D2.3

Service Package for Open Schooling for Schools

WP2

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1. Executive Summary

This document presents a Service Package for supporting schools in implementing Open Schooling Activities (OSA) within the ICSE Science Factory project. Drawing on implementation experiences across five partner countries, it offers practical strategies for engaging schools and supporting them throughout the process. OSA bring schools together with families, local organizations, and communities to address real-world challenges in three topics- Green Deal, Digitalization, and Health- following five phases: Know, Plan, Execute, Share, and Evaluate.

Implementation exceeded targets, with over 230 OSA reaching more than 3700 participants across Europe. OSA engaged diverse groups including students, families, teachers, and community members from urban and rural settings across all age ranges. This diversity of participation demonstrated that Open Schooling can work in very different circumstances.

A distinctive feature of ICSE Factory is its integration of artificial intelligence (AI) tools and emerging technologies, not as auxiliary resources but as core pedagogical instruments. Students learn to critically evaluate AI-generated information, use Machine Learning for data analysis, and program sensors for real-world monitoring, developing essential 21st-century competencies alongside traditional scientific skills.

Through systematic analysis of fifteen selected OSA, a framework emerged addressing two critical questions: how to get schools involved and how to support them effectively. For recruitment, evidence showed personal contacts and teacher training work consistently, while promotional campaigns typically fail. Teachers need concrete planning tools and designated mentors with regular check-ins, not vague support offers. Partnerships require clear protocols framing collaboration as mutual benefit, not one-way requests. Assessment must recognize collaboration and community impact alongside traditional outcomes.

Schools faced common challenges: building trust initially, gaps in teacher knowledge about partnerships, limited time, and coordination across institutions. Effective strategies overcame these through existing relationships, structured training with career incentives, integrating OSA rather than adding work, and clear protocols with regular meetings.

Several factors characterized successful OSA. Schools participated because teachers were contacted personally and offered training with recognized credentials. Activities connected to existing curriculum requirements and came with practical tools, clear examples, and designated mentors who stayed in regular contact. Partnerships worked when presented as shared challenges benefiting both sides. The key was strategic support rather than abundant resources.

Practical tools proved more valuable than abstract frameworks, and proactive mentoring worked better than reactive problem-solving

Three elements support sustainability: distinguishing what works from what doesn't, framework flexibility for local adaptation, and teacher capacity building alongside networks for continuation without permanent external support. Evidence suggests this is achievable: teachers from training programs developed multiple OSA independently, partnerships persisted beyond formal requirements, and materials transferred successfully across contexts.

2. Introduction and Context

2.1. Objectives of Work Package 2 - Lighthouse Activities and Open Schooling

Work Package 2 (WP2) on "Lighthouse activities and Open Schooling" serves as a keystone of the ICSE Science Factory project, addressing the first objective of providing collaborative science real-life learning opportunities for all citizens.

WP2 encompasses four primary objectives:

- To offer communities members real-problem solving opportunities, contributing to lifelong learning: This objective recognizes the need to engage citizens of all ages in meaningful scientific activities that demonstrate the practical applications of science in addressing real-world challenges.
- To run lighthouse activities: These activities represent collaborative, interdisciplinary workshops where local consortium members and enterprises work together on real-life problems for community members, thereby contributing to a lifelong learning continuum for all.
- To encourage schools to run open schooling activities: This involves supporting schools in implementing open schooling activities within their communities, supported by mentors and guidelines provided by project partners.
- To continuously optimize activities in the sense of design research: This ensures that all activities are refined through iterative cycles of design, piloting, evaluation, and optimization to maximize their effectiveness and quality.

This deliverable, D2.3 "Service Package for Open Schooling", constitutes a core output of WP2, providing schools with comprehensive guidance, resources, and support mechanisms to

implement OSA. As such, in this document best practice examples from partner countries are shared and concrete strategies to win and support schools are provided.

It is worth highlighting that each country adapted the service package to its national context and published it on its respective national website.

2.2.   Open Schooling Activities Definition

Within the scope of WP2, and specifically Task 2.3, a proposed definition of OSA was developed for use within this project. Thus, as explained in the document "Open Schooling" the EU definition (EU, 2015) is adopted for this type of activities, according to which OSA consist of collaborative activities developed by schools in cooperation with various community stakeholders (families, businesses, universities, science centers, local authorities), which aim (Bogner & Sotiriou, 2023):

- Connect formal learning with informal contexts, allowing students to interact with real science and scientists to understand how science works in real life
- Actively involve different members of society (professionals, scientists, families) in projects that bring real-life situations into the classroom
- Promote scientific literacy and increase students' motivation and interest in scientific and technological areas
- Establish partnerships that allow for the construction of specialized knowledge, the creation of networks for work and sharing, and the practical application of results
- Encourage families to become real partners in school life and activities, contributing to the development of scientific capital within the family environment

In other words, OSA are activities that open the school to the community and bring the community into the school, creating a meaningful and contextualized learning continuum.

2.3. OSA Implementation Design

a) Description

The ICSEfactory OSA implementation design synthesizes insights from established European frameworks, particularly OSOS (Open Schools for Open Societies) and MOST (Meaningful Open

Schooling Connects Schools to Communities), while incorporating experiences from partner countries and focusing on three thematic areas: Green Deal, Digitalization, and Health.

The design draws on OSOS's emphasis on community problem identification and external partnerships, and MOST's structured evaluation component. However, the ICSEfactory implementation design for OSA emphasizes community needs assessment as the starting point, includes a structured planning phase to ensure feasibility, offers flexibility in evaluation approaches, and in some OSA there is a clear connection to curriculum themes.

The ICSEfactory OSA implementation design follows five interconnected phases (Figure 1). While presented sequentially, these phases often overlap and may involve iterative cycles along the OSA development.

Action Plan Development
Students collaborate with partners to develop detailed action plan.

Dissemination & Engagement
Students disseminate findings through presentations, reports, events, and media; engage community

1   3   5

KNOW → **PLAN** → **EXECUTE** → **SHARE** → **EVALUATE**

Topic Exploration & Definition
Students identify relevant topics or problems; define problem statement

2

Implementation & Data Analysis
Students implement plan, collect data, analyze findings, develop solutions, and document process

4

Reflection & Assessment
Students assess project success, community impact, learning outcomes, and stakeholder feedback

Figure 1. OSA implementation design.

1. KNOW: Students identify and explore relevant topics through community engagement, surveys, observation, or teacher/student proposals. This may include authentic local problems, interesting scientific phenomena, relevant social issues, or themes that connect to students' lives and community needs. They discuss and analyze the selected focus, conduct initial research using various sources (including AI tools when appropriate), and identify potential partners or resources. The teacher facilitates discussion, helps develop research questions, supports critical thinking about information sources, and assists in partnership identification. This phase produces a clear topic definition or problem statement, initial research findings, potential partner list, and draft OSA objectives.

2. PLAN: Students collaborate with identified partners to develop a detailed, feasible action plan. This includes establishing formal partnerships, setting specific measurable objectives, creating timelines and assigning responsibilities, determining data collection methods, and identifying resource needs. Partners provide expert perspective on feasibility and methodology, while teachers facilitate planning meetings and ensure curriculum alignment. Outputs include a detailed activity plan, partnership agreements, data collection protocols, timeline with milestones, and resource list.

3. EXECUTE: Students implement their activity plan through systematic data collection, regular team meetings, ongoing partner consultation, data analysis, and solution development. They test and refine proposed interventions while documenting the entire process. Partners provide technical support and help interpret findings, while teachers monitor progress and support problem-solving. This phase produces collected data, analysis results, evidence-based solutions, process documentation, and lessons learned.

4. SHARE: Students disseminate findings through diverse formats including presentations, reports, videos, social media, and/or community events. They organize science fairs, workshops, or public exhibitions, engage with local media, and create reusable resources for others. Community members attend events, provide feedback, and participate in implementing solutions. Outputs include multiple communication products, documentation of events, media coverage, and stakeholder feedback.

5. EVALUATE: Students assess OSA success against initial objectives, evaluate community impact, conduct self and peer evaluation, analyze learning outcomes, collect partner and community feedback, and identify lessons for future activities. This systematic reflection helps students understand what worked well and areas for improvement. The evaluation phase produces

assessment reports, learning outcome documentation, stakeholder feedback summaries, and recommendations for future initiatives.

b) Organization and Target Group

OSA within ICSEfactory are interdisciplinary activities focused on the three core themes: Green Deal, Digitalization, and Health. These long-term activities typically span several days, weeks and months.

OSA involve participants from the school community, including students, teachers, partners from the ICSE Factory project, external stakeholders such as scientists or professionals, parents or family members, and broader community members. The participant group collectively initiates activities and chooses topics, ensuring authentic ownership and relevance.

The primary aim is for participants to work scientifically on real-life problems within their own community or school context, developing both scientific competencies and civic engagement. Schools run these activities in their communities with support from mentors provided by project partners and following structured guidelines.

OSA can take various forms including workshops, extended projects, or school markets on specific topics to which schools invite external participants such as parents, scientists, and enterprise representatives.

An important connection exists between LHA and OSA: LHA- short-term interdisciplinary workshops offered by external stakeholders and universities to the broader community- can serve as kickoff events for OSA. They convey the enjoyment of science while helping participants understand it, potentially inspiring schools to develop longer-term projects around similar topics. This creates a continuum from initial engagement through LHA to sustained investigation through OSA.

Based on this design and organization, OSA were developed and implemented in the five partner countries, as described in the following sections.

3. Methodology

3.1. Timeline and Status Quo

According to the indicators outlined for the ICSE Factory project, the implementation of 40 OSA per partner country was planned, which would correspond to 200 OSA across Europe and an estimated reach of 250 participants per country and, consequently, 1250 participants across Europe.

The data reported by all partners are summarized in Table 1 and a more detailed list of the OSA implemented by each country is available in Annex A.

Table 1. Number of implemented OSA and participants.

Country	Number OSA	Total participants	Female participants
Croatia	35	239	135
Cyprus	40	208	109
Germany	79	980	482
Portugal	42	1355	612
Turkey	41	921	466
TOTAL	**237**	**3703**	**1803**

It should be noted that there may be discrepancies between the figures presented in this document and those in the WP5 deliverable. This is because additional OSA and implemented beyond the formal evaluation period. For that reason, these post-evaluation OSA are documented here but were not included in the WP5 assessment.

To present and define a Service Package for Open Schooling, three OSA from each partner country were selected that best exemplify its different elements and serve as reference cases. The approach to defining and presenting Service Packages for Open Schooling through the selection of exemplary OSA cases aligns closely with the methodology employed in the Make it Open project (Make it Open, 2021)

This selection, whose criteria are presented in the next section, was made considering the reports prepared for each OSA, the template for which is presented in the Annex B and included the following dimensions:

- Description of the activity
- Summary (purpose, scope, and content of the event)
- Description of the implementation process of the activity

- Strategies to win schools
- Schools support
- Key-success factors
- Challenges
- Reflective remarks
- Outcomes (outcomes, achievements, and participant feedback)

This approach, like the one employed in the Make it Open project recognizes the importance of documenting multiple dimensions of OSA, from implementation strategies to support measures and presenting them in accessible formats that facilitate replication and adaptation across different educational contexts.

This parallel methodology demonstrates a growing consensus in the European Open Schooling community about the need for well-documented, transferable service packages that can guide educators through the complexities of implementing Open Schooling initiatives.

3.2. OSA Selection

As previously mentioned, three OSA from each partner country were selected to identify and exemplify best practices. The selection criteria were the following:

- Alignment with Open Schooling Principles: The OSA should demonstrate school openness to the community, collaboration with external partners, and respond to local needs. The OSA should show how different stakeholders worked together and formed meaningful partnerships, with schools acting as active community members, not just organizing activities.
- School Engagement Strategies: The OSA should show approaches to engage stakeholders (schools, students, or community members), using varied methods such as personal contacts, training sessions, communication campaigns, or motivational incentives.
- Diverse and High-Quality Support: The OSA should provide diverse support covering multiple dimensions: well-structured activities and quality educational materials; regular mentoring with constructive feedback and effective communication; teacher training with real impact on professional development; and practical technical and logistical support.
- Link Between Support and Results: There should be visible connections between the support provided and the outcomes achieved. Schools should provide positive feedback

identifying what helped most. Teachers should demonstrate improved skills and confidence. There should be signs that schools can continue the practices on their own.

- Transferability Potential or Innovative Value: The engagement strategies and support measures should be replicable in other contexts or demonstrate innovative approaches that spread Open Schooling practices. Documentation should be detailed enough to understand implementation requirements.

3.3. OSA Analysis

After selecting the OSA, they were subjected to a systematic analysis of the individual reports of each activity, from which patterns emerged that allowed the conceptualization of a framework for the Service Package, as described in the next sections.

4. Best Practices Examples

4.1. Overview of the selected OSA

Table 2 presents a characterization of the OSA selected as best practice examples, and in the following subsections these OSA are briefly described. Detailed reports for each activity can be found in Annex C.

Table 2. Selected best practice examples of OSA, by country.

