration was considered and assessed between partners, to assess the level of partnership cooperation and its satisfaction (**annex 1**).

Studies about **effectiveness** have largely been concerned with the impact of school level factors on students' learning and progresses. It assumes that the environment at school level can impact the attitudes of teachers and students and therefore - mostly indirectly - their consequent successes in teaching and learning (OECD, 2017). In this context, **effectiveness** is measure as the degree of fulfilment of the specific objectives, such as digital competence (**annex 2**) but also the teachers' views of their school and classroom climates (**annex 3**).

Curricular innovation allows students to develop the ability to apply the knowledge and skills developed in key disciplines, enabling them to analyse, reason and communicate with each other, to solve problems in a variety of situations (OECD, 2023). Moreover, in the digital age of the 21st century, curricular innovation cannot be dissociated from the uses of digital tools in school education. That is why to evaluate the **Innovative Management of the Curricula** we considered specific features of the learning activities designed to fulfil the projects' objectives that involved the use of digital tools in learning, the curricular transversality enables by them and also the level of contextualization that teachers were able to put into the students' learning tasks. More specifically, we analysed the uses of digital tools in the learning activities, difficulties and solutions (**annex 4**), spaces and other resources given to students to develop the smart house (**annex 5**), and school report towards project's activities (**annex 6**).

Finally, any Erasmus+ funded project is required to have a substantial impact not only on the capacities of participating organisations but also in relevant and related stakeholders. Measures must be put in place to ensure a real sustainability of the proposed activities and outputs after the project

lifetime, namely through promote the mainstreaming and effective use/implementation of the project results. That is why the **impact and sustainability** was considered by the movements that the project was able to raise through its dissemination on the multiplier events (**annex 7**).

3. Data collection instruments and procedures

3.1. Reporting, monitoring and evaluation questionnaire - Annex 1

Objectives: this questionnaire aimed to collect participants' perception about the partnership, focusing on the level of achievement of each project objective, as well as the satisfaction with the project's activities.
Procedures: the questionnaire in English was made available and completed online by the participants from partner organisations after project meetings or other staff exchange activities. Data was collected approximately in the following periods:

- 30 September 2023 (after the 2nd transnational team meeting)
- 25 June 2023 (after the 3rd transnational team meeting, online)
- 04 December 2024 (after the 4th transnational team meeting, online)

3.2. Competences' diagnose pre and post learning activities questionnaire – Annex 2

Objective: this questionnaire sought to collect the schools' participant students' self-perceptions of their digital competences before and after participating in the project activities and to verify their evolution throughout the project. **The questionnaire is based on DigComp EU framework.**
Procedures: the questionnaire included a set of Likert scales focused on digital skills; it was made available and completed online by the participant students in the following periods:

- October 2023 (pre questionnaire)
- June 2024 (post questionnaire)

3.3. Competences' diagnose pre and post learning activities questionnaire for teachers – Annex 2

Objective: this questionnaire sought to collect the teachers' perceptions of the digital competences of their students.
Procedures: the questionnaire included a set of Likert scales focused on digital skills; it was made available and completed online only one teacher in June 2024.

3.4. Schools' climate analysis - Annex 3

Objectives: this questionnaire aimed to collect participants' perception about the school climate and needs. At the end, the report includes an analysis of this project's benefits on different items.
Procedures: the questionnaire in English was made available and completed online by the participants from partner organisations after project meetings or other staff exchange activities. Data was collected

3.5. Activity report form - Annex 4

Objectives: the activity report requires the teachers to give their impressions and appreciation of the implementation of the learning activities they designed for the project, including an overview of who participated (students, teachers, families, non-teaching staff, others.) and in which conditions they

participated. In addition, it sought to assess issues related to success, difficulty and constraints, as well as the contributions of the activities to student learning.
Procedures: the activity reports of the learning activities were completed by the school's teachers by the end of each project activity (approximately July 2024).

3.6. Additional collaborations – Annex 5

Objectives: short report about the school Santiago Apostol with a collaboration with UPV students and TEYFL.
Procedures: Santiago Apostol report was done by UPV by monitoring university students at the school. UPV students were coordinated in a collaborative manner with Santiago Apostol and UPV.

3.7. Final schools' reflection – Annex 6

Objectives: This report is provided by the heads of each school at the end of the project. It aims to obtain an evaluation of the benefits of the project.
Procedures: the report is obtained by each school's coordinator.

References

Carretero, S.; Vuorikari, R. and Punie, Y. (2017). DigComp 2.1: The Digital Competence Framework for Citizens with eight proficiency levels and examples of use, EUR 28558 EN, doi:10.2760/38842

European Commission (2021). Erasmus+ Programme Guide. Retrieved from https://erasmus-plus.ec.europa.eu/document/erasmus-programme-guide-2021-version-3

OECD (2017), PISA 2015 Assessment and Analytical Framework: Science, Reading, Mathematic, Financial Literacy and Collaborative Problem Solving, revised edition, PISA, OECD Publishing, Paris. http://dx.doi.org/10.1787/9789264281820-en (School Questionnaire)

Smith, T. K., Connolly, F., & Pryseski, C. (2014). Positive School Climate: What It Looks Like and How It Happens Nurturing Positive School Climate for Student Learning and Professional Growth. Baltimore Education Research Consortium, https://baltimore-berc.org/wp-content/uploads/2014/02/SchoolClimateFeb2014.pdf

ANNEXES

Annex 1 - Questionnaires by the end of each activity engaging international partners

QUESTIONS are based on:

1. Project objectives:
    i. Providing an innovative educational approach based on the STEAM.
    ii. Improving students' soft skills: communication, collaboration, critical thinking, assertively and resilience.
    iii. Raising the environment awareness of our students.
    iv. Testing cutting-edge pedagogical approaches.
    v. Providing implementation guidance.
    vi. Improving the digital skills of the students involved in the project.
2. Level of satisfaction with:
    i. COORDINATION
    ii. COLLABORATION
    iii. INTERACTION
    iv. RELEVANCE
    v. CONTRIBUTION
3. Positive aspects
4. Aspects to improve

The findings from the three transnational meetings have been consolidated and are presented in a grouped format for clarity.

Satisfaction Level

The overall satisfaction across all indicators is reflected in the ratings, which predominantly fall within the range of 4 to 5. This indicates a high level of satisfaction from all project partners regarding the various aspects of the project discussed during the meetings.

Challenges

The most significant challenge observed was in the area of COLLABORATION. During the second transnational meeting, collaboration received a rating of 4%, indicating that it was the area with the most difficulty. The hybrid format of the meeting, which combined both in-person and remote participation, seemed to hinder effective communication. This was especially problematic during a critical moment when key decisions needed to be made, as the lack of fluid communication created obstacles in reaching a consensus.

Solution to the Issue

To address this challenge, the project coordinator took proactive steps. The coordinator worked intensively to clarify the roles and responsibilities of each partner within the project. This effort aimed to ensure that everyone had a clear understanding of their contributions and responsibilities, which helped to resolve the collaboration issues and gain the necessary consent from all partners moving forward.

In summary, while the overall satisfaction from the transnational meetings was high, the hybrid format posed a challenge in terms of collaboration, particularly in moments requiring important decisions. The coordinator's efforts to clarify roles and responsibilities helped to overcome this obstacle and improve the situation.