Country	Name of the OSA	Topic(s)	Duration	Total number of participants	Number of partticipanti ng females	Age range of the participan ts	Partners involved	Foundation al aspects (IBL, RLP, SSI, CDI)
Croatia	Can we ignore microplastics?	Health, Green Deal	2 months	6	3	16-17	PMF, XV. Gimnazija	RLP
	SOS application for newly enrolled student	Health, Digitalization	6 months	8	5	16-17	PMF, V. Gimnazija	RLP
	The sustainable school of the future	Green Deal, Digitalization	6 months	5	2	14	PMF, OS J. Pupacic	IBL
Cyprus	Interactive Botanical Garden	Green Deal, Digitalization	3 months	7	4	14	UNIC, CPI, Partner school	RLP
	Green City	Green Deal, Health	5 days	15	6	11-14	UNIC	SSI, PBL
	Thermal Heat Island	Green Deal, Digitalization	6 months	40	22	15-17	UNIC, CPI, Lanitio High School	SSI, PBL
Germany	Designing Jigsaw Lamps	Digitalization	1 week	9	3	14	University, school	IBL, RLP
	Dysphagia-Cooking	Health	2 weeks	8	8	15-18	ICSE, vocational schools Wolfach, nursing home Hausach	RLP
	School Garden at IKG	Green Deal	2022-now	>100	n.d.	11+	Holzbau Bambusch, City of Tuttlingen, J. Friedrich Storz (stone supplier), Musikhochschule Trossingen, Multiple teachers and students from all disciplines at IKG	RLP
Portugal	Classroom Environment. Effects on Student Well-Being	Health, Digitalization	2 months	12	11	13-15	IE-ULisboa, Agrupamento de Escolas Fragata do Tejo + Clube Ciência Viva	IBL, RLP
	Recycling robot	Green Deal, Digitalization	2 months	41	21	8-11	IE-ULisboa, Escola Básica/JI José Tagarro e Escola Básica D. António de Ataíde	SSI, RLP

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	Estuary water quality	Green Deal, Digitalization	2 months	20	14	16-20	IE-ULisboa, Escola Básica e Secundária Alfredo da Silva	IBL, SSI, RLP
Turkey	Wet Road Warning System - Mini Smart Road	Green Deal, Digitalization	1 month	3	0	13-14	HU, Kastamonu University, Kayı Middle School, TUBİTAK,	IBL, RLP
	From tea pulp to compost	Green Deal	4 months	16	8	6-7	ÖÖV, Maya Schools, Tea growers	RLP
	Healthy Nutrition Assistant - Scratch Project	Health, Digitalization	2 months	5	3	11-13	HU, Kastamonu University, Kayı Middle School, TUBİTAK,	CDI, RLP

a) Croatia

- **OSA "Can we ignore microplastics?" (Health/ Green Deal)**

Students began with a literature review on microplastics and their health impacts, then received training from a biology professor on sampling, filtering, and analyzing water samples. They collected water from team members' homes across different parts of the city and estimated how much microplastic their peers were consuming based on concentration levels and typical water consumption.

The results showed no major differences between city areas, but the amounts consumed were concerning. Students presented their findings at a school event and at the ICSE Science Fair in Zagreb, raising awareness among students, families, and the wider community. The project was recognized as one of the best at the national fair.

- **OSA "SOS application for newly enrolled student" (Health, Digitalization)**

This six-month OSA at Peta Gimnazija Zagreb addressed Health and Digitalization themes, supported by a mathematics teacher, a psychology professor, and a computer science specialist.

Students developed an online platform to help first-year secondary students adapt to high school. The idea came from the students themselves, who wanted to support younger peers facing psychological and emotional transition challenges.

After reviewing literature on motivation and self-regulated learning and consulting with the psychology professor, they identified five key dimensions: feeling good at school, success expectations, success estimation, deep learning, and fear of failure. The team built a web application using four development tools, learning programming and design skills along the way. They tested a questionnaire with senior students, analyzed responses using AI to cluster data and create three student profiles with personalized feedback. The OSA won best project at the national ICSE fair and can be used by students in other schools, making it highly replicable.

- **OSA "The sustainable school of the future " (Green Deal/Digitalization)**

Over six months, students from Josip Pupačić Primary School in Omiš designed a vision for a new sustainable school building to address a real problem: their school operates across two locations without adequate infrastructure for modern education.

Working with two teachers, architects, sustainability experts, and local partners including the municipal company Peovica, students learned 3D modeling in Minecraft and surveyed students and residents about their needs. They explored ecological solutions for energy, building materials, shape and orientation, and biodiversity protection while developing their model.

Students documented the process through photos and videos, then presented their work at school and at the ICSE Science Factory School Fair. The project provided concrete suggestions for an actual building project being considered by Omiš City Council. The OSA was recognized as a flagship open schooling activity and won best project at the national science fair.

b) Cyprus

- **OSA "Interactive Botanical Garden" (Green Deal/ Digitalization)**

This three-month OSA at Pagkyprion Gymnasion was initiated internally by a motivated school team committed to interdisciplinary, project-based learning. Rather than requiring external outreach, the project emerged organically from teacher-led initiatives that aligned with both student interests and curriculum goals, following the teacher's participation in ICSE Science Factory training. The activity addressed Green Deal and Digitalization themes, supported by partners from the University of Nicosia (UNIC) and the Cyprus Pedagogical Institute (CPI), targeting students and community members.

Students explored the properties of aromatic plants—widely known in the local Cypriot context—and examined how climate change affects their growth and sustainability, combining scientific research with digital tools and entrepreneurship. Working in teams with teacher support, they researched the medicinal, culinary, and cosmetic value of these plants, created QR codes linking to explanatory multimedia content, and built a physical model of an imagined botanical garden. In the final stage, they incorporated entrepreneurial thinking by envisioning how the garden could become a real initiative, including ideas such as producing and marketing herb-based products, creating a learning space for younger students, or promoting the garden as an ecotourism site.

- **OSA "Green City" (Green Deal/ Health)**

This five-day OSA was part of a summer school program hosted by the University of Nicosia (UNIC), where students voluntarily enrolled to participate in interdisciplinary, hands-on STEM learning experiences. The activity addressed Green Deal and Health themes, with support from UNIC and two visiting physicists.

The activity focused on designing cities that prioritize green spaces, renewable energy, and low environmental impact. Students explored key features of sustainable cities, including solar energy, green roofs, recycling systems, pedestrian-oriented design, and urban biodiversity.

A key feature was the involvement of two visiting physicists who introduced students to the physics of renewable energy systems, energy consumption, and urban microclimates, providing scientific relevance and demystifying scientific careers. After the research phase, students built a physical model of the "Green City" using recycled materials to represent green infrastructure, serving as a communication tool to present their ideas to peers and educators.

- **OSA "Thermal Heat Island" (Green Deal/ Digitalization)**

This six-month OSA at Lanitio High School emerged through a co-design approach where students brainstormed themes related to science and their local environment, ultimately selecting Urban Heat Islands as a meaningful and contextually relevant topic. The activity addressed Green Deal and Digitalization themes, with support from the school, the Cyprus Pedagogical Institute (CPI), and the University of Nicosia (UNIC), targeting students, teachers, and community members.

The activity aimed to investigate the urban heat island phenomenon through real data collection and analysis, using digital sensors to measure temperature variations in different locations. Implementation began with project team visits to present objectives and build relationships. Organized into groups, students identified specific community locations, conducted measurements at different times over multiple days, analyzed data by creating visual representations such as graphs to draw conclusions about factors contributing to urban heat accumulation, and prepared to share their results in public forums including science fairs and local environmental conferences.

c) Germany

- **OSA "Designing Jigsaw Lamps" (Digitalization)**

Over three months, students from the mathematics club at Marie-Curie-Gymnasium designed "puzzle lamps"—spherical lampshades assembled from identical pieces without glue. The activity emerged when ICSE, through personal contacts, proposed the topic to the math club teacher, who found it exciting and presented it to students. The highly motivated

students chose to participate, working with a plotter that digitizes and cuts hand-drawn shapes to analyze existing commercial designs and create their own.

The club meets on Saturday mornings throughout the year, with the main work happening over two consecutive Saturdays. After 90 minutes learning mathematical principles and analyzing existing designs, students spent the first morning developing prototypes. They needed only a few pieces initially to test if shapes and connections worked, then refined them through 3-4 iterations. To avoid bottlenecks, mass production happened between and after the Saturday sessions, with the plotter remaining at school for three months so students could make additional copies.

Students presented their lamps at the ICSE Science Factory Fair, demonstrating how the plotter works and explaining the mathematical principles on a poster.

- **OSA "Dysphagia-Cooking" (Health)**

This two-week activity at Wolfach Vocational School emerged when ICSE contacted a specialist teacher, a trained home economist with care home experience, through an employee whose home school is BS Wolfach. The dysphagia topic aligned well with the school's home economics curriculum, which includes "special forms of nutrition".

Eight students learned about dysphagia (swallowing difficulties) and used molecular gastronomy techniques to create adapted meals for nursing home residents. Working in pairs over two Thursday mornings, they prepared cauliflower soup, bratwurst, rösti, vegan sauce, soft chocolate, and cinnamon foam- all finely puréed and re-shaped using silicone molds and texturizers to create visually appealing dishes suitable for patients with swallowing difficulties.

After a test cooking session, students prepared an increased quantity and set a welcoming table for elderly guests brought by van from the partnering nursing home in Hausach.

- **OSA "School Garden at IKG" (Green Deal)**

This ongoing OSA at Immanuel-Kant-Gymnasium in Tuttlingen emerged as a single-school initiative after the original school garden was demolished for renovation. When only a simple lawn was initially planned, students and teachers jointly advocated for a vibrant, multifunctional space, empowering student voices through the student council's involvement. Supported by awards including the Schulhofträume prize from Deutsche Kinderhilfswerk, the school has developed a comprehensive outdoor learning space with

over 100 participants, including multiple partners such as Holzbau Bambusch, Tuttlingen City Council, and teachers from all disciplines.

The garden now includes a green classroom, pond, beehives, experimental facilities, digital learning environments using CoSpaces, and artistic installations. Implementation involved students in CAD planning for a greenhouse and garden house, creating insect habitats inspired by historical landmarks, designing artistic mosaics based on Ovid's Metamorphoses, producing a school song and logo, sculpting Immanuel Kant, and sourcing local ecological materials. Nearly all school subjects are involved in its ongoing use and development.

d) Portugal

- **OSA "Classroom Environment. Effects on Student Well-Being" (Health/ Digitalization)**

This two-month OSA at Agrupamento de Escolas Fragata do Tejo was implemented through the Clube Ciência Viva by teachers trained through the ICSE Science Factory partnership. The topic created strong motivation through immediate personal relevance: students investigated their own classroom environmental conditions. Supported by IE-ULisboa, the activity addressed Digitalization and Health themes through an interdisciplinary approach (Physics and Chemistry, Mathematics, Natural Sciences, Geography, ICT), targeting students and the wider community.

Using Arduino-based sensor systems, students monitored temperature, humidity, and CO_2 levels in real-time across different classrooms while conducting surveys on comfort and well-being perceptions. After receiving training on sensor operation and environmental monitoring principles, students worked in small groups to assemble sensors, program Arduino systems, and collect data over several days. They analyzed results, identified patterns, and related findings to scientific literature, using AI tools for data analysis while developing critical thinking about ethical technology use.

The OSA concluded with student presentations to the school community and families during an open day.

- **OSA "Recycling Robot" (Green Deal/ Digitalization)**

This two-month OSA at Escola Básica/JI José Tagarro and Escola Básica D. António de Ataíde emerged from an ongoing IE-ULisboa training workshop on "STEM Education and its role in developing Scientific Literacy of primary school students." Facilitators collaborated with teachers to co-design and adapt the activity to specific classroom contexts and curriculum

requirements. Addressing Green Deal and Digitalization themes, the project promoted environmental awareness and computational thinking among 41 primary students (grades 3-4) and their families.

Students investigated solid urban waste production in their schools, focusing on milk cartons as a case study. After watching videos and discussing waste problems, they weighed milk cartons and calculated waste production at class, school, and national scales. Using Mentimeter, they created word clouds expressing environmental commitments. Students then rotated through three programming stations: a virtual garbage truck game on tablets, mBot robots navigating from recycling bins to waste, and challenges in the Open Roberta Lab virtual environment.

The project concluded with an interactive exhibition during an open day, where students demonstrated robots, displayed calculations and graphs, and explained recycling to approximately 120 community members.

- **OSA "Estuary water quality" (Green Deal/ Digitalization)**

This OSA at Escola Alfredo da Silva was designed with three teachers collaborating to integrate content across Physics and Chemistry, Chemical Analysis, and Chemistry, Safety and Environment. The topic created exceptional local relevance: students investigated the Tagus Estuary adjacent to their school, connecting personally with the area's remarkable environmental transformation from industrial pollution (former Quimigal chemical plant) to water quality now suitable for swimming. The activity lasted two months and supported 20 vocational students' preparation for professional internships and final assessments, targeting students, teachers, and community members.

Using AI tools (ChatGPT, Perplexity, machine learning platforms), students researched reference values, validated analytical methods, and investigated water quality parameters including temperature, pH, salinity, nitrites, and ammonia. Thanks to the school's proximity to the river, students collected samples directly from the estuary during class. In Chemical Analysis classes, they performed volumetric and potentiometric analyses (acid-base, redox, precipitation titrations), then used machine learning decision tree models to classify water as "healthy" or "polluted." The OSA concluded with an AI-assisted water quality assessment and a school exhibition where students presented their findings.

e) Turkey

- **OSA "Wet Road Warning System - Mini Smart Road" (Green Deal/ Digitalization)**

This OSA at Kayı Middle School emerged from student discussions about local environmental and safety problems, with accidents caused by slippery roads identified as a relevant and tangible issue in their community. The two-months OSA used existing networks between Hacettepe University staff and science teachers, was framed as an innovative STEM learning opportunity, and aligned with national curriculum objectives for digital competencies. Ten middle school students worked with teachers, parents, and IT experts to develop a functional sensor-based model system using Arduino microcontrollers to detect road slipperiness and alert drivers.

During preparation, students received Arduino programming and sensor integration workshops, then constructed physical road models using cardboard and foam. They programmed Arduino microcontrollers to activate warning mechanisms (flashing LEDs or buzzers) when sensors detected wetness above predetermined thresholds. Students engaged in iterative testing, experimenting with moisture levels and continuously modifying code, with ChatGPT providing debugging support and helping them understand programming logic.

The activity culminated in a school-wide demonstration where students presented functional prototypes to teachers, peers, and families.

- **OSA "From tea pulp to compost" (Green Deal)**

This term-long OSA at Maya Schools Oran Campus was implemented within the ICSE Science Factory framework with support from Önce Öğretmen Foundation, which provided tailored educational materials including lesson plans, composting guides, and activity sheets. The project engaged ten 1st-grade students (ages 6-7) alongside teachers, parents, school administration, cafeteria staff, and Çiğdemim Foundation, which will receive the donated compost.

Students learned about the tea plant, recycling, and composting through activities covering tea's journey from garden to pulp, organic waste types, and their role among recyclables. An online parent meeting introduced the project, and promotional posters engaged the school community. Students collected nitrogen-containing waste (tea pulp from home and school, eggshells, apple peels from the cafeteria) and carbon-containing materials (wastepaper from classrooms, forest materials from the school garden). After making informative

presentations to older grades requesting contributions, students and teachers cut materials into small pieces and added them to a one-cubic-meter compost bin in the Environmental Laboratory.

The mixing and moistening process is ongoing, with compost expected after 2-3 months to be donated to Çiğdemim Association.

- **OSA "Healthy Nutrition Assistant - Scratch Project" (Health/ Digitalization)**

This three-month OSA at Kayı Middle School was introduced through established Hacettepe University-school teacher networks, emphasizing its interdisciplinary nature integrating health, ICT, and science as an innovative educational opportunity. The free, student-friendly Scratch platform and focus on 21st-century skills (digital literacy, critical thinking) facilitated school engagement. Nine middle school students worked with teachers, families, and support from Hacettepe University and a healthy nutrition center.

Students explored food groups, caloric values, and nutritional components by researching commonly consumed meals, then created Scratch applications displaying detailed nutritional information when users clicked on dishes. After awareness sessions on healthy eating using posters, videos, and presentations, students selected 3-5 meals from homes or the school cafeteria and researched nutritional data using reliable sources like the national health database. They developed simplified Scratch interfaces triggering nutritional value displays.

Support included teacher guides, nutrition data templates, example Scratch projects, and online mentoring sessions. Strategic grouping and templates addressed varying digital skill levels, while curated resource lists solved database access challenges. The OSA culminated in a school science fair presentation.

5. Defining a Service Package for Schools

5.1. Evidence from Implemented OSA

The systematic analysis of the fifteen activities implemented in Croatia, Cyprus, Germany, Portugal, and Turkey revealed consistent and recurring patterns that enabled the development of a conceptual framework for the OSA Service Package that addresses two critical features: (1)

strategies to win schools and (2) mechanisms to support schools throughout their OSA (Figure 2).

a) Strategies to Win Schools

Analysis of the implemented OSA shows that some engagement strategies consistently succeeded while others failed, regardless of how promising they appeared. This section examines five approaches that proved effective in practice, drawing on real evidence from the documented activities to show works and what does not.
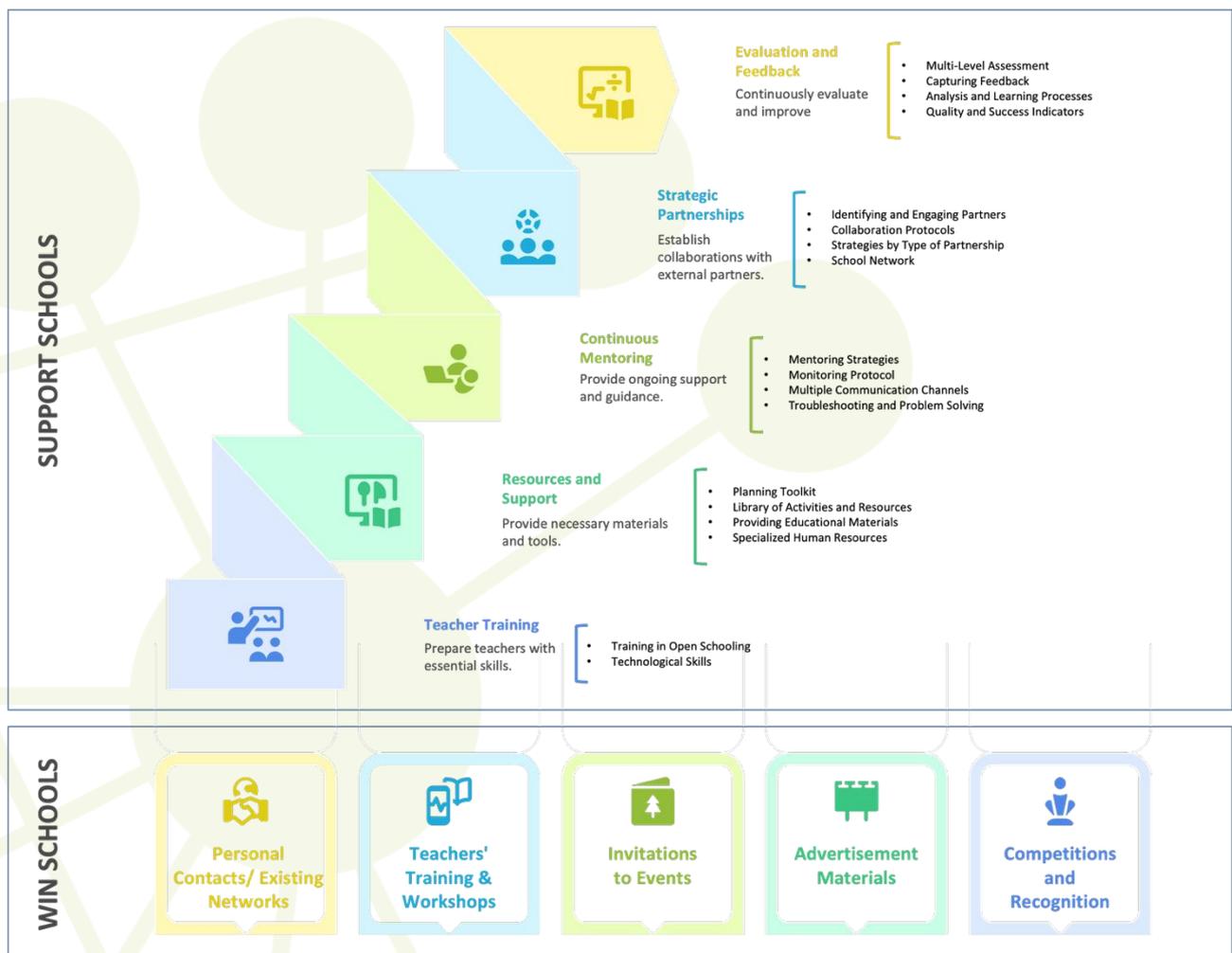
Figure 2. ICSE Factory Service Package for Schools.

- **Personal Contacts and Use of Existing Networks**

Personal connections proved far more effective than any formal recruitment strategy. The German OSA "Designing Jigsaw Lamps" succeeded by directly contacting a math club teacher, while extensive promotional efforts- posters, flyers, newsletters, conventions, and science festivals- produced nothing. The "Dysphagia-Cooking" OSA had similar results through personal contacts. Both found that "it is easier to convince teachers on a content-related level by talking about what a project could look like in terms of content, and not about the general concept of Open Schooling".

Long-term institutional partnerships built on these personal relationships created even stronger foundations. Croatian activities like "SOS.petagimnazija" and "Can we Ignore Microplastics?" drew on existing ICSE Science Factory connections, as did the Portuguese OSA. These established relationships meant trust already existed, communication was straightforward, and OSA could start quickly. The Cypriot "Interactive Botanical Garden" shows this perfectly: the teacher had attended training programs, built connections with the team, and confidently ran the project independently without needing ongoing support.

- **Teachers' Training and Workshops**

Teacher training proved another key strategy. Portugal developed two 100-hour professional development programs during the OSA implementation phase that offered career progression credits. Teachers who participated in the training subsequently developed several OSA in their schools, including "Estuary Water Quality", "Classroom Environment", and "Recycling Robot". The Cypriot "Interactive Botanical Garden" and "Thermal Heat Island" activities followed a similar approach, with participating teachers having attended training programs that gave them both conceptual understanding and practical skills for designing activities and managing partnerships.

The value of training extended beyond initial recruitment. When Portuguese students in the "Estuary Water Quality" OSA struggled to find reference values for estuarine waters, the training relationship meant project members could step in quickly, introducing Perplexity as a better research tool. Training worked because it addressed real gaps: many teachers simply do not know how to develop partnerships, implement inquiry-based learning, or engage communities effectively. The training filled these gaps while showing teachers that OSA are doable. Offering recognized credits for career progression made participation even more attractive.

- **Invitations to Lighthouse Activities and Science Fairs**

Science fairs and exhibitions provided platforms for showing Open Schooling work, though they worked better for validation than recruitment. Croatian OSA participated in the national ICSE science fair, with "SOS.petagimnazija" and "Sustainable School of the Future" both winning best project awards. German activities presented at the ICSE Science Factory fair, and Portuguese students shared their "Estuary Water Quality" findings at a school exhibition.

A clear pattern emerged: schools presenting at fairs were already deeply engaged before participating. These events celebrated existing commitments rather than creating new ones. Whether observing presentations inspires other schools to start OSA remains unproven in the documentation.

However, the Cypriot "Green City" summer school tried something different: students enrolled voluntarily in an intensive program without requiring their schools to commit. But it is uncertain whether summer enthusiasm translates to regular school implementation.

- **Advertisement and Promotional Materials**

According to the reports, generic promotional materials proved to be ineffective for recruiting schools. Both German activities "Designing Jigsaw Lamps" and "Dysphagia-Cooking" reported the same result: comprehensive promotion through "posters, flyers, our newsletter, at a convention with the partner schools and at a public science festival" yielded nothing. Direct contact with individual teachers, however, successfully recruited participants.

The reasons for this failure are probably related to the fact that schools face constant requests to join external programs, making generic materials easy to dismiss. Teachers need personalized assurance that an activity will work in their classroom with their students. Promotional materials cannot answer questions, address concerns, or adapt to specific contexts the way personal conversations can.

Still, promotional materials served other purposes. They gave legitimacy to teachers already recruited personally, helped share project results with wider audiences, and created visibility with institutional stakeholders.

- **Competitions and Recognition**

Recognition through competitions and awards provided valuable validation for participating schools, though documented evidence suggests they function more as celebration mechanisms than primary recruitment tools. Croatian OSA "SOS.petagimnazija" and

"Sustainable School of the Future" both won best project at the national ICSE science fair, while the German "School Garden at IKG" received the Schulhofträume prize from Deutsche Kinderhilfswerk.

However, the timing reveals a limitation: schools were already committed before winning awards. They did not join Open Schooling to compete- their work simply became suitable for competition. Awards might function differently if announced before projects start, especially if offering financial or material resources that address schools' real constraints although no evidence were collected to support this approach.

b) Mechanisms to Support Schools

Regarding the mechanisms to support schools throughout their OSA, and as illustrated in Figure 2 this framework is based on five dimensions that illustrate the identified patterns of the OSA and that are described below.

- **Dimension #1: Teacher training**

The analysis of the 15 OSA demonstrates that teacher preparation is crucial to success.

Training in Open Schooling

Teacher training took different forms. Portugal and Cyprus used structured programs with officially recognized credits for career progression. Portuguese teachers completed 100-hour professional development leading to activities like "Estuary Water Quality" and "Recycling Robot" and Cypriot teachers attended ICSE training programs that enabled independent OSA development. Other countries took flexible approaches. Germany adapted training to specific needs. For example, the teacher who implemented the OSA "Dysphagia-Cooking" attended a specialized cooking course matching the activity's focus. Croatia built on teachers' existing project-based experience and university connections. Turkey used focused intensive workshops. Both strategies worked: structured programs prepared teachers systematically with career incentives, while flexible training adapted to specific contexts and existing expertise.

Technological Skills

Technical skills proved challenging in nearly half the OSA, showing teachers need practical technology training. This training has two goals: building basic expertise to help students

troubleshoot problems and developing confidence to learn alongside students. The Turkish "Mini Smart Road" project shows how focused micro-training works. Many students and teachers did not know Arduino or basic electronics, so training covered software installation, basic code structure, and troubleshooting like checking connections when sensors did not respond. Code templates gave students starting points to adapt, speeding up progress. Using ChatGPT for debugging helped fill technical gaps. The Turkish "Healthy Nutrition Assistant" took a different approach: training emphasized that not knowing everything was normal. Teachers practiced exploring Scratch with students, modeling how to check documentation and experiment. This made not-knowing legitimate and turned errors into learning opportunities. The Cypriot "Interactive Botanical Garden" shows that technical skills go beyond coding: students created QR codes and developed business concepts, which required teachers to learn simple tools and frameworks they could then facilitate without being experts.