The link to this report summary could be accessed by the commission at:

https://forms.office.com/Pages/AnalysisPage.aspx?AnalyzerToken=ul77y8SYLhbu0L4wqlI7el180lxSofSg&id=31VGvnOsH0CnrhmMO3LQxhHbEIN-RMlEpEEWs97lQARUM08xUVhDVklHREZMMVVRQkFOTFNDSlQ5MC4u

Annex 2 - Competences' diagnose pre and post learning activities questionnaire

Students' Results

The overall analysis of students' attitudes toward digital technology reveals several key insights about their habits, skills, and motivation in using digital tools:

- Frequency of Computer and Device Use: On average, students report using computers or other devices for academic study about once or twice a week. This suggests that, while students do engage with digital tools for educational purposes, it may not be a daily practice or a frequent part of their routine.

- Smartphone Usage: All students use smartphones almost daily, indicating that mobile devices are integral to their daily lives. However, the use of other personal devices at home, such as tablets or laptops, occurs much less frequently, pointing to a preference for smartphones over other digital tools.

- Internet Usage: More than 75% of students use the internet primarily for social networking purposes, which highlights the dominance of social media in their online activities. Over 50% also use the internet to search for information, reflecting an interest in utilizing digital resources for learning or exploration. However, the use of digital devices for content creation is noticeably lower, suggesting that students may not be as engaged in producing their own digital content, such as writing, video production, or other forms of creation.

- Technological Skills: When it comes to technological skills, students generally consider themselves proficient in using apps and computer applications. This self-assessment indicates confidence in their ability to navigate digital tools, especially in terms of applications designed for productivity or entertainment.

- Interest in STEAM Subjects: In terms of motivation, students show a strong interest in STEAM (Science, Technology, Engineering, Arts, and Mathematics) subjects, with particular enthusiasm for mathematics and experimentation. This suggests that they are not only capable of using digital tools but are also highly engaged in subjects that require analytical and creative thinking, which are closely tied to digital literacy.

Comparison Between Schools

Turan school students exhibit a notably positive attitude toward digital activities from the start. They approach digital tasks with confidence and a readiness to engage. In contrast, students at Santiago Apóstol, who are, on average, about four years younger than those at Turan, display a slightly lower level of data literacy, especially in terms of processing and analysing content. This difference in data literacy skills could be attributed to their younger age, which may mean less exposure or experience with handling and processing information digitally.

Impact of the Project

Overall, the project has had a notably positive impact on the students' attitudes. One of the most significant improvements has been in the students' sense of responsibility when it comes to using digital devices. They have become more aware of how to approach problem-solving in digital environments, suggesting that the project has fostered greater maturity and critical thinking regarding digital technology.

In summary, the analysis reveals that while students are highly engaged with smartphones and social media, their use of digital tools for academic purposes and content creation remains limited. Their technological confidence is primarily focused on apps and productivity tools, and there is a marked enthusiasm for STEAM subjects. The age gap between students at different schools plays a role in their digital literacy skills, with older students generally exhibiting more advanced skills. Most notably, the project has successfully contributed to improving students' sense of responsibility and their approach to digital problem-solving.

Teachers' Results

After completing the learning activities, the teachers participated in the same opinion survey regarding their students' digital skills. The results revealed some interesting contrasts between the perceptions of the teachers and the self-reported abilities of the students, particularly in two schools: Turan and Santiago Apóstol.

At Turan, the teachers assessed their students' digital aptitude as being higher than the students themselves believed. In other words, the educators rated the students' digital capabilities above the average self-assessment given by the students. Moreover, there was a noticeable gap between the students' reported use of digital devices and how the teachers perceived this usage. This discrepancy suggests that students might either overestimate or underestimate their own engagement with technology, or that teachers may not fully observe the extent to which students are utilizing digital tools in their daily activities.

In contrast, at Santiago Apóstol, the situation was the reverse. Teachers tended to evaluate their students' digital skills as being lower than the students' own perceptions of their abilities. In this case, the students rated themselves more highly in terms of digital competence than their teachers did. This indicates a disconnect where students may have a more optimistic view of their digital proficiency than their teachers believe to be accurate.

These contrasting findings suggest that students' own maturity levels play a significant role in shaping their self-assessment of digital skills. The students' perception of their capabilities may not always align with the reality of their skills, and it seems to be influenced by their understanding of what digital competencies actually entail. This discrepancy is likely related to how well students grasp the full scope of digital skills across various dimensions of the DigComp framework, a comprehensive model used to assess digital competence. As such, the maturity of a student—both in terms of age and experience—appears to influence not only their digital skill level but also their self-awareness of these skills. In other words, students may not fully understand the breadth and depth of digital competencies required in the framework, leading to a mismatch between self-assessment and actual capability.

Annex 3 – Schools' climate analysis

The questionnaire collects various specific information about the student population, including:

1. Demographic Information: It asks about the number of students whose first language differs from the language of instruction, students holding citizenship from a different country, and those belonging to minority ethnic, cultural, or religious groups.

2. Disability Status: It inquires about students with mental and physical disabilities, as well as those living under state care or apart from their families for various reasons.

3. Financial Support: The questionnaire assesses how many students benefit from public (state-based) and private financial support to stay in education across different educational levels (Primary, Lower Secondary, and Upper Secondary).

4. Class Size and Participation: It gathers data on the average class size for different educational levels and the number of students participating in the project, including a breakdown by gender and the number of teachers involved.

This information aims to provide a comprehensive overview of the student population's diversity and needs, which can inform educational strategies and support systems.

The purpose of gathering data on class sizes in different educational levels includes several key objectives:

1. Resource Allocation: Understanding class sizes helps in determining the allocation of resources, such as teachers and classroom materials. Smaller class sizes may require more teachers, while larger classes might necessitate different teaching strategies or additional support staff.

2. Educational Quality: Class size is often linked to the quality of education. Research suggests that smaller class sizes can lead to more individualized attention for students, better student engagement, and improved educational outcomes. By collecting this data, the questionnaire aims to assess the potential impact of class size on student learning.

3. Program Evaluation: The data can be used to evaluate the effectiveness of educational programs and initiatives. If certain programs are implemented in smaller classes, their success can be compared to those in larger classes to determine the best practices for teaching and learning.

4. Identifying Needs: By analysing class sizes across different educational levels (Primary, Lower Secondary, Upper Secondary), the questionnaire can help identify specific needs and challenges faced by each level. This can inform targeted interventions and support strategies.

5. Policy Development: The information can contribute to policy discussions regarding optimal class sizes and educational standards, helping to shape future educational policies and practices.

Overall, gathering data on class sizes is crucial for understanding the educational environment and making informed decisions to enhance student learning experiences.

GENERAL REMARKS OF SANTIAGO APOSTOL:

Average Class Sizes:

- Primary Education: 100 students
- Lower Secondary Education (General): 35 students
- Lower Secondary Education (Vocational): 30 students

Participation in the Project:

- Number of boys participating: 13
- Number of girls participating: 6
- Number of male teachers: 2
- Number of female teachers: 0

Issues and challenges

Educational achievement and truancy (regular absenteeism or arriving late) are the most significant problems. Therefore, Ecothings project improved school climate in many ways.

How has this project helped students understand other classmates' realities?