- **Dimension #2: Resources and Support**

All OSA depended on adequate material, pedagogical, and technical resources. Nearly half faced equipment limitations, highlighting the need to ensure schools have necessary means.

Planning Toolkit

Structured planning tools proved essential for running OSA. The Portuguese "Classroom Environment" used templates to help three teachers to coordinate across five disciplines, namely in identifying contributions, creating integrated calendars, and establishing synthesis moments. Planning tools also compensated for limited support: the Cypriot teacher that run the OSA "Interactive Botanical Garden" worked alone but successfully integrated multiple dimensions using ICSE frameworks and templates that were accessible through initial ICSE Science Factory training. Another example is the Croatian OSA "Sustainable School of the Future" that shows how tools manage extended timelines: this six-month project used systematic milestones from establishing goals (Month 1) through 3D modeling and construction (Months 2-4) to completing the Minecraft design and presentations (Months 5-6). This illustrates how such complex coordination benefits significantly from structured planning tools.

Library of Activities and Resources

Quality educational materials proved to be essential across most OSA. The Turkish activity "Healthy Nutrition Assistant" used teacher guides, nutritional data templates, and Scratch

examples that helped students with different programming skills to progress at their own pace. Templates saved research time by providing ready-made structures for organizing nutritional information, while guides emphasized that teachers not knowing everything upfront was normal and even valuable. The German OSA "Designing Jigsaw Lamps" provided materials, visual examples of existing puzzle lamps, and guidance on iterative design. Students analyzed connection mechanisms and ornamentation patterns before developing their own designs. The OSA "Can we ignore microplastics?" (Croatia) benefited from specialized training materials, including statistical methods that enabled rigorous research recognized at the national ICSE Science Fair. However, gaps remained: the Portuguese OSA "Classroom Environment" would have benefited from documented troubleshooting procedures for Arduino sensors, reducing reliance on external support.

Providing Educational Materials

Material resources proved to be fundamental for OSA success. Three strategies worked: supplying specialized materials schools lack, providing complete equipment kits that stay permanently, and organizing simple resources on time. The OSA "Dysphagia-Cooking" implemented in Germany needed specialized binding agents, silicone molds, precision scales, and specialist literature. ICSE Project provided these, enabling students to prepare meals for elderly residents with swallowing difficulties. The Turkish OSA "Wet Road Warning System" shows another approach: Hacettepe University supplied complete Arduino kits with sensors, components, and cables that remained in the school afterward, creating sustainable capacity. Similarly, the Cypriot OSA "Thermal Heat Island" needed digital temperature sensors and data loggers for students to investigate urban heat over six months. UNIC and CPI provided this equipment, enabling authentic research across different locations and times rather than simplified simulations.

Specialized Human Resources

Access to specialized expertise was essencial because 10 of the 15 OSA identified external experts as key success factors, while 8 mobilized diverse community members. The Croatian OSA "Can we ignore microplastics?" depended on a biology professor from the Faculty of Science, Zagreb, who trained students in sampling, filtering, and analyzing microplastics. Similarly, the activity "SOS.petagimnazija" developing a mental health platform needed dual expertise: a psychology professor that guided students on psychological dimensions, while a computer science specialist provided technical app development guidance.

Community mobilization also proved valuable. The activity "Dysphagia-Cooking (Germany) drew on cafeteria staff for waste collection, canteen personnel for logistics, and nursing home residents as final participants. Teacher's in home economics and care homes provided essential disciplinary expertise.

- **Dimension #3: Continuous mentoring**

Most OSA required external expertise beyond what schools could provide. Ten activities identified external specialists as key success factors, while eight mobilized diverse community members for essential support.

Mentoring Strategies

Clear mentorship support prevents teachers from feeling isolated when problems arise. Without explicit responsibility assignment and communication channels, teachers do not know whom to contact for help. Successful mentorship balances accessibility with sustainability, ensuring responsive support without overwhelming mentors.

Naturally, different contexts require different mentoring setups. For example, the OSA "Green City" (Cyprus) used intensive mentorship: two visiting physicists worked with 15 students over five days. On the other hand, the German OSA "School Garden at IKG" used intermittent mentorship over two years: external experts provided concentrated input at critical moments. Also, the Portuguese "Recycling Robot" OSA used co-design mentorship: IE-ULisboa facilitators worked with teachers to create worksheets and guides together and the Turkish activity "Healthy Nutrition Assistant" combined online mentoring sessions with asynchronous support through guides and a designated contact person, accommodating teacher schedules while maintaining accessibility.

Monitoring Protocol

Regular monitoring ensures that support does not depend only on teachers asking for help. Proactive check-ins identify problems before they escalate and normalize support as standard practice. In this sense, in the Turkish OSA "Wet Road Warning System" email and video conferences were combined: quick Arduino questions were answered via email with photos, while complex programming issues needed video calls where mentors viewed code in real-time.

Also, monitoring intensity can be adjusted based on teacher experience as ir happened in the German OSA "Dysphagia-Cooking" that needed less intensive support because the teacher had professional background in home economics and care homes, but channels remained open for guidance when necessary. However, long projects benefit from phase-based monitoring: the OSA "Sustainable School of the Future" (Croatia) developed for six months with distinct phases- checking milestone completion and identifying blockers before transitions proved more useful than generic biweekly check-ins.

Multiple Communication Channels

Successful mentoring uses multiple communication channels for different needs. Real-time communication helps with immediate problems. For instance, when the Portuguese participating students in the "Estuary Water Quality" OSA struggled to find estuarine parameter values, IE-ULisboa members helped them to overcome this issue. In general, face-to-face worked better for hands-on skills: in the German OSA "Designing Jigsaw Lamps", a scientist made two Saturdays visits to demonstrate plotter operation directly, enabling students to handle materials and get immediate feedback on prototypes. Also, asynchronous channels provided flexible support. The Cypriot OSA "Thermal Heat Island" used scheduled email and video check-ins with a designated contact person, allowing teachers to seek help on their own schedules while maintaining regular touchpoints.

Troubleshooting and Problem Solving

All OSA encounter obstacles, but good mentoring teaches teachers to diagnose issues and find solutions rather than solving problems for them. As such, in the OSA "Mini Smart Road" (Turkey) students struggled with Arduino and coding. Instead of providing ready solutions, mentors simplified code structures, provided templates, and showed students how to use ChatGPT for debugging. This taught both technical skills and critical thinking about AI tools. Also, in the Portuguese activity "Estuary Water Quality" students faced different challenges as they could not find reference values for estuarine waters because searches returned drinking water standards instead. To solve this problem, mentors introduced Perplexity as a better research tool and taught advanced search strategies, helping students develop more sophisticated search skills.

- **Dimension #4: Strategic Partnerships**

Analysis of OSA showed that partnerships with external stakeholders were fundamental across most activities: personal contacts helped establish collaborations, while local relevance facilitated stakeholder engagement.

Identifying and Engaging Partners

Teachers often do not know what resources exist locally or recognize connections through informal networks. Structured partner mapping makes these opportunities visible. In the Cypriot "Green City" OSA students related to visiting physicists. The Croatian microplastics activity accessed a biology professor for scientific sampling training and the Portuguese OSA "Estuary Water Quality" benefited from IE-ULisboa collaboration through ICSE Science Factory partnerships.

However, building successful partnerships requires specific skills and strategies. As such, the Croatian OSA "Sustainable School of the Future" framed collaboration as mutual benefit because partnerships work better as shared challenges than as one-way requests: the invited architect gained user perspectives and Peovica company demonstrated sustainability commitment through visible projects.

Beyond framing partnerships as mutual benefit, successful engagement requires adapting communication to different audiences. The German "Dysphagia-Cooking" OSA adapted communication to different audiences: parents heard about professional competencies, administration about curriculum, staff about logistics, residents about social dimensions. In general, personal contacts often work better than public promotion, as reported in the German "Designing Jigsaw Lamps" OSA. Finally, parental involvement depends on student age: in the Turkish activity "From Tea Pulp to Compost" with 6-7 years old children multiple communication channels were used because young kids struggle to communicate project details. In the case of the OSA "SOS.petagimnazija" (Croatia) with 17-18 year-olds minimal parental involvement was needed and students managed everything independently.

Collaboration Protocols

The establishment of explicit agreements between schools and external partners prevents misunderstandings that can deteriorate relationships and even compromise activities. External partners often lack familiarity with school dynamics, while teachers may not understand professional partners' expectations. As such, defining mutual expectations at the beginning establishes the basis for effective partnerships

Emphasizing reciprocal benefits proved essential in the Croatian OSA "The Sustainable School of the Future", where collaboration was framed as a shared challenge rather than a request for help. The architect gained unique professional perspectives while the enterprise demonstrated commitment to urban sustainability. Similarly, the Cypriot OSA "Interactive Botanical Garde"" connected with traditional local knowledge through culturally relevant aromatic plants, though formal participation of community experts would have properly acknowledged their contributions and respected cultural ownership.

Finally, the German "Dysphagia-Cooking" OSA illustrated the need for sophisticated coordination when managing multiple stakeholders, involving students, teachers, nursing home residents, and specialized suppliers across a complex network with diverse needs and expectations.

Strategies by Type of Partnership

Different types of partners require distinct approaches because they have diverse motivations, constraints, and organizational cultures.

University partnerships in sensitive areas demand careful ethical frameworks, as exemplified by the Croatian OSA "SOS.petagimnazija". Collaboration with psychology professor proved to be essential for the mental health activity, providing not only technical knowledge but also guidance on data collection, confidentiality, and communication when working with vulnerable populations.

Intensive but temporally limited partnerships can be effective when specific expertise is needed at specific phases of the OSA. For instance, the German activity "Designing Jigsaw Lamps" exemplified this approach, where an ICSE scientist made two visits to work on Catalan solids, providing concentrated expertise within clearly defined expectations.

Lastly, community organization partnerships create authentic purpose for student work. The Turkish "From Tea Pulp to Compost" OSA collaborated with Çiğdemim Foundation, which received the final product, creating genuine reciprocity where both parties benefited meaningfully.

School Network

School networks for OSA implementation work well because teachers learn better from peers who have dealt with the same problems. Sharing resources and solutions helps reduce isolation and builds momentum for Open Schooling initiatives.

Science fairs help schools to connect, but these connections usually fade without proper follow-up. At a national fair in Croatia, students from the "Can We Ignore Microplastics?" OSA presented their findings and met others working on similar topics. A formal network could have turned those brief encounters into ongoing collaborations - teachers comparing microplastic data across regions or organizing joint events together.

- **Dimension #5: Evaluation and feedback**

Analysis of OSA showed that assessment and feedback mechanisms are essential for continuous improvement: Open Schooling needs evaluation that recognizes recognizing collaboration, process, and community impact. The aim is to capture learning, celebrate successes, understand challenges, and improve future implementations.

Multi-Level Assessment

Multi-level assessment proved necessary because Open Schooling involves different objectives and stakeholders: test scores alone ignore competency development, partnerships, and community impact.

Additionally, process matters as much as results. In Portugal's OSA "Classroom Environment", when students struggled with data interpretation, teachers added statistics to math lessons and that adaptive response is valuable learning that final outcomes would not show. Awards validate work but miss details. German OSA "School Garden at IKG" won national prizes for the restored garden, giving outside recognition but prizes focused on visible outputs.

To sum up, good assessment needs varied approaches. Cypru's "Thermal Heat Island" students collected temperature data and presented at conferences. The strongest indicator of learning was students' desire to publish their findings and collaborate with university researchers which demonstrated that they had developed authentic scientific identity rather than simply completing assignments.

Capturing Feedback

Effective feedback requires multiple sources and timing: end-of-project surveys miss adjustment opportunities, while single-source feedback overlooks other perspectives.

Turkey's OSA "Wet Road Warning System" shows how multiple viewpoints strengthen findings. Students reported increased science interest while teachers observed more participation and this convergence validates motivational impact. Also, external evaluation adds expert perspectives but has limitations. The activity "Sustainable School of the Future"

(Croatia) won at the national science fair, yet jury members only saw hours of presentation rather than months of learning, and their criteria may not align with pedagogical goals. In fact, the most authentic validation comes from end-users as illustrated in Germany's OSA "Dysphagia-Cooking", where nursing home residents gave feedback on meals that students prepared. Their satisfaction proved students had developed real competency - creating food that met medical requirements while remaining enjoyable, testing whether skills work in practice rather than just theory.

Analysis and Learning Processes

Feedback only matters if it leads to actual improvements because without systematic analysis, it just piles up without changing anything.

In fact, implementation problems reveal useful insights. In Portugal's OSA "Estuary Water Quality", students could not find reference values using traditional tools, so researchers introduced Perplexity AI, which worked better for specialized searches and that might be a practical lesson worth sharing with other projects. Also, teaching strategies that emerge cal for closer examination. In the German OSA "Designing Jigsaw Lamps", the scientist let students develop prototypes through trial and error before discussing principles. This productive failure worked, but raises questions: when does struggle help versus frustrate? What support kept failure from leading to giving up? Understanding this helps future mentors know when to use the strategy.