The project has played a significant role in broadening students' perspectives by exposing them to diverse realities and viewpoints. Through collaboration with peers from different backgrounds and cultures, students have gained a deeper understanding of the varied experiences and challenges that their classmates face. This exposure has not only enhanced their empathy and awareness but has also encouraged them to envision new possibilities for their own learning and future aspirations. By engaging with others' realities, students have developed a more comprehensive and open-minded approach to their education and the world around them.

How has this project helped reduce truancy?

The project has successfully contributed to reducing truancy by fostering increased student motivation to attend school. One of the key ways it has achieved this is through the provision of engaging, project-based activities that are directly connected to real-world applications. These activities allow students to see the relevance of their education in a practical context, making their learning experience more meaningful and exciting. As a result, students are more eager to participate in school, attend classes regularly, and actively engage in the learning process.

How has this project helped improve school achievement?

The project has positively impacted school achievement by enabling students to engage with complex academic concepts in a more practical, hands-on manner. This approach has allowed students to bridge the gap between theoretical knowledge and real-life experiences. By applying their learning to concrete tasks, students have been able to better understand and retain challenging concepts, resulting in improved academic performance. The project’s experiential learning model has helped make abstract ideas more accessible and relatable, fostering deeper comprehension and mastery of the curriculum.

How has this project helped improve the school climate?

The project has contributed to an improved school climate by promoting a collaborative and inclusive atmosphere. By introducing students to a wide range of perspectives through teamwork and shared activities, it has encouraged mutual respect and understanding among peers. The project has also provided students with engaging and meaningful learning experiences that foster a sense of belonging and positive involvement in the school community. These elements have collectively created a more supportive and welcoming environment, where students feel valued and motivated to contribute to a positive school culture.

In summary, this project has also highlighted the need for our school to enhance professional development in digital competence and in implementing projects involving electronics and programming as a hands-on practice that brings motivation and reduces truancy.

GENERAL REMARKS OF TURAN:

How has this project help students to understand other classmate realities?

This project helped students understand their classmates' realities by encouraging collaboration across diverse groups. Through shared activities such as coding and environmental projects, students from different backgrounds and abilities had the opportunity to work together and learn from each other's perspectives. The project also promoted discussions around social and cultural topics, fostering empathy and understanding. By collaborating on tasks that addressed real-world issues, students were able to connect with their peers' unique challenges and experiences, broadening their worldview and enhancing mutual respect. This environment of cooperation and shared learning encouraged students to appreciate their classmates' diverse realities and perspectives.

How has this project help to reduce truancy?

This project helped reduce truancy by increasing student engagement and motivation through its hands-on, interdisciplinary approach. By focusing on coding and environmental sustainability, the project provided students with exciting, real-world learning opportunities that made school more relevant and interesting. Students were more likely to attend regularly to participate in activities they found meaningful and enjoyable. Additionally, the project's emphasis on collaboration and teamwork created a sense of belonging, making students feel more connected to their peers and school. This sense of community and involvement in a shared purpose encouraged students to attend school consistently. Furthermore, the project's positive impact on the school climate, with its focus on mutual respect and support, contributed to a more welcoming and inclusive environment, reducing the factors that often lead to truancy.

How has this project help to improve school achievement?

This project helped improve school achievement by offering students practical, hands-on learning experiences that enhanced their academic skills. Through the integration of coding with environmental activities, students strengthened their digital skills and scientific understanding, directly contributing to their academic development. The interdisciplinary approach also encouraged critical thinking, problem-solving, and creativity, all of which are key to academic success. Moreover, by promoting collaboration and peer learning, the project provided opportunities for students to deepen their understanding through shared knowledge and teamwork. The increased engagement and motivation resulting from the project's relevance to real-world issues led students to take a more active role in their education, which positively impacted their overall academic performance and achievement.

How has this project help to improve school climate?

This project helped improve the school climate by fostering a sense of community, collaboration, and mutual respect among students and staff. By engaging students in interdisciplinary activities such as coding and environmental sustainability, the project created opportunities for students from diverse backgrounds to work together, which strengthened peer relationships and reduced social barriers. The emphasis on teamwork and shared goals also promoted a positive and supportive atmosphere, where students felt valued and empowered. Additionally, the project's focus on respect for individual differences and inclusivity contributed to a more tolerant and welcoming environment. Teachers' active involvement in guiding and supporting students through the project helped build stronger relationships between staff and students, further enhancing the overall school climate. As a result, the project created a more engaged, respectful, and cohesive school environment.

In summary, this project decreased truancy in several ways. By offering an interdisciplinary approach that combines coding and environmental activities, the project provides students with engaging, hands-on learning experiences that connect directly to their interests and real-world issues. This relevance sparks excitement and motivation, encouraging students to attend school regularly. Additionally, the project fostered a supportive and inclusive environment, promoting a sense of belonging through teamwork across different schools. Students who feel respected and valued are

more likely to stay engaged and attend classes. The opportunity to take ownership of their learning through activities like coding and environmental projects also fostered a sense of responsibility, further motivating students to attend school regularly. Moreover, by addressing emotional and social needs through an improved school climate, where mutual respect and supportive peer relationships are emphasized, the project helped students feel more connected to their school, reducing the likelihood of truancy. Finally, the project's focused on academic achievement, particularly in digital skills and environmental awareness, boosted students' confidence and motivation, encouraging consistent school attendance to continue contributing to the project's success.

On the other hand, this project improved the school climate in several important ways. By fostering collaboration and inclusivity through interdisciplinary learning, students from different backgrounds and abilities had the opportunity to work together on meaningful tasks. This sense of unity and shared purpose strengthened peer relationships, reduced bullying, and promoted mutual respect. The project’s emphasis on digital skills and environmental sustainability also aligned with the students' interests, which increased engagement and motivation, leading to a more positive and active school atmosphere. Moreover, the project encouraged a supportive learning environment where students felt valued and empowered, addressing challenges such as students skipping classes or lacking respect for teachers. By offering opportunities for active participation and ownership of their learning, the project helped create a culture of responsibility and respect, ultimately improving the overall school climate. Additionally, teachers’ involvement in guiding and supporting students in these projects enhanced relationships between staff and students, further contributing to a positive school environment.

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Annex 4 – Activity report form

ACTIVITY REPORT SANTIAGO APOSTOL

TITLE ECOTHINGS	**LEVEL:** *10-12 Years old*

PEOPLE WHO PARTICIPATED IN THE ACTIVITY

STUDENTS
Number: **19** No. Girls: **6** Age range: from **10** to **12** Schooling level(s): 6th
Any student with special needs? Y/N **YES** If Yes, How many? 1
Please, specify, **TEA**
Any foreign student? Y/N **NO** If Yes, How many? _____
Please, specify country of birth, _____

TEACHERS
Number: **2** No. Women: **0** Age range: from **43** to **44**
Subjects: PROJECTS (MATHS AND ENVIRONMENTAL STUDIES) & ARTS
Overall experience in international projects: × None ☐ Little ☐ Some ☐ Plenty
Overall experience with technology: ☐ None × Little ☐ Some ☐ Plenty

OTHERS (please specify) _____
Number: ____ No. Women: ____ Age range: from _____ to _____
Type of participation: _____

(add as many others as needed)

ADDITIONAL INFORMATION (when applicable): _____
_____
_____

TYPE OF ACTIVITY

Briefly describe the type of activity (eg., practical, lab work, computer work, group work, peer work, research, simulation, jigsaw, debate, class discussion, quiz, etc…)

We used the computers for creating presentations and doing group projects. We also learned programming and the basics of electronics.

Was there a **direct** work in the **ecohouse**? × Yes ☐ No
If no, explain _____

Did it involve student's **work** in development kits (esp32, raspberry pi…)? ☐ Yes × No
If yes, explain? _____

Did it involve students' use of other **ICT tools?** × Yes ☐ No
If yes, please specify used hardware and software **FACILINO**

Did students work/collaborate in **groups**? × Yes ☐ No
If yes, please explain (egs., informal peers or random groups, fix groups, jigsaw groups,…) __

Yes, students collaborated in interactive, heterogeneous groups facilitated by an adult with a clear didactic objective.

Were there adaptations for special needs students? × Yes ☐ No
If yes, please specify _____

Is the activity linked with some **SGD?** × Yes ☐ No
If yes, please explain how do you think is it linked. **The activity aimed to visualize energy-saving possibilities in the home and reflect on their efficiency and feasibility. This links to SDG 7: Affordable and Clean Energy and SDG 13: Climate Action.**

TIMELINE OF THE ACTIVITY

Start Date 01/10/23 End Date 30/05/2024 No. sessions: 22 Total duration (hours) 33 h

CURRICULUM FRAMING OF THE ACTIVITY

Curricular subject(s) and levels (when applicable) involved in the activity	Curricular theme(s) addressed in the activity
6th GRADE SUBJETCS: PROJECTS (MATHS AND ENVIRONMENTAL STUDIES) & ARTS	Development of logical thinking and problem-solving through games and programming activities. Performing calculations to compare the energy consumption of different devices or activities. Exploring the creative possibilities of technology. Promoting individual and collective responsibility in the use of resources.

ACTIVITY OVERALL APPRAISAL

Successes: what you or the students most appreciated?
The students were fascinated to discover how technology can be integrated into various spaces within a home, including the living room, kitchen, and bedroom. They were particularly impressed by the range of tasks that could be automated. The activity also provided them with hands-on experience using programming software and basic electronics, allowing them to understand the principles behind home automation and its role in energy efficiency.
Difficulties and constraints: what were your main constraints or experienced difficulties?
Our students face significant barriers to technology access due to their socio-economic circumstances. Their opportunities to engage with technology are largely limited to the time they spend at school, and unfortunately, our current resources do not allow us to fully bridge this digital divide. As a result, many students reach the ages of 10-12 without the digital literacy skills that are essential for success in today's world. Furthermore, the social challenges faced by our students can sometimes manifest as disruptive behavior in the classroom, making it even more crucial to provide them with the support they need.
Overcoming: how did you overcome experienced difficulties/constraints or what you suggest to change for the next time to overcome them?

Bridging the digital divide requires a multi-faceted approach. We must enhance technology education in early grades, provide professional development to improve teachers' digital competency, and invest in expanding access to technology resources and materials within our schools. This will ensure that all students have the opportunity to develop the digital skills necessary for success.

COLLECTED SUCCESSE EVIDENCES

Please identify here your collected success evidences and attach them to this report

- [x] Photos of the activity development
- [ ] Videos produced by teachers
- [ ] Videos produced by students
- [ ] Written students products of the activity (reports, posters, presentations, brochures…)
- [ ] Others (please specify) _____

Please identify the files names you wish to attach to your activity report

CONTRIBUTIONS TO PROGRESS TOWARDS THE PROJECTS' OBJECTIVES

How much do you think the activity contributed to progress towards the projects' objectives?

Objective 1: Providing an innovative educational approach based on the STEAM.

Not much ① ② ③ ④ **⑤** Very much

Objective 2: Improving students' soft skills: communication, collaboration, critical thinking, assertively and resilience.

Not much ① ② ③ **④** ⑤ Very much

Objective 3: Raising the environmental awareness of our students.

Not much ① ② ③ **④** ⑤ Very much

Objective 4: Testing cutting-edge pedagogical approaches.

Not much ① ② ③ ④ **⑤** Very much

Objective 5: Providing implementation guidelines that will include both technological and pedagogical aspects.

Not much ① ② **③** ④ ⑤ Very much

Objective 6: Improving the digital skills of the students involved in the project.

Not much ① ② ③ ④ **⑤** Very much

UNIVERSITAT POLITÈCNICA DE VALÈNCIA

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ACTIVITY REPORT SANTIAGO APOSTOL

TITLE Programmable Smart Microcontoller Cards	**LEVEL:** **9 - 10**

PEOPLE WHO PARTICIPATED IN THE ACTIVITY

STUDENTS
Number: 29 No. Girls: 18 Age range: from 14 to 16 Schooling level(s):9 - 10
Any student with special needs? No

Any foreign student? No

TEACHERS
Number: 1 . Women: 0 Age: 37
Subjects: How to use microcontroller boards?
Overall experience in international projects: ☑ None ☐ Little ☐ Some ☐ Plenty
Overall experience with technology: ☐ None ☐ Little ☐ Some ☑ Plenty

TYPE OF ACTIVITY
Lab work, Computer work, Group work,
Students were given general information about the basic purpose, pin structure and how to program cards such as Arduino, Raspberry Pi Pico W and esp32.
A few basic circuits were designed on Tinkercad (such as LED lighting and extinguishing) and students were asked to reproduce these circuits in groups. The groups were set as two people each.

Was there a **direct** work in the **ecohouse**? ☑ Yes ☐ No

Did it involve student's **work** in development kits (esp32, raspberry pi…)? ☑ Yes ☐ No

Arduino Uno R3 microcontroller board was used in the study.

Did it involve students' use of other **ICT tools?** ☑ Yes ☐ No
Arduino Uno R3 microcontroller board and Tinkercad were used in the study.

Did students work/collaborate in **groups**? ☑ Yes ☐ No
Students were randomly divided into groups

Were there adaptations for special needs students? ☐ Yes ☑ No
No, there were no students with special needs in the group

Is the activity linked with some **SGD?** ☐ Yes ☑ No

TIMELINE OF THE ACTIVITY

Start Date 11/10/2023 End Date 25/10/2023 No. sessions: 3 Total duration (hours) 2

CURRICULUM FRAMING OF THE ACTIVITY

Curricular subject(s) and levels (when applicable) involved in the activity Lists basic microcontroller boards. Understands the properties of the input and output pins on Arduino. Recognizes how analog and digital communication signals work.	Curricular theme(s) addressed in the activity ROBOTIC COMPONENTS

ACTIVITY OVERALL APPRAISAL

Successes: what you or the students most appreciated?
10th grade students helping 9th grade students in everything

Difficulties and constraints: what were your main constraints or experienced difficulties?
The readiness levels of 10th grade students were high and 9th grade students were low. At this point, 9th graders started to fall behind and became demoralized.

Overcoming: how did you overcome experienced difficulties/constraints or what you suggest to change for the next time to overcome them?
In group work, I distributed the 9th and 10th graders in a balanced way and gave additional research assignments for the 9th graders.