Understanding what works well matters too. As an example, the OSA "From Tea Pulp to Compost" (Turkey) reported no challenges, crediting strong school support with resources, time, and space. The simple lesson that can be learned is that institutional commitment makes projects run better.

Quality and Success Indicators

Quality indicators help assess whether OSA achieved its goals, enable comparisons across contexts, and demonstrate value. External validation like awards provides objectivity: Croatia's "SOS.petagimnazija" won best project at the national science fair, giving clear recognition. But awards have limitations because they celebrate exceptional work while ordinary projects may still meet important goals, jury criteria do not always match Open Schooling priorities, and they judge final outputs rather than learning processes.

Qualitative indicators often reveal impact that numbers miss. For exemple, in the OSA "Wet Road Warning System" (Turkey), students said they were surprised that coding could affect

real situations, while parents appreciated the practical focus. These perception changes are indicators of genuine impact even when not easily quantifiable - student surprise suggests they fundamentally changed how they understood coding's purpose and utility. Participation in academic venues also indicates quality. Students that participated in Germany's OSA "Designing Jigsaw Lamps" presented a poster at an international conference and published in the Bridges Conference Proceedings, showing their work met standards for specialist audiences. Though such indicators should be paired with evidence of what students learned through the experience, not just that they participated.

6. Recommendations & Guidelines

Based on the systematic analysis of the OSA implemented across five partner countries, this section presents evidence-based recommendations and practical guidelines for schools, educators, and project coordinators seeking to implement successful OSA. These recommendations address both the recruitment phase (winning schools) and the implementation phase (supporting schools) that constitute the Service Package for Schools.

6.1. Recommendations for Winning Schools

The data collected reveals that personal relationships matter far more than promotional campaigns. Across all partner countries, schools that joined OSA did so because someone they trusted approached them directly. Meanwhile, carefully designed promotional materials like posters, flyers and newsletters consistently failed to generate interest. A probable reason is because teachers face constant requests to join external programs and need personalized assurance that activities will actually work in their classrooms. This strategy requires mapping existing connections, organizing informal meetings for genuine dialogue, and focusing conversations on specific content rather than abstract concepts. Peer-to-peer recruitment amplifies this effect, as teachers trust colleagues who have successfully implemented OSA. The focus on personal relationships reflects findings across previous European projects. For example, the Make it Open project found that schools joined OSA through trusted connections rather than promotional materials, leading their Strategic Plan (Make it Open, 2022, p.37) to prioritize existing networks and "change agents", i.e., teachers who promote internally for the initiative. The MULTIPLIERS documented the same pattern, showing that personal visits from project

leaders substantially increased engagement compared to remote communication (Multipliers, 2023).

Teacher training functions simultaneously as preparation and recruitment. Professional development programs that offer career progression credentials while addressing real gaps equip teachers with necessary competencies. Training should combine theoretical frameworks with practical skills, include ongoing mentoring beyond initial sessions, and create learning communities for sustained peer support. The recognition that teacher training serves both preparation and recruitment functions is validated by other previous Open Schooling projects. Make it Open organized training programs that simultaneously introduced open schooling concepts and recruited committed schools, offering professional development through Erasmus+ schemes as tangible incentives (Make it Open, 2022, p.37). MULTIPLIERS specifically noted that participating teachers valued acquiring knowledge and expertise in developing Open Schooling educational materials and saw the project as contributing to their professional growth (Multipliers, 2022). Finally, the SLEs project emphasizes supporting teachers through workshops, recognizing that well-supported teachers become promoters for OSA (SLEs, 2024a).

Successful OSA connect directly to existing curriculum requirements rather than adding extra work to full schedules. When activities address locally meaningful issues, students engage differently. When recruiting schools, it should be emphasized how OSA fit naturally into existing subjects, meet learning objectives teachers must already fulfill, and connect to issues students see in their everyday lives. Schools need flexible models they can adapt, not rigid prescriptions. Once again, this recommendation aligns with former Open Schooling projects: for example, Make it Open developed flexible paths (light, medium, and in-depth) that schools could adapt to their existing structures, and activities that fit naturally into existing subjects (Make it Open, 2022). In the MULTIPLIERS project, participants appreciated how the project promoted a real-life context in learning that aligned with required learning objectives (Multipliers, 2022).

Science fairs and exhibitions work better for celebrating existing work than recruiting new participants. They serve important functions when combined with authentic classroom visits, structured follow-up protocols, and direct connections with implementing teachers who can share realistic experiences including challenges. The observation that science fairs work better for celebrating existing work than recruiting new participants aligns with the Make it Open project that included final events with awards to recognize innovative projects, positioning these as culmination points rather than entry points (Make it Open, 2022). Similarly, MULTIPLIERS' multiplier events serve to showcase student work to the community (Multipliers, 2024c,).

Schools are increasingly attracted to programs that prepare students for digital futures. ICSE Factory's integration of AI tools, sensors, and Machine Learning platforms offers tangible 21st-century skills that appeal to both teachers seeking professional development and schools aiming to modernize their curricula. This technological focus, combined with critical thinking about AI use, distinguishes ICSE Factory from other projects.

6.2.   Recommendations for Supporting Schools

Teacher preparation proved crucial across two main areas. First, training in Open Schooling principles can take different forms: structured programs with recognized credentials for career progression, or flexible approaches adapted to specific needs and existing teacher expertise. Second, technical skills training addresses the challenges nearly half the OSA faced with technology. This training has two goals: building basic expertise to help students troubleshoot problems and developing confidence to learn alongside students. This is consistent with the strategic plan of the Make it Open project that explicitly states: "Part of the initial role of the hub coordinator with schools is to introduce open schooling to them and train them on the materials we have produced as a project" (Make it Open, 2022, p. 43). Likewise, the SLEs project recommends "comprehensive training programs for teachers to facilitate their engagement with multiple stakeholders" (SLEs, 2024a, p. 6).

Schools need practical tools: planning toolkits with adaptable templates, activity libraries documenting complete OSA implementations, technology-specific tutorials, and appropriate strategies for providing materials. Sometimes schools need specialized items they cannot obtain locally; other times complete equipment kits build sustainable capacity; and sometimes they just need guidance on gathering resources through normal channels. This need for comprehensive and adaptable resources is also evidenced by how MULTIPLIERS developed comprehensive toolkits including "examples of tools for students and teachers to promote authentic scientific activities outside the classroom, activities to promote and scaffold students' inquiry, modelling and argumentation skills" (Multipliers, 2024a, p. 6).

Ongoing mentorship prevents isolation when problems arise. Designated mentors with clear responsibilities, multiple contact methods, and proactive check-ins work better than vague offers to help. Mentoring intensity should flex based on implementation phase and teacher experience, with pathways for experienced teachers to mentor newcomers. This structured approach to mentorship is validated across European projects. For example, SLEs emphasizes "mentoring programs in the form of a peer-to-peer support system can be established, allowing

students but also teachers to benefit from one-to-one support and guidance from industry professionals, university faculty, or public authority representatives" (SLEs, 2024b, p. 24).

Most OSA require external expertise beyond what schools can provide independently. Supporting schools in finding and working with partners requires maintaining databases of willing collaborators and clear protocols specifying contributions, timelines, and communication. Different partnership models fit different situations: intensive short-term involvement, periodic consultation, or ongoing collaboration. Framing partnerships around mutual value rather than one-way requests increases meaningful engagement. Evidence from European projects confirms these partnership principles: MULTIPLIERS recommends to have members and stakeholders actively participate in putting together OSA because it makes everything more authentic, brings fresh perspectives to the table, and allows close connection with students (Multipliers, 2023,), while quantitative validation comes from SLEs evaluation data showing that "Partnerships with other stakeholders provided educators with valuable resources, expertise, and real-world connections for students' STE(A)M learning experiences" with a rating of 4.88/5 (SLEs, 2024b, p. 61).

Evaluation for Open Schooling must assess multiple dimensions: student learning, implementation process quality, community impact, and support effectiveness. This requires collecting feedback from multiple stakeholders at different points using varied methods, then conducting regular analysis cycles to identify lessons that apply elsewhere. These evaluation principles are comprehensively implemented across European projects: for example, SLEs' Learner Engagement Evaluation Methodology (SLEs, 2023) provides detailed frameworks for evaluating student learning, implementation process quality, and community impact.

Simply connecting schools does not create lasting networks. What works is systematic organization: scheduled meetings with defined goals, online spaces for ongoing communication, and chances to work together on shared challenges. When these structures are absent, initial enthusiasm quickly dissipates and schools drift back to isolation. Recognizing this challenge, MULTIPLIERS developed the "5 Co-Model" specifically addressing this through structured Communication, Coordination, Collaboration, Costs, and Collection of Materials (Multipliers, 2024c). Their recommendations include: "Communicate and interact regularly with all the OSC members, online and in person, by using multiple activities and interventions" (Multipliers, 2024b, p. 22).

7. Conclusions

This document presents the Service Package for Open Schooling developed within the ICSE Science Factory project. Through systematic analysis of OSA implemented across five partner countries, patterns emerged that enabled the development of a comprehensive framework addressing two critical dimensions: strategies for win schools and mechanisms for supporting them throughout implementation. The Service Package addresses both aspects systematically. For winning schools, it provides evidence-based strategies emphasizing the establishment of relationships and the connection to local issues. For supporting implementation, it offers structured guidance on teacher preparation, resource provisioning, mentoring protocols, partnership development, and assessment frameworks.

The analysis drew on implementation experiences from OSA that far exceeded project targets, with over 200 activities implemented compared to the projected target. These activities engaged diverse participants across all age groups and addressed the three priority themes: Green Deal, Health, and Digitalization.

A defining characteristic of the ICSE Factory approach is its pioneering integration of AI and emerging technologies as core pedagogical tools, transforming students from passive technology consumers into critical evaluators and competent users of these tools. While Make it Open combines maker education with community problem-solving through physical prototyping, MULTIPLIERS focuses on transforming students into science communicators within their communities, and SLEs emphasizes building collaborative learning networks across formal and informal settings, ICSE Factory distinguishes itself through systematic integration of AI tools, Machine Learning platforms, and other technologies into the scientific inquiry process. This technological sophistication - evident in students using ChatGPT and Perplexity for research validation, programming Arduino sensors for environmental monitoring, and applying Machine Learning models for water quality classification - represents a significant advancement in Open Schooling. Furthermore, ICSE Factory's structured approach combining high-capacity cross-sectoral partnerships with public science conventions and fairs creates unique knowledge dissemination mechanisms. Unlike Make it Open's focus on maker spaces, MULTIPLIERS' emphasis on peer-to-peer science communication, or SLEs' concentration on learning continuities, ICSE Factory specifically develops students' capacity to critically evaluate AI-generated information while conducting authentic scientific investigations. This combination of advanced digital literacy, challenge-driven innovation, and systematic mentoring through diverse partnerships positions ICSE Factory as a distinctive model for preparing students for increasingly digitalized scientific futures while maintaining critical thinking and scientific rigor.

7.1. Contribution to Project Objectives

The Service Package contributes directly to WP2's objective of encouraging schools to run open schooling activities within their communities. By documenting what works in recruiting and supporting schools, this deliverable transforms isolated experiences into transferable knowledge that others can apply.

The contribution manifests in several concrete dimensions. For school recruitment, the evidence clearly shows that personal networks and professional development programs work far better than promotional campaigns. The distinction between what sounds promising and what works in practice proves valuable for anyone planning to engage schools in OSA. In fact, Make it Open's emphasis on "change agents" and internal networks (Make it Open, 2022, p.37) and MULTIPLIERS' successful use of personal visits from project leaders (Multipliers, 2023) the same message: personal relationships beat mass marketing every time.

The five-dimensional framework provides schools with practical implementation support that addresses real challenges schools face. Teacher preparation necessarily extends beyond Open Schooling principles to include technical competencies, as evidenced by Make it Open's training camps which integrate both pedagogical and technical components (Make it Open, 2022). Furthermore, schools require comprehensive support systems comprising planning toolkits, activity libraries, and material provisioning strategies. The MULTIPLIERS project demonstrates this approach through their extensive toolkits that facilitate the transition from theoretical understanding to practical application (Multipliers, 2024a, p.6).

Effective mentoring structures necessitate clearly defined responsibilities and systematic check-ins. This structured approach is evident in Make it Open's bi-monthly Hub calls and Slack groups (Make it Open, 2022, p.41) and MULTIPLIERS' regular meetings with members of the Open Schooling community. Partnership development similarly requires established protocols and frameworks that articulate mutual benefits for all stakeholders.

Assessment methodologies must expand beyond traditional academic metrics to encompass collaboration skills, process-based learning, and community impact. SLEs addresses these multifaceted assessment needs through their Learner Engagement Evaluation Methodology (SLEs, 2023), while Make it Open implements longitudinal surveys and quarterly reports (Make it Open, 2022, p.46) to capture comprehensive project outcomes from multiple perspectives.

Perhaps most importantly, the Service Package demonstrates that successful Open Schooling does not require exceptional circumstances or extraordinary resources. What matters is

collaboration built on trust through sustained relationships, authentic problems, integration into existing structures rather than addition of new burdens, and flexibility to adapt general frameworks to specific contexts. This conclusion is reinforced by MULTIPLIERS' "5 Co-Model" for sustainable networks (Multipliers, 2024c) and Make it Open's emphasis on utilizing existing school networks (Make it Open, 2021, 2022).

7.2.   Looking Forward

The Service Package provides a foundation for sustained Open Schooling beyond the formal project period, and several elements support this sustainability. The distinction between approaches that work and those that do not prevents wasted effort on ineffective strategies. The framework's flexibility allows adaptation to diverse contexts while maintaining core principles. Investing in teacher development and establishing networks creates conditions for activities to continue without permanent external support.

The real test will be whether the partnerships, training programs, and networks established during implementation continue generating new OSA. Evidence from the documented activities suggests this is achievable. Teachers who participated in professional development programs went on to develop multiple OSA independently. Partnerships between universities and schools extended beyond initial formal activities. Materials and protocols created for one context were successfully adapted and reused in others.

This deliverable supplies practical tools and realistic strategies that others can take and adjust to their circumstances, building on the foundation established by pioneering European initiatives like Make it Open, MULTIPLIERS, and SLES. Make it Open combines maker education with open schooling to tackle community challenges; MULTIPLIERS creates partnerships where students become science multipliers in their communities; and SLES weaves together STEM and non-STEM approaches in multi-stakeholder learning ecosystems. By making these proven approaches accessible and adaptable, the Service Package advances the European vision of transforming schools into genuine community innovation hubs. It demonstrates that successful pedagogical innovation emerges when we bring together validated tools, authentic school-community partnerships, and flexible strategies that respond to local contexts, ultimately enhancing scientific literacy, developing citizenship competencies, and creating educational pathways that work in real school settings.

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9. National websites

Country	Website Address
Croatia	https://sciencefactory.math.hr/
Cyprus	https://pure.unic.ac.cy/en/projects/icse-science-factory
Germany	https://icse.ph-freiburg.de/icse-science-factory/
Portugal	https://icsesf.ie.ulisboa.pt/
Turkey	https://hstem.hacettepe.edu.tr/tr/icse_science_factory-41
International website	https://icse.eu/international-projects/icse-factory/

10. Annexes

- Annex A- List of OSA implemented, by country
- Annex B- Report template for OSA
- Annex C- OSA reports of best practices examples

Annex A

List of all OSA implemented by country

Croatia

OSA no.	Name of the OSA	Topic(s)	Duration	Total number of participants	Number of participating females	Age range of the participants	Partners involved [enterprises, etc] Associated partners	Foundational aspects (IBL, RLP, SSI, CDI)
1	With sensors to happy plants	Green deal, digitalization	1 month	9	8	11-13	FER, HMD, OS S. K. Gjalski	RLP
2	With sensors to happy plants	Green deal, digitalization	1,5 months	14	12	12-54	FER, PMF, OS V. Descak	RLP
3	Oral hygiene	Health	3 months	7	5	12-34	PMF, HMD, Dental college, OS Dragalic	IBL
4	With sensors to happy plants	Green deal, digitalization	1 month	11	8	13-14	FER, HMD, OS A.B. Simic	RLP
5	Nail polish – shiny on the outside, toxic on the inside	Health	4 months	10	5	13-14	PMF, OS S.S. Kranjcevic	IBL
6	Quality of air in Karlovac	Green deal, digitalization	10 months	8	5	12-13	PMF, OS Dubovec	RLP
7	The influence of the proximity of the river on atmospheric conditions	Green deal	4 months	5	3	16-17	PMF, Gimnazija P. Preradovica	RLP
8	What lichens tell us	Health	5 months	9	6	11-13	PMF, OS Banija	IBL
9	SOS application for newly enrolled students	Health, digitalization	6 months	8	5	16-17	PMF, V. Gimnazija	RLP
10	Sustainable school of the future	Green deal, digitalization	6 months	5	2	14	PMF, OS J. Pupacic	IBL
11	Can we ignore microplastics	Green deal	2 months	6	3	16-17	PMF, XV. Gimnazija	RLP
12	Do biometric measurements need math	Green deal	4 months	6	5	16-17	PMF, SS M Blazine Labin	IBL
13	What does light have to do with it	Green deal	2 months	15	10	11-12	PMF, OS V. Descak	IBL
14	Urban heat island effect and solutions for building smart cities	Green Deal	3 months	7	5	14	PMF, OS. S. Budinica	IBL
15	Smart piano	Digitalization	2 months	3	1	17	PMF, FER, VIDI X, Tehnicka skola Tesla	IBL
16	Retro games	Digitalization	2 months	3	0	18	PMF, FER, VIDI X, Tehnicka skola Tesla	IBL
17	Didactic aid for learning programming of microcontrollers and robots	Digitalization	2 months	7	0	18	PMF, FER, VIDI X, Gimnazija Osijek	IBL
18	Smart greenhouse	Digitalization, green deal	2 months	11	3	15-17	PMF, FER, VIDI X, Elektrostrojarska obrtnicka skola Zagreb	IBL
19	E-man, don't be angry	Digitalization	2 months	4	1	16-18	PMF, FER, VIDI X, SS Marka Marulica	IBL
20	What is sound	Digitalization	3 months	6	1	16-17	PMF, FER, VIDI X, Gimnazija Velika Gorica	IBL
21	Research robot	Digitalization	2 months	3	1	18	PMF, FER, VIDI X, Strojarska tehnicka skola F. Bosnjakovica	IBL

OSA no.	Name of the OSA	Topic(s)	Duration	Total number of participants	Number of participating females	Age range of the participants	Partners involved [enterprises, etc] Associated partners	Foundational aspects (IBL, RLP, SSI, CDI)
22	Space "umbrella"	Digitalization	1 month	12	11	17-18	High School Mate Blažine Labin	RLP
23	Making filaments from PET	Green Deal	3 months	6	2	16-17	High School Slatina	IBL, SSI
24	Sky tech (from colours to sensors)	Digitalization	6 months	9	6	13-14	Elementary School Dubovac	SSI, CDI
25	Dark facades, hot cities	Green Deal	6 months	7	5	13-14	Elementary School Josip Pupačić Omiš	IBL, SSI
26	Smoke without fire	Health	3 months	6	2	16-18	XV. Gymnasium Zagreb	IBL, RLP
27	sos.petagimnazija (follow-up)	Digitalization	3 months	8	4	16-18	V. Gymnaisum Zagreb	SSI
28	Filipović's innovators for a better neighbourhood	Green Deal	3 months	8	0	12-13	Elementary School Ivana Filipovića	RLP
29	Light pollution	Green Deal	2 months	7	7	15-17	Gymnasium Josipa Slavenskog Čakovec	IBL, RLP
30	Noise	Green Deal	2 months	3	0	15-17	Gymnasium Josipa Slavenskog Čakovec	RLP, SSI
31	Applying AI in the use of youth language	Digitalization	2 months	3	0	15-17	Gymnasium Josipa Slavenskog Čakovec	IBL
32	Climate change and nesting of birds	Green Deal	6 months	4	2	13-14	Elementary School Bogumil Toni Samobor	IBL, SSI
33	Influence of noise	Green Deal	3 months	4	2	13-14	Elementary School Bogumil Toni Samobor	RLP, SSI
34	Organic coconut and olive oil cremes	Green Deal	1 months	5	5	16-17	Prehrambeno tehnološka škola Zagreb	IBL
35	Organic soap	Green Deal	3 months	8	4	13-14	Elementary School Silvije Strahimir Kranjcevic	IBL

Cyprus

OSA no.	Name of the OSA	Topic(s)	Duration	Total number of participants	Number of participating females	Age range of the participants	Partners involved [enterprises, etc] Associated partners	Foundational aspects (IBL, RLP, SSI, CDI)
1	QR Code City Explorer	Green Deal/ Digitalization	6 months	5	3	12 to 15	Pagkyprion High School/ industry/ CPI	CDI, IBL
2	QR Code City Explorer	Green Deal/ Digitalization	6 months	5	4	12 to 15	Pagkyprion High School/ industry/ CPI	CDI, IBL
3	Green City	Green Deal/ Health	5 days	5	2	11 to 14	UNIC	SSI, PBL
4	Green City	Green Deal/ Health	5 days	5	2	11 to 14	UNIC	SSI, PBL
5	Green City	Green Deal/ Health	5 days	5	2	11 to 14	UNIC	SSI, PBL
6	Thermal Heat Island	Green Deal/Digitalization	6 months	5	4	15 to 17	Lanitio High School/ CPI/UNIC	SSI, PBL
7	Thermal Heat Island	Green Deal/Digitalization	6 months	5	3	15 to 17	Lanitio High School/ CPI/UNIC	SSI, PBL
8	Thermal Heat Island	Green Deal/Digitalization	6 months	5	2	15 to 17	Lanitio High School/ CPI/UNIC	SSI, PBL
9	Thermal Heat Island	Green Deal/Digitalization	6 months	5	4	15 to 17	Lanitio High School/ CPI/UNIC	SSI, PBL
10	Thermal Heat Island	Green Deal/Digitalization	6 months	5	1	15 to 17	Lanitio High School/ CPI/UNIC	SSI, PBL
11	Thermal Heat Island	Green Deal/Digitalization	6 months	5	3	15 to 17	Lanitio High School/ CPI/UNIC	SSI, PBL
12	Thermal Heat Island	Green Deal/Digitalization	6 months	5	2	15 to 17	Lanitio High School/ CPI/UNIC	SSI, PBL
13	Thermal Heat Island	Green Deal/Digitalization	6 months	5	3	15 to 17	Lanitio High School/ CPI/UNIC	SSI, PBL
14	Noise pollution	Health/Green Deal	3 months	5	2	17	UNIC/CPI/Partner school	RLP
15	Noise pollution	Health/Green Deal	3 months	5	2	17	UNIC/CPI/Partner school	RLP
16	Smart Energy Savers: Designing Sensor-Based Circuits for Efficient Homes	Green Deal/Digitalization	2 months	8	3	15 to 16	UNIC/CPI/Partner school	IBL
17	Interactive Botanical Garden	Green Deal/Digitalization	3 months	7	4	14	UNIC/CPI/Partner school	IBL, RLP
18	Inside Out: Exploring the Human Body, Health, and Habits with Augmented Reality	Health/Digitalization	5 days	5	3	8 to 12	UNIC/CPI/Partner summer school	IBL, RLP
19	Inside Out: Exploring the Human Body, Health, and Habits with Augmented Reality	Health/Digitalization	5 days	5	2	8 to 12	UNIC/CPI/Partner summer school	IBL, RLP
20	Inside Out: Exploring the Human Body, Health, and Habits with Augmented Reality	Health/Digitalization	5 days	6	3	8 to 12	UNIC/CPI/Partner summer school	IBL, RLP
21	Inside Out: Exploring the Human Body, Health, and Habits with Augmented Reality	Health/Digitalization	5 days	5	2	8 to 12	UNIC/CPI/Partner summer school	IBL, RLP

OSA no.	Name of the OSA	Topic(s)	Duration	Total number of participants	Number of participating females	Age range of the participants	Partners involved [enterprises, etc] Associated partners	Foundational aspects (IBL, RLP, SSI, CDI)
22	Inside Out: Exploring the Human Body, Health, and Habits with Augmented Reality	Health/Digitalization	5 days	6	4	8 to 12	UNIC/CPI/Partner summer school	IBL, RLP
23	Inside Out: Exploring the Human Body, Health, and Habits with Augmented Reality	Health/Digitalization	5 days	5	3	8 to 12	UNIC/CPI/Partner summer school	IBL, RLP
24	Inside Out: Exploring the Human Body, Health, and Habits with Augmented Reality	Health/Digitalization	5 days	5	3	8 to 12	UNIC/CPI/Partner summer school	IBL, RLP
25	Inside Out: Exploring the Human Body, Health, and Habits with Augmented Reality	Health/Digitalization	5 days	5	3	8 to 12	UNIC/CPI/Partner summer school	IBL, RLP
26	STEM in Motion: Learning Math and Science through Kinems	Digitalization	3 days	5	3	8 to 12	UNIC/CPI/Partner summer school	IBL, CDI
27	STEM in Motion: Learning Math and Science through Kinems	Digitalization	3 days	5	2	8 to 12	UNIC/CPI/Partner summer school	IBL, CDI
28	STEM in Motion: Learning Math and Science through Kinems	Digitalization	3 days	5	2	8 to 12	UNIC/CPI/Partner summer school	IBL, CDI
29	STEM in Motion: Learning Math and Science through Kinems	Digitalization	3 days	5	3	8 to 12	UNIC/CPI/Partner summer school	IBL, CDI
30	STEM in Motion: Learning Math and Science through Kinems	Digitalization	3 days	5	2	8 to 12	UNIC/CPI/Partner summer school	IBL, CDI
31	STEM in Motion: Learning Math and Science through Kinems	Digitalization	3 days	5	3	8 to 12	UNIC/CPI/Partner summer school	IBL, CDI
32	STEM in Motion: Learning Math and Science through Kinems	Digitalization	3 days	5	4	8 to 12	UNIC/CPI/Partner summer school	IBL, CDI
33	STEM in Motion: Learning Math and Science through Kinems	Digitalization	3 days	5	2	8 to 12	UNIC/CPI/Partner summer school	IBL, CDI
34	STEM in Motion: Learning Math and Science through Kinems	Digitalization	3 days	5	3	8 to 12	UNIC/CPI/Partner summer school	IBL, CDI
35	Air Quality Explorers	Green Deal/Digitalization	5 days	6	3	8 to 12	UNIC/CPI/Partner summer school	IBL, RLP
36	Air Quality Explorers	Green Deal/Digitalization	5 days	5	3	8 to 12	UNIC/CPI/Partner summer school	IBL, RLP
37	Air Quality Explorers	Green Deal/Digitalization	5 days	5	2	8 to 12	UNIC/CPI/Partner summer school	IBL, RLP
38	Air Quality Explorers	Green Deal/Digitalization	5 days	5	2	8 to 12	UNIC/CPI/Partner summer school	IBL, RLP
39	Air Quality Explorers	Green Deal/Digitalization	5 days	5	3	8 to 12	UNIC/CPI/Partner summer school	IBL, RLP