COLLECTED SUCCESSE EVIDENCES

Please identify here your collected success evidences and attach them to this report

☐ Photos of the activity development
☐ Videos produced by teachers
☐ Videos produced by students
☐ Written students products of the activity (reports, posters, presentations, brochures…)
☐ Others (please specify) _____

Please identify the files names you wish to attach to your activity report

CONTRIBUTIONS TO PROGRESS TOWARDS THE PROJECTS' OBJECTIVES

How much do you think the activity contributed to progress towards the projects' objectives?

Objective 1: Providing an innovative educational approach based on the STEAM.

Not much ① ② ③ ❹ ⑤ Very much

Objective 2: Improving students' soft skills: communication, collaboration, critical thinking, assertively and resilience.

Not much ① ② ③ ④ ❺ Very much

Objective 3: Raising the environmental awareness of our students.

Not much ① ② ③ ❹ ⑤ Very much

Objective 4: Testing cutting-edge pedagogical approaches.

Not much ① ② ③ ❹ ⑤ Very much

Objective 5: Providing implementation guidelines that will include both technological and pedagogical aspects.

Not much ① ② ③ ❹ ⑤ Very much

Objective 6: Improving the digital skills of the students involved in the project.

Not much ① ② ③ ④ ❺ Very much

TITLE Working with Sensors	**LEVEL:** **9 - 10**

PEOPLE WHO PARTICIPATED IN THE ACTIVITY

STUDENTS

Number: 20 No. Girls: 9 Age range: from 14 to 16 Schooling level(s):9 - 10
Any student with special needs? No

Any foreign student? No

TEACHERS

Number: 1 . Women: 0 Age: 37
Subjects: How to use microcontroller boards?
Overall experience in international projects: ☑ None ☐ Little ☐ Some ☐ Plenty
Overall experience with technology: ☐ None ☐ Little ☐ Some ☑ Plenty

TYPE OF ACTIVITY

Lab work, Computer work, Group work,
Students, who know the general structure of microcontroller cards and the working logic of the pins, worked on how to connect and program the sensors.

Was there a **direct** work in the **ecohouse**? ☑ Yes ☐ No

Did it involve student's **work** in development kits (esp32, raspberry pi…)? ☑ Yes ☐ No
Arduino Uno R3 microcontroller board was used in the study.

Did it involve students' use of other **ICT tools?** ☑ Yes ☐ No
Arduino Uno R3 microcontroller board and Tinkercad were used in the study.

Did students work/collaborate in **groups**? ☑ Yes ☐ No
Students were randomly divided into groups

Were there adaptations for special needs students? ☐ Yes ☑ No
No, there were no students with special needs in the group

Is the activity linked with some **SGD?** ☐ Yes ☑ No

TIMELINE OF THE ACTIVITY

Start Date 08/11/2023 End Date 30/10/2023 No. sessions: 6 Total duration (hours) 4

CURRICULUM FRAMING OF THE ACTIVITY

Curricular subject(s) and levels (when applicable) involved in the activity	Curricular theme(s) addressed in the activity
It uses sensors such as LDR sensor, PIR sensor, heat and humidity sensor, soil moisture sensor, rain sensor for its purpose. It establishes the connection of a sensor to a microcontroller board and programs the board for its purpose.	ROBOTIC COMPONENTS

ACTIVITY OVERALL APPRAISAL

Successes: what you or the students most appreciated?
They were able to immediately grasp a new sensor according to its working principle and use it by linking it with previous sensors.

Difficulties and constraints: what were your main constraints or experienced difficulties?
Some of the sensors suggested in the project documents are sold differently in our country. This situation worried some students.

Overcoming: how did you overcome experienced difficulties/constraints or what you suggest to change for the next time to overcome them?
What seemed like a problem at first was overcome when the students were able to make the new sensors they encountered look like the previous ones.

COLLECTED SUCCESSE EVIDENCES

Please identify here your collected success evidences and attach them to this report
☐ Photos of the activity development
☐ Videos produced by teachers
☐ Videos produced by students
☐ Written students products of the activity (reports, posters, presentations, brochures…)
☐ Others (please specify) _____

Please identify the files names you wish to attach to your activity report

CONTRIBUTIONS TO PROGRESS TOWARDS THE PROJECTS' OBJECTIVES

How much do you think the activity contributed to progress towards the projects' objectives?

Objective 1: Providing an innovative educational approach based on the STEAM.

Not much ① ② ③ ④ **5** Very much

Objective 2: Improving students' soft skills: communication, collaboration, critical thinking, assertively and resilience.

Not much ① ② ③ ④ **5** Very much

Objective 3: Raising the environmental awareness of our students.

Not much ① ② ③ **4** ⑤ Very much

Objective 4: Testing cutting-edge pedagogical approaches.

Not much ① ② ③ **4** ⑤ Very much

Objective 5: Providing implementation guidelines that will include both technological and pedagogical aspects.

Not much ① ② ③ **4** ⑤ Very much

Objective 6: Improving the digital skills of the students involved in the project.

Not much ① ② ③ ④ **5** Very much

TITLE Working with Sensors	**LEVEL:** **9 - 10**

PEOPLE WHO PARTICIPATED IN THE ACTIVITY

STUDENTS

Number: 20 No. Girls: 9 Age range: from 14 to 16 Schooling level(s):9 - 10
Any student with special needs? No

Any foreign student? No

TEACHERS

Number: 1 . Women: 0 Age: 37
Subjects: How to use microcontroller boards?
Overall experience in international projects: ☑ None ☐ Little ☐ Some ☐ Plenty
Overall experience with technology: ☐ None ☐ Little ☐ Some ☑ Plenty

TYPE OF ACTIVITY

Lab work, Computer work, Group work,

Students, who know the general structure of microcontroller cards and the working logic of the pins, worked on how to connect and program the sensors.

Was there a **direct** work in the **ecohouse**? ☑ Yes ☐ No

Did it involve student's **work** in development kits (esp32, raspberry pi…)? ☑ Yes ☐ No
Arduino Uno R3 microcontroller board was used in the study.

Did it involve students' use of other **ICT tools?** ☑ Yes ☐ No
Arduino Uno R3 microcontroller board and Tinkercad were used in the study.

Did students work/collaborate in **groups**? ☑ Yes ☐ No
Students were randomly divided into groups

Were there adaptations for special needs students? ☐ Yes ☑ No
No, there were no students with special needs in the group

Is the activity linked with some **SGD?** ☐ Yes ☑ No

TIMELINE OF THE ACTIVITY

Start Date 08/11/2023 End Date 30/10/2023 No. sessions: 6 Total duration (hours) 4

CURRICULUM FRAMING OF THE ACTIVITY

Curricular subject(s) and levels (when applicable) involved in the activity	Curricular theme(s) addressed in the activity
It uses sensors such as LDR sensor, PIR sensor, heat and humidity sensor, soil moisture sensor, rain sensor for its purpose. It establishes the connection of a sensor to a microcontroller board and programs the board for its purpose.	ROBOTIC COMPONENTS

ACTIVITY OVERALL APPRAISAL

Successes: what you or the students most appreciated?
They were able to immediately grasp a new sensor according to its working principle and use it by linking it with previous sensors.

Difficulties and constraints: what were your main constraints or experienced difficulties?
Some of the sensors suggested in the project documents are sold differently in our country. This situation worried some students.

Overcoming: how did you overcome experienced difficulties/constraints or what you suggest

to change for the next time to overcome them?
What seemed like a problem at first was overcome when the students were able to make the new sensors they encountered look like the previous ones.