OSA no.	Name of the OSA	Topic(s)	Duration	Total number of participants	Number of participating females	Age range of the participants	Partners involved [enterprises, etc] Associated partners	Foundational aspects (IBL, RLP, SSI, CDI)
40	Air Quality Explorers	Green Deal/Digitalization	5 days	5	3	8 to 12	UNIC/CPI/Partner summer school	IBL, RLP

OSA no.	Name of the OSA	Topic(s)	Duration	Total number of participants	Number of participating females	Age range of the participants	Partners involved [enterprises, etc] Associated partners	Foundational aspects (IBL, RLP, SSI, CDI)
1	Molecular kitchen	Health	3 days	17	12	16	University, school	RLP
2	Tilings from the Lasercutter	Digitalisation	2 weeks	8	5	10	University, school	RLP
3	Molecular kitchen	Health	2 weeks	14	10	18	University, school	RLP
4	School Rallye with Actionbound	Digitalisation	3 month	4	2	16	University, school	IBL, CDI
5	Molecular kitchen	Health	1 week	13	4	14	University, school	RLP
6	Wood and molecular kitchen	Health + Green Deal	3 days	15	7	8	2 universities, school	RLP
7	3d-printed fuel cell car design	Digitalisation + Green Deal	2 years				University, school	IBL, RLP
8	Sustainable School Breakfast	Health	1 week	24	11	13	University, school	RLP
9	Mathematical phenomena and digital tools meet textile design	Digitalisation	5 months	18	15	20	2 university faculties, school	IBL, RLP
10	Jigsaw Lamps from the Laser Cutter	Digitalisation	5 days	20	5	15	university, school	RLP
11	Molecular kitchen	Health	2 days	17	4	13	University, school, IHK	RLP, IBL
12	Molecular kitchen/Science Cooking	Health	3 days	17	6	15	University, School,	RLP, IBL
13	Dysphagia Food	Health	2 weeks	16	8	22	University, Vocation School, Nursing Home, Nursing home kitchen	
14	Bubble Girls	Health/Digitalsation	3 days	15	15	14	university, school, NFLP	RLP
15	Energy saving	Green Deal/Sustainability	1 week	26	10	13	1 teacher, 1 extracurricular learning location	RLP
16	eco footprint	Green Deal/Sustainability	6 weeks	16	8	12	1 teacher, 1 company	RLP
17	Waste reduction/ separation	Green Deal/Sustainability	6 weeks	10	4	12	1 teacher, 1 company	RLP
18	Climate adaptions	Green Deal/Sustainability	6 weeks	9	2	13	1 teacher, 1 company	RLP
19	Healthy and sustainable nutrition	Green Deal/Sustainability/Health	11 months	15	8	15	1 teacher, 1 extracurricular learning location	RLP
20	Healthy nutrition at school	Health	9 months	20	12	14		RLP

OSA no.	Name of the OSA	Topic(s)	Duration	Total number of participants	Number of participating females	Age range of the participants	Partners involved [enterprises, etc] Associated partners	Foundational aspects (IBL, RLP, SSI, CDI)
21	Sustainable advent	Green Deal/Sustainability/Health	6 weeks	8	4	15		RLP
22	Sustainable advent fair	Green Deal/Sustainability/Health	2 weeks	200	100	12		RLP
23	Forest kitchen 1	Green Deal/Sustainability/Health	3 month	22	10	8-10	university, school	RLP
24	Forest kitchen 2	Green Deal/Sustainability/Health	3 month	18	7	8-10	university, school	RLP
25	Forest kitchen 3	Green Deal/Sustainability/Health	3 month	21	11	8-10	university, school	RLP
26	Forest kitchen 4	Green Deal/Sustainability/Health	3 month	22	10	8-10	university, school	RLP
27	Forest kitchen 5	Green Deal/Sustainability/Health	3 days	28	10	11-15	university, school	RLP
28	STEM experiments	Green Deal/Sustainability					NFLP, school	RLP, IBL
29	STEM experiments	Green Deal/Sustainability					NFLP, school	RLP, IBL
30	Designing Jigsaw Lamps	Digitalisation	1 week	9	3	14	University, school	IBL, RLP
31	3D-printing and Cooking	Digitalisation/Health	1 month	11	2	7-11	University, NFLP, school	RLB, IBL
32	Molecular Cooking	Health	3 weeks	8	1	8-10	University, NFLP, school	RLP, IBL
33	Molecular Cooking and Dysphagia	Health	3 weeks	8	8	16-18	University, school, enterprises	RLP
34	Molecular Cooking and Dysphagia	Health	2 weeks	14	8	14-16	University, school, enterprises	RLP
35	3D Printing and Cooking	Health	2 weeks	17	7	16-18	University, school	RLP, IBL
36	Development of an underwater drone that collects microplastics	Green Deal/Sustainability	12 month	3	0	11-13	SFZ Tuttlingen	IBL, RLP
37	Mushrooms for future	Green Deal/Sustainability		3	0	15-16	SFZ Tuttlingen	IBL, RLP
38	Intelligent dustbin	Green Deal/Digitalization	8 month	3	0	11-12	SFZ Tuttlingen	IBL, RLP
39	Urban climate studies	Green Deal/Digitalization	9 months	3	2	12-13	SFZ Tuttlingen	IBL, RLP
40	Watersaving system	Green Deal/Digitalization		3	0	15-16	SFZ Tuttlingen	IBL, RLP
41	Drone development for reconnaissance of forest fires	Green Deal/Digitalization	8 month	3	0	11-12	SFZ Tuttlingen	IBL, RLP
42	Regeneration of demineralizers	Green Deal/Digitalization	8 month	2	0	16-17	SFZ Tuttlingen	IBL, RLP

OSA no.	Name of the OSA	Topic(s)	Duration	Total number of participants	Number of participating females	Age range of the participants	Partners involved [enterprises, etc] Associated partners	Foundational aspects (IBL, RLP, SSI, CDI)
43	Development of a sustainable insulation material from old rubber mattresses	Green Deal/Digitalization	12 month	3	3	15-16	SFZ Tuttlingen	IBL, RLP
44	Global change ahoi	Green Deal/Digitalization	12 month	3	3	15-16	SFZ Tuttlingen	IBL, RLP
45	Operating solar cells with self-produced dyes	Green Deal/Digitalization	8 month	2	2	12-13	SFZ Tuttlingen	IBL, RLP
46	Mix it smart	Digitalisation	14 month	2	0	16-17	SFZ Tuttlingen	IBL, RLP
47	Degradability of PET bottles	Green Deal	8 month	3	3	12-13	SFZ Tuttlingen	IBL, RLP
48	Bioplastics out of fruits	Green Deal/Sustainability	8 month	3	1	12-15	SFZ Tuttlingen	IBL, RLP
49	Heavy purse - Mathematical analyses to avoid small change	Digitalization	8 month	2	0	13	SFZ Tuttlingen	IBL, RLP
50	Accessibility for young and old	Health/Digitalization	7 month	2	2	13-14	SFZ Tuttlingen	IBL, RLP
51	Trees on the wall, which facade is good for the country?	Green Deal/Digitalization	7 month	2	1	13-14	SFZ Tuttlingen	IBL, RLP
52	On the trail of sound - health care	Green Deal/Digitalization	7 month	1	1	12	SFZ Tuttlingen	IBL, RLP
53	Caught in the trap - studies on Drosera species		7 month	3	0	13-14	SFZ Tuttlingen	IBL, RLP
54	The plants call for help	Green Deal/Digitalization		3	2	17-18	SFZ Tuttlingen	IBL, RLP
55	Perfect cut for your garden	Green Deal/Digitalization	7 month	3	3	15-16	SFZ Tuttlingen	IBL, RLP
56	Taraxakum koksaghyz - a plant of the future for the rubber industry?	Green Deal/Sustainability		2	3	13-14	SFZ Tuttlingen	IBL, RLP
57	Starch-based plastic	Green Deal/Sustainability	7 month	2	2	13-14	SFZ Tuttlingen	IBL, RLP
58	Mushrooms made from copper coins		7 month	3	0	15-16	SFZ Tuttlingen	IBL, RLP
59	The smart first aider	Digitalization		2	1	16-17	SFZ Tuttlingen	IBL, RLP
60	Development of a rocket test stand	Digitalization	7 month	3	0	17-18	SFZ Tuttlingen	IBL, RLP
61	Test rig for vertical wind turbines	Green Deal/Digitalization	7 month	3	0	17-18	SFZ Tuttlingen	IBL, RLP
62	Polycitric acid as a sustainable plastic	Green Deal/Sustainability		3	1	13-16	SFZ Tuttlingen	IBL, RLP
63	An AI supported waste collection robot	Green Deal/Digitalization		1	0	16	SFZ Tuttlingen	IBL, RLP
64	Microclimate in seagrass meadows	Green Deal/Sustainability		3	3	15-17	SFZ Tuttlingen	IBL, RLP
65	Banach Tarski in the light of modern mathematics	Digitalization		2	1	16-17	SFZ Tuttlingen	IBL, RLP
66	Solar-powered sweeper	Green Deal/Digitalization		3	0	13-14	SFZ Tuttlingen	IBL, RLP
67	Optimization of a spaghetti cannon	Digitalization	7 month	3	0	17-18	SFZ Tuttlingen	IBL, RLP
68	BNE goes international with Maja schools	Green Deal/Digitalization		25	18	12-13	SFZ Tuttlingen, IKG Tuttlingen	IBL, RLP
69	Sustainable spring flowers	Green Deal/Sustainability		20	18	11-18	SFZ Tuttlingen, IKG Tuttlingen	IBL, RLP
70	Green seating oasis for the school garden	Green Deal/Sustainability		20	14	14-15	SFZ Tuttlingen, IKG Tuttlingen	IBL, RLP
71	digital Rallyes and Escape Boxes	Digitalization	4 month	15	8	12-14	University, School,	IBL, CDI

OSA no.	Name of the OSA	Topic(s)	Duration	Total number of participants	Number of participating females	Age range of the participants	Partners involved [enterprises, etc] Associated partners	Foundational aspects (IBL, RLP, SSI, CDI)
72	Forest kitchen	Green Deal/Sustainability/Health	1 month	16	10	8-10	university, school	RLP
73	Talking Tree	Green Deal	2 month	18	5	15	University, School,	RLP
74	3D Printing	Digitalisation	4 Months	23	13	12	1 teacher, 1 extracurricular learning location	IBL
75	Bees	Green Deal	1 year	7	4	11	1 teacher, 1 extracurricular learning location	IBL
76	saving energy	Green Deal	1 Woche	28	10	13	1 teacher, 1 company	IBL
77	Learn to learn	Green Deal	3 Wochen	30	11	10	1 teacher, 1 company	IBL
78	Natur and river	Green Deal	10 Wochen	13	8	11	1 teacher, 1 extracurricular learning location	IBL
79	water wheel	Green Deal	3 Tage	3	0	15	1 teacher, 1 company	IBL

Portugal

OSA no.	Name of the OSA	Topic(s)	Duration	Total number of participants	Number of participating females	Age range of the participants	Partners involved [enterprises, etc] Associated partners	Foundational aspects (IBL, RLP, SSI, CDI)
1	Discovering Itineraries with Google Earth	Digitalization	7 hours (3 days)	22	12	8-10	A.E. Vialonga	IBL, RLP
2	The caves and the balance of ecosystems	Digitalization/ Green Deal	350 min + 7 hours (full day)	73	32	13-15	A.E. Caneças/ A.E. São João do Estoril/ A.E. Vasco Santana	IBL, RLP
3	Sustainable Revitalization of Portela Secondary School	Digitalization/ Green Deal	400 min	26	15	15-17	Escola Secundária da Portela	IBL, RLP
4	Well-being in the classroom	Digitalization/ Health/ Green Deal	540 mim	15	0	14-18	A.E. Eduardo Gageiro	RLP
5	From steam to AI	Digitalization	6 weeks	23	12	14-16	A.E. de Alhandra, Sobralinho e S. João dos Montes	IBL, RLP, SSI
6	Compost in ESPAV	Digitalization/ Health/ Green Deal	7 weeks	36	6	11-20	A.E. Alvalade	IBL, RLP, SSI, CDI
7	Sustainable practices: The efficiency of technology in irrigation systems	Digitalization/ Green Deal	8 weeks	20	9	9-10	A.E. Póvoa de Santa Iria	IBL, RLP, CDI
8	Behind the scenes of wine	Digitalization/ Green Deal	5 months	25	15	17-18	A.E. Ponte de Sor	IBL, RLP
9	Investigating the Performance of Solar Ovens	Green Deal	180 min	23	12	9-10	Escola Vasco Moniz	IBL
10	Design and Build Models of Sustainable Cities	Green Deal/ Health	5 months	31	14	13-15	A.E. Pedro Jacques Magalhães/ Oficina STEM do Clube Ciência Viva	RLP, CDI
11	Are the Portuguese healthy citizens?	Health	300 min	40	22	13-14	A.E.Padre Bartolomeu de Gusmão	SSI, RLP
12	Determination of the concentration of a laboratory waste, with TI Nspire technology	Digitalization/ Green Deal	315 min	55	30	17-18	A.E. Amadora Oeste	RLP
13	Automation of the school garden irrigation system	Digitalization/ Green Deal	12 x 90 min	28	1	15-16	A.E. Leal da Câmara	RLP, CDI
14	Safe streets. Safe School	Digitalization	16 hours	22	10	7-9	Escola Básica Artur Alves Cardoso	RLP
15	Robotech Guardian	Digitalization/ Green Deal	3 months	23	13	10-11	A.E. Fernando Namora	RLP
16	Recycle with artificial inteligence	Digitalization/ Green Deal	450 min	10	1	16-17	Agrupamento de Escolas Monte da Lua	RLP