COLLECTED SUCCESSE EVIDENCES

Please identify here your collected success evidences and attach them to this report

☐ Photos of the activity development
☐ Videos produced by teachers
☐ Videos produced by students
☐ Written students products of the activity (reports, posters, presentations, brochures…)
☐ Others (please specify) _____

Please identify the files names you wish to attach to your activity report

CONTRIBUTIONS TO PROGRESS TOWARDS THE PROJECTS' OBJECTIVES

How much do you think the activity contributed to progress towards the projects' objectives?

Objective 1: Providing an innovative educational approach based on the STEAM.
Not much ① ② ③ ④ ❺ Very much

Objective 2: Improving students' soft skills: communication, collaboration, critical thinking, assertively and resilience.
Not much ① ② ③ ④ ❺ Very much

Objective 3: Raising the environmental awareness of our students.
Not much ① ② ③ ❹ ⑤ Very much

Objective 4: Testing cutting-edge pedagogical approaches.
Not much ① ② ③ ❹ ⑤ Very much

Objective 5: Providing implementation guidelines that will include both technological and pedagogical aspects.
Not much ① ② ③ ❹ ⑤ Very much

Objective 6: Improving the digital skills of the students involved in the project.
Not much ① ② ③ ④ ❺ Very much

UNIVERSITAT POLITÈCNICA DE VALÈNCIA

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TITLE Presentation of Ecohouse in different schools	**LEVEL:** **5 - 6**

PEOPLE WHO PARTICIPATED IN THE ACTIVITY

STUDENTS

Number: about30 No. Girls: about 15 Age range: from 10 to 12 Schooling level(s): 5 - 6
Any student with special needs? No

Any foreign student? No

TEACHERS

Number: 3. Women: 3 Age: 35 to 40
Subjects: How to use microcontroller boards?
Overall experience in international projects: ☑ None ☐ Little ☐ Some ☐ Plenty
Overall experience with technology: ☐ None ☐ Little ☐ Some ☑ Plenty

TYPE OF ACTIVITY

Computer work, Group work,
Our students presented the house they built in different schools. 5. gave basic robotics and programming lessons to 6th grade students.

Was there a **direct** work in the **ecohouse**? ☑ Yes ☐ No

Did it involve student's **work** in development kits (esp32, raspberry pi…)? ☑ Yes ☐ No
Arduino Uno R3 microcontroller board was used in the study.

Did it involve students' use of other **ICT tools?** ☑ Yes ☐ No
Our students carried out basic robotics and programming activities mostly through tinkercad

Did students work/collaborate in **groups**? ☑ Yes ☐ No

Were there adaptations for special needs students? ☐ Yes ☑ No
No, there were no students with special needs in the group

Is the activity linked with some **SGD?** ☑ Yes ☐ No

TIMELINE OF THE ACTIVITY

Start Date 11/03/2024 End Date 15/03/2024 No. sessions: 4 Total duration (hours) 8

CURRICULUM FRAMING OF THE ACTIVITY

Curricular subject(s) and levels (when applicable) involved in the activity Prepares original projects using advanced sensors.	Curricular theme(s) addressed in the activity PROJECT DEVELOPMENT

ACTIVITY OVERALL APPRAISAL

Successes: what you or the students most appreciated?
After their basic training, our students assembled the house themselves and took ownership of the project. It was very exciting to see this in the activities we organized in schools.

Difficulties and constraints: what were your main constraints or experienced difficulties?
Our students sometimes found it difficult to communicate with younger and more mobile students.

Overcoming: how did you overcome experienced difficulties/constraints or what you suggest to change for the next time to overcome them?
In order to overcome the communication problem, we got some help from the teachers of the students in the schools we visited. With their help and some experience, we overcame the communication problems.

COLLECTED SUCCESSE EVIDENCES

Please identify here your collected success evidences and attach them to this report

☐ Photos of the activity development
☐ Videos produced by teachers
☐ Videos produced by students
☐ Written students products of the activity (reports, posters, presentations, brochures…)
☐ Others (please specify) _____

Please identify the files names you wish to attach to your activity report

CONTRIBUTIONS TO PROGRESS TOWARDS THE PROJECTS' OBJECTIVES

How much do you think the activity contributed to progress towards the projects' objectives?

Objective 1: Providing an innovative educational approach based on the STEAM.

Not much ① ② ③ ④ ❺ Very much

Objective 2: Improving students' soft skills: communication, collaboration, critical thinking, assertively and resilience.

Not much ① ② ③ ④ ❺ Very much

Objective 3: Raising the environmental awareness of our students.

Not much ① ② ③ ❹ ⑤ Very much

Objective 4: Testing cutting-edge pedagogical approaches.

Not much ① ② ③ ❹ ⑤ Very much

Objective 5: Providing implementation guidelines that will include both technological and pedagogical aspects.

Not much ① ② ③ ❹ ⑤ Very much

Objective 6: Improving the digital skills of the students involved in the project.

Not much ① ② ③ ④ ❺ Very much

Annex 5 – Additional collaborations and ECOTHINGS awards

20 UPV students were proposed to collaborate as volunteer teachers with Santiago Apóstol under the ECOTHINGS project. Students organized themselves into 5 interventions under the supervision of school faculty. In each intervention, 6 UPV students formed 3 groups of schoolchildren working on block-coding to develop basic exercises (**Figure 1**).

To prepare interventions with children, the teachers' team developed different materials in basic exercises on block-programming as well as to conceptualise an overall project for building a smart house. This volunteer activity has helped us understand how to conceptualize the project and define a sequence of sessions appropriate to the age and profile of the children. Therefore, we can say that one of the outcomes of the experience has benefited the ECOTHINGS project itself and its researchers.

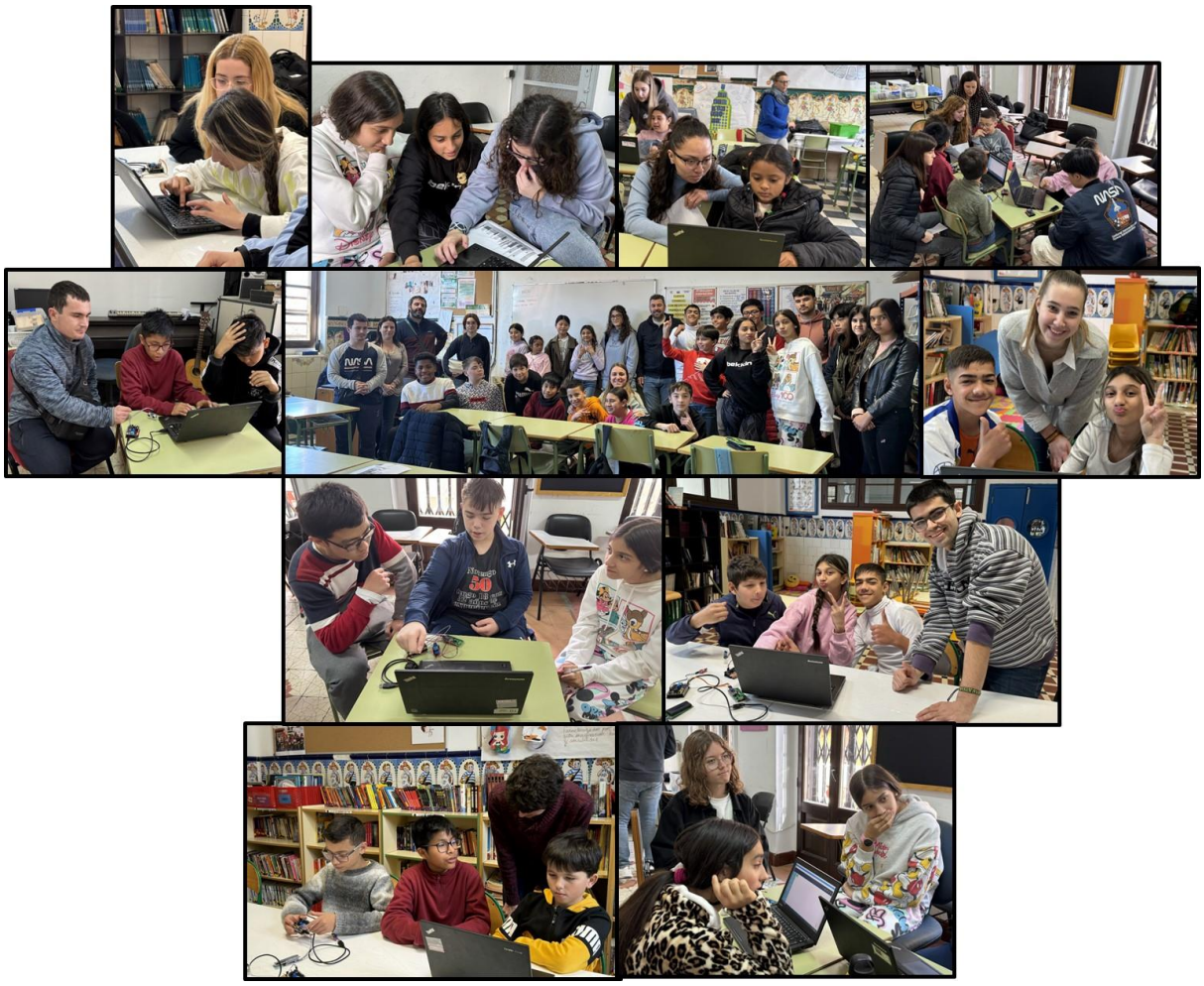

Figure 1. UPV students helping children in Santiago Apostol school 2023-2024

From these activities, we highlight the autonomy and responsibility of UPV students to organize sessions, make decisions on how to approach teaching, as well as the tolerance and patience when facing a different audience, which was a novelty for them.

Educational transference benefits

To evaluate the volunteering activity at Santiago Apóstol, we interviewed both school students and their teachers (activity observers) as well as to our students. We emphasize the STEM value, with a high positive benefit in students' attitude toward technology, as well as the reciprocal social value. On the one hand, children were impressed by the young university students and learned about what university studies means. On the other hand, our youngers learned about social diversity inside their own community, and demonstrated to the school faculty seriousness, discipline, and closeness to the

children. Additionally, the intervention helped create a dynamic among the children involving agents other than their usual tutors, increasing their attention, involvement, and confidence in their classroom participation.

By the end of the experience in Santiago Apostol school, we carried out an interview with our UPV students, plus with school's teachers and 20 participating children. Audio interviews were recorded, and transcripts analysed revealing both difficulties and benefits.

Difficulties

About difficulties observed by UPV students, they highlighted that understanding the overall project goals for children was difficult. Children don't use to understand why they do each exercise or use each sensor. Moreover, regarding block programming learning, UPV students said that it seems more intuitive than it really is. There are too many components and too many new names. Children are not capable of doing it autonomously.

Therefore, we discovered the importance of doing these short and very practical sessions to explain simple examples to the children. Thus, UPV students' interventions were crucial generating a high beneficial impact on children and to the progress of ECOTHINGS project.

However, it was necessary to sum up every one of the simple examples to show the real goal of the project to these children. It was planned by an event at Santiago Apóstol School who received a group of 8 youngers 14 years old from Turan Erdogan Yilmaz High School in Kalkan, Antalya, Turkey (Figure 2). The purpose of a 3-days visit was to consolidate the project where children and youngers had to assemble the miniature smart home, learning about technology and energy efficiency. As a result of the prior training with UPV students, children were able to enjoy the experience with confidence and determination, maximizing the learning curve and reducing inattentiveness (Figure 6).

Benefits

About benefits of the experience, we found advantages for the school, children and UPV students:

Benefits for the school: Due to their age, children are a difficult audience. Sometimes they are uncontrollable or present concentration problems. However, children perceive our UPV students as people who high knowledge in robotics and who dedicate their time selflessly to help them. This generates a positive feeling in them stablishing a strong connection, improving their attention and attitude during the sessions.

Regarding sessions structure, with the support of the university students it was possible to work in small groups, with much closer support and individualized attention. A very practical and more didactic work was done than just explaining everything on the blackboard, allowing much more progress in each session.

Benefits for children: Regarding the experience, the words "like," "fun," "laugh," and "different" are repeated in children speech. Regarding the attitude of the UPV students towards them, we found comments of gratitude and admiration for the help received and the good relationship established stand out. Children have been able to express themselves more openly with our university students, with more confidence than with their school's teachers due to the age difference.

On the other hand, children can see themselves reflected in what they can become or aspire to be within STEM studies. The university students serve as role models in a socially depressed context such as the school where they have volunteered. Regarding the possibility of repeating the experience, there is unanimity that they would indeed repeat it with UPV students.

Benefits for UPV students: They become aware of their luck because of their quality education, family and environmental stability, and allowance to high education access. This reality drives them to give their best during the sessions, with patience and exercising their communication skills with a different audience than usual, forcing them to work hard on how they organize each session and explain themselves to children who without no experience or knowledge about computers. In return, they receive personal reinforcement and self-esteem by feeling that children have grown quite fond of them.

Eventually, although our students have sufficient background to face the sessions, the challenge of teaching forces them not only to understand concepts about programming but also to apply them to new situations and explain their knowledge with a narrative that builds understanding from the simplicity of each piece to the complexity of the interaction between components. It is a personal cognitive challenge that they appreciate as a different and motivating experience.

Other benefits: Additional beneficiaries of the experience were two vocational training students from La Purísima School in Valencia. These two students, who were interns at UPV, also assisted in developing the miniature smart home. Through their internships, they learned to program the ESP32 microcontroller, integrating various types of sensors and actuators. Additionally, they participated in the 3-day intervention with the high school from Kalkan, Antalya, applying their training both technically and in user support (Figure 3).

Rewards

The initiative received the Lueny Morell Award 2024 by InnovaHiEd Academy.

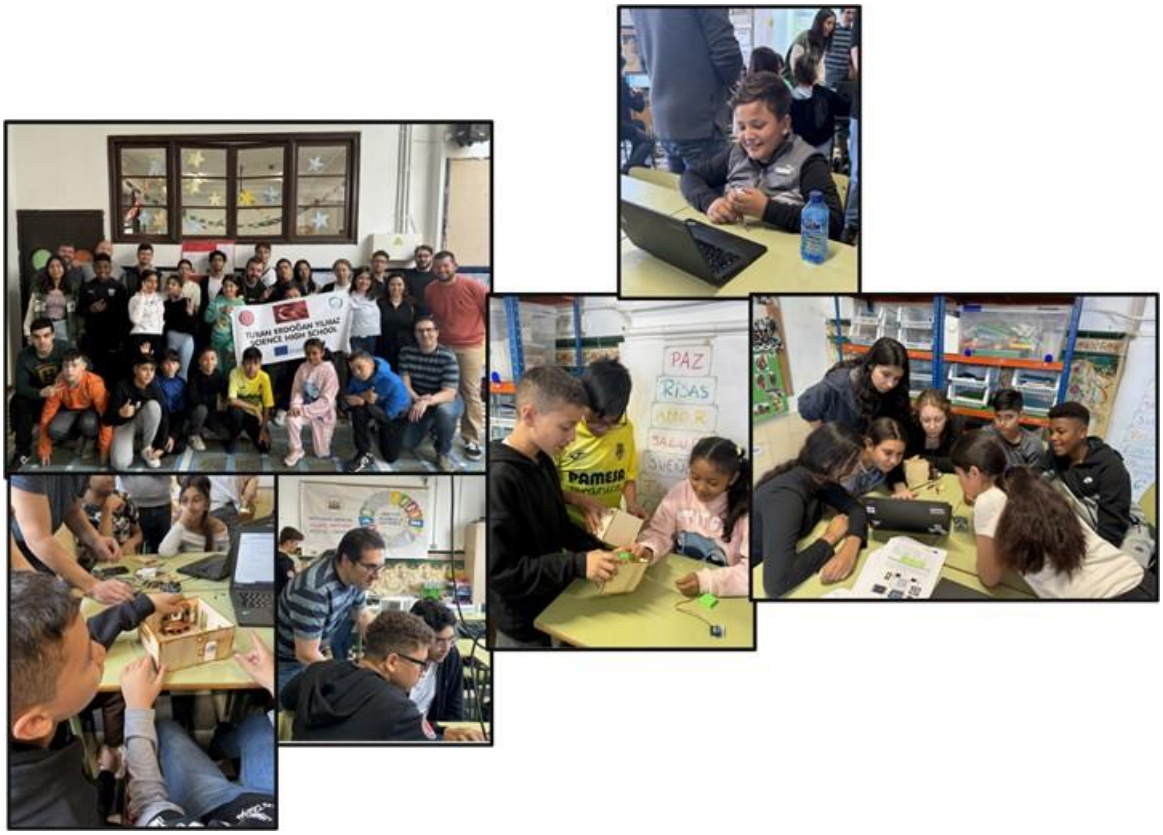

Figure 2. Students from a high school of Kalkan, Antalya, visited Santiago Apostol school, May 2024.

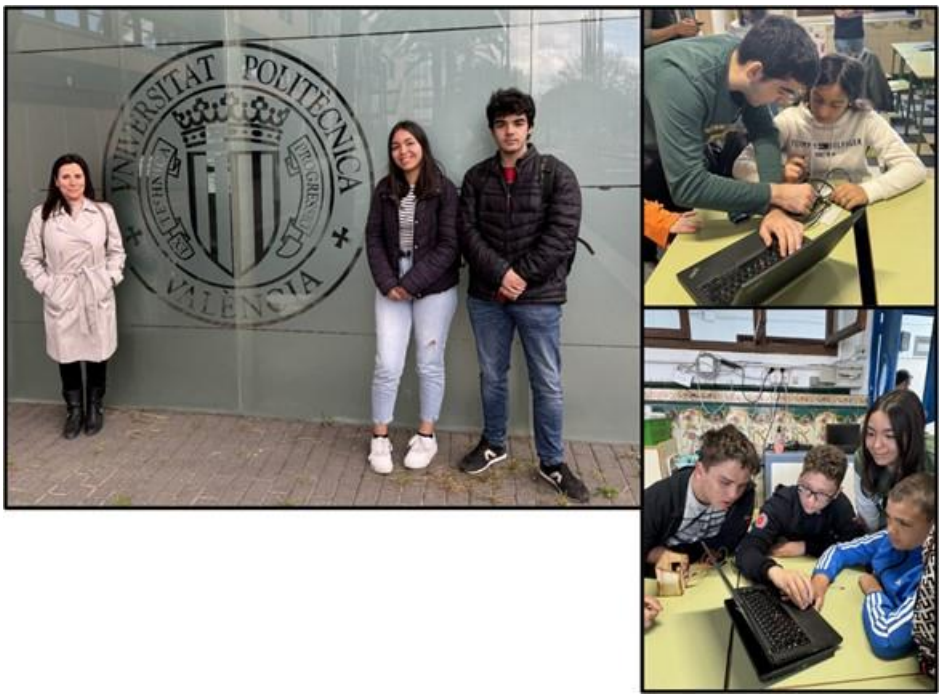

Figure 3. Students from VET education collaborating in Santiago Apostol interventions.

Annex 6 – Final schools' reflection

The impact of the Ecothings project on Santiago Apóstol Primary School includes technical know-how: electric circuits, servo mechanisms, software design and control, block programming usage, app design, environmental science, 3D printing and laser cut tools etc. These activities alone had an undeniable impact on our pupils' problem-solving, logical thinking, resilience, entrepreneurial and critical thinking skills.

Nonetheless, the project had an impact also on their communication, collaboration, creativity and assertive skills through a thoroughly designed pedagogical plan based on the Lev Vygotsky's Theory of Social Learning, Howard Gardner Multiple Intelligence Theory and the principles of Dialogic Learning, that set the ideal conditions for them to develop such skills.

The third impact lay on the transdisciplinary approach of the scheduled LTTAs: building technological solutions to solve real environmental problems implied improving a considerable number of basic and non-basic skills, i.e. mathematics, physics, ecology, English language, applied science etc. We would also like to highlight that the low-cost feature of our hardware, together with the domotics approach that characterised the hardware/software combination, allowed the project to have a significant impact also on the socially disadvantaged ethnic groups our schoolwork's with: Roma and immigrants coming from low-income families.

Last but not least, the international nature of the programme allowed the children to get to know different cultures and customs in the European Union, specifically in Turkey.

The second target group included the primary teachers involved. Our educational eco-technological pack was conceived to be a powerful tool in the hands of teachers who pursue the STEM approach in their classes. The philosophy behind the PRs was not only providing them with affordable technological tools, but also with a tested pedagogical guide based on theories which have proven themselves both effective and efficient, theories that allow the children to play the main role in their learning process. Modern technology merged with a solid pedagogical approach for innovative teachers.
Moreover, the teachers involved experienced the numerous advantages of transnational cooperation and are willing to apply the acquired knowledge to future projects, both at an internal and external level.

The third target group was the internship staff that took part in both the eco-technological courses carried out at our school during the school years 2022-2023 and 2023-2024, as well as the blended mobility of students. Colegio Santiago Apóstol Cabanyal employs a considerable number of non-teaching personnel (social workers, psychologists, educators, volunteers etc.) who play a fundamental role in spreading effective pedagogical initiatives throughout the Learning Community that characterises the school's work.

The fourth target group includes the school national and international network. The impact in terms of technology implementation, merging it with innovative pedagogical theories and fostering a trans-disciplinary approach within their teaching methodology went beyond the school walls and was shared with local, national and international partners.

For all of the above, we believe that taking part in such an ambitious project strengthened and expanded our school's teaching methodologies and was surely worth implementing.

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TURAN PICTURES