OSA no.	Name of the OSA	Topic(s)	Duration	Total number of participants	Number of participating females	Age range of the participants	Partners involved [enterprises, etc] Associated partners	Foundational aspects (IBL, RLP, SSI, CDI)
17	Our garden	Green Deal	450 min	14	8	6-7	Escola Básica de Proença-a-Nova	RLP
18	Conductive and non-conductive materials	Digitalization	270 min	23	11	9-11	Escola Básica da Sertã	IBL
19	New age researcher Monitoring Carbon Dioxide levels	Digitalization/ Green Deal	600 min	30	15	17-18	Escola Secundária da Portela	IBL
20	IA to learn science	Green Deal	300 min	25	13	8-9	Escola Básica Vila Velha de Rodão	IBL
21	Vegetable garden at school	Green Deal	450 min	23	12	8-9	Escola Básica Vila Velha de Rodão	IBL
22	Machine Leaning	Digitalization/ Green Deal	>100 min	22	12	7-8	Escola Afonso de Paiva	IBL
23	Garden at school	Digitalization/ Green Deal	>500 min	27	13	8-10	Escola Afonso de Paiva	IBL
24	Recycling robot	Digitalization/ Green Deal	180 min	41	21	8-11	Escola Básica/JI José Tagarro e Escola Básica D. António de Ataíde	SSI, RLP
25	Acid-Base Balance and the Effects of Temperature and Ocean Acidification on Corals	Digitalization/ Green Deal	360 min	48	19	15-17	Escola Secundária da Portela	IBL, RLP
26	Photovoltaic Panels, an option to consider	Digitalization/ Green Deal	180 min	43	18	15-20	Escola Secundária Seomara da Costa Primo	IBL, RLP
27	Classroom environment quality: a STEM activity using Machine Learning (ML)	Digitalization/ Health	>300 min	18	1	16-19	Escola Secundária de Santa Maria	IBL, RLP
28	Identification of potentially toxic chemical elements in dermocosmetic products	Health	>500 min	4	3	16-17	Escola Secundária de Miraflores + Laboratório de Física da Faculdade de Ciências e Tecnologia da Universidade Nova de Lisboa	IBL, RLP, SSI
29	Estuary water quality	Digitalization/ Green Deal	>500 min	20	14	16-20	Escola Básica e Secundária Alfredo da Silva	IBL, RLP, SSI
30	Machine Learning and Solution Concentration	Digitalization	360 min	29	1	15-18	Escola Secundária Gago Coutinho	IBL, CDI
31	What are the spontaneous plants that exist in our school?	Digitalization/ Green Deal	>500 min	24	14	6-7	Escola Básica Coruchéus + Academia Ciência Viva	IBL

OSA no.	Name of the OSA	Topic(s)	Duration	Total number of participants	Number of participating females	Age range of the participants	Partners involved [enterprises, etc] Associated partners	Foundational aspects (IBL, RLP, SSI, CDI)
32	Sustainability and Oceans	Digitalization/ Green Deal	>500 min	103	48	12-14	Escola B/S de Gama Barros	IBL, RLP
33	Classroom Environment: Effects on Student Well-Being	Digitalization/ Health	540 mim	12	11	13-15	Agrupamento de Escolas Fragata do Tejo + Clube Ciência Viva	IBL, RLP
34	To freeze or not to freeze…that is the question?	Digitalization	2 weeks (aprox. 200min)	92	46	6-9	Agrupamento de Escolas de Caneças	IBL
35	Impact of Noise on the Learning of Students aged 13 to 15 in a School Context.	Digitalization/ Health	1 month (>500 min)	24	9	13-15	Agrupamento de escolas de São João do Estoril	IBL, RLP
36	Effect of environmental factors on animals - Experiment with earthworms	Digitalization/ Green Deal	240 min (2 weeks)	21	11	8-9	Escola JI/EB1 do Cobre	IBL
37	From Indivisible to Quantum	Digitalization	>500 min	82	38	14-15	Agrupamento de Escolas Vasco Santana, Agrupamento de Escolas de Caneças, Agrupamento de Escolas São João do Estoril	IBL
38	Health and environment in the classroom	Digitalization/ Health	>200 min	24	4	16-17	Escola Secundária Quinta do Marquês	IBL, RLP
39	Sustainable Elements: The Periodic Table and the Future of the Environment	Digitalization/ Green Deal	>300 min	56	28	14-16	Escola Secundária Pedro Nunes	IBL, RLP
40	Responsible AI: Care and Criteria for Reliable Research	Digitalization/ Green Deal	>200 min	26	14	13-17	Escola Básica de São Vicente	IBL, RLP
41	Photovoltaic panel in a blackout	Digitalization/ Green Deal	270 min	27	9	15-16	Escola Secundária António Damásio	IBL, RLP
42	Use of Artificial Intelligence in the Construction of Communications in Science	Digitalization/ Green Deal	>300 min	25	15	17-19	Escola Secundária de Odivelas	IBL, RLP

Turkey

OSA no.	Name of the OSA	Topic(s)	Duration	Total number of participants	Number of participating females	Age range of the participants	Partners involved [enterprises, etc] Associated partners	Foundational aspects (IBL, RLP, SSI, CDI)
1	Pet Journey PetG	Green Deal	3 months	200	90	11--13	ÖÖV, HU Javsu, TEKMER, Maya Schools, Bala Municipality, Beynam Emine Erişen School	RLP
2	PetJourney 3D Printing	Digitalization Green Deal	3 months	200	90	11--13	ÖÖV, HU Prota design Meta 3D	IBL, CDI
3	Exercise Street	Health	2 months	10	8	11--13	ÖÖV Ministry of Youth and Sports, Gölbaşı Municipality	IBL
4	No Obstacles to Seeing	Digitalization Health	1 months	16	10	12--14	HU Middle East Technical University Development Foundation Schools, LEGO	IBL, CDI
5	Green roofs	Sustainability	6 weeks	10	6	11--13	ÖÖV Maya Schools	RLP
6	Re-using	Sustainability	2 months	10	5	11--13	HU Maya Schools	RLP
7	Healthy Nutrition Assistant-Scratch Project	Digitalization Health	2 months	5	3	11--13	HU Kastamonu University, Kayı Middle School TUBİTAK	CDI, RLP
8	Digital Storybook: Create Your Own Story with Coding	Digitalization	2 months	4	2	10--14	HU Kastamonu University, Kayı Middle School TUBİTAK	IBL
9	Ancestral Heritage: Preserving Local Seeds	Digitalization Health	1 months	10	8	10--14	HU Kastamonu University, Kayı Middle School TUBİTAK,	IBL
10	Drinking Water Quality in Villages: Safe Water for Health	Sustainability	2 months	6	3	11--13	HU Foruier Education, Texas Instrument, STEM Maker Academy	RLP, IBL

OSA no.	Name of the OSA	Topic(s)	Duration	Total number of participants	Number of participating females	Age range of the participants	Partners involved [enterprises, etc] Associated partners	Foundational aspects (IBL, RLP, SSI, CDI)
11	Innovative Solutions with Biomimicry: Energy Efficiency with the Sunflower	Sustainability	2 months	6	4	10--11	HU Pleksi Inc, DoraToy Kayı Middle School Kastamonu Provincial Directorate of National Education, Kastamonu University	CDI, IBL
12	Future Health Technologies with Wireless Energy	Health	6 weeks	5	3	13--14	HU Pleksi Inc, DoraToy, Kayı Ortaokulu, Kastamonu İl Milli Eğitim, Kastamonu Üniversitesi	IBL
13	Oxygen production kit for use in mining	Health	2 months	8	2	14--17	HU TED Zonguldak College	IBL
14	Effects of fast food culture on human health	Health	2 months	9	6	14--17	HU	IBL
15	Sustainability and digitalization in the education system	Digitalization	2 months	9	9	14--17	HU TED Zonguldak College	IBL
16	The effects of using coal on the environment and human health	Sustainability	2 months	9	7	14--17	HU Families, Kastamonu Municipality	IBL
17	Effective green roofs	Sustainability	2 months	10	6	13--14	HU Maya Schools, ODTÜ GVO	IBL
18	Ecosystem in my school garden	Sustainability	2 months	10	5	13--14	HU Maya Schools, Tohumluk Foundation	IBL
19	Enviroment lab	Sustainability, Digitalization	6 months	100	60	7--14	ÖÖV Maya Schools, Ankara University, Gölbaşı District National Education, Pleksi Plus, Gölbaşı District Governor's Office, Ayaş Trout Farm	RLP IBL, CDI
20	Wet Road Warning System – Mini Smart Road	Digitalization	1 months	3	0	13-14	HU	RLP IBL

OSA no.	Name of the OSA	Topic(s)	Duration	Total number of participants	Number of participating females	Age range of the participants	Partners involved [enterprises, etc] Associated partners	Foundational aspects (IBL, RLP, SSI, CDI)
							Kastamonu University, Kayı Middle School TUBİTAK,	
21	Geometric Art Designs: The Meeting of Mathematics and Aesthetics	Digitalization	2 weeks	5	3	13-14	HU high school of fine arts	IBL
22	Smart Notebook: Reminder-Enabled Note-Taking System	Digitalization	2 weeks	4	4	13-14	HU Kayı Primary School	IBL
23	Eco-Friendly Rainwater Harvesting Systems	health, Sustainability	3 months	42	25	5-6	ÖÖV Tohumluk Foundation WWF	RLP CDI
24	I Practice Conscious Sports	Health	4 months	15	8	12--13	ÖÖV Ministry of Youth and Sports, Gölbaşı Municipality, Baselife Club, Ministry of Health	RLP
25	Digital Citizenship Education	Digitalization	1 months	20	12	8--9	ÖÖV Massachusetts Institute of Technology, European Schoolnet	IBL, CDI
26	Aquaponics	Sustainability	4 months	6	2	11--12	ÖÖV District Directorate of Agriculture, Rize University, Maya Schools,	IBL
27	Healthy Nutrition in Aquaponics	Sustainability, Health	3 months	6	2	11--12	ÖÖV District Directorate of Agriculture, Rize University, Maya Schools, Akdeniz University, Uşak University	IBL, RLP
28	Agroecology	Sustainability	3 months	15	8	9--10	ÖÖV Tarım Müdürlüğü	IBL
29	Recycle Journey	Sustainability, Digitalization	2 months	12	1	12--13	ÖÖV Maya Schools,	RLP
30	Solar Panel Toy Project	Digitalization	3 months	9	2	13--14	ÖÖV GMR Energy	IBL
31	Wool Hats from Old Kazakhs	Sustainability	4 months	100	50	7--14	ÖÖV	RLP CDI

OSA no.	Name of the OSA	Topic(s)	Duration	Total number of participants	Number of participating females	Age range of the participants	Partners involved [enterprises, etc] Associated partners	Foundational aspects (IBL, RLP, SSI, CDI)
							Maya School, Çiğdemim Association, Municipality, Ministry of Culture, Parents, Tohumluk Foundation, Gölbaşı District Governor's Office	
32	Flour Moth Project	Sustainability	4 months	6	3	11--12	ÖÖV Maya School, Agricultural High School, Gölbaşı Municipality, Gölbaşı District National Education, Ankara University, Gölbaşı Poultry Farm, Tohumluk Foundation	IBL, RLP
33	From Seed to Field	Sustainability	4 months	20	12	11--12	ÖÖV Farmers of Eymir Village	RLP
34	Sustainable Oyster Mushroom Cultivation	Sustainability	4 months	6	4	11--12	ÖÖV An Expert about fungies	IBL, CDI
35	Pollinator Pathways: Living Laboratories for Children and Communities	Sustainability, Health	3 months	15	8	7--8	ÖÖV Maya Schools,	SSI
36	From Tea Pulp to Compost	Sustainability	4 months	16	8	6--7	ÖÖV Maya Schools, Tea growers, Çidemim Foundation	RLP
37	Ocean Debris Cleanup	health, Sustainability	3 months	5	4	9--13	ÖÖV Ankara University	IBL, RLP
38	Sustainable Urban Design	Sustainability, Digitalization	3 months	10	5	11--13	ÖÖV Güneş Architecture, Minecraft Turkey, Ankara Solar	IBL, RLP
39	Smart Waste Separation	Digitalization, Sustainability, Health	1 months	2	1	13-14	ÖÖV Kastamonu University, Kayı Ortaokulu, DoraToy,	RLP
40	Wireless Electricity with Tesla Coils	Sustainability	1 months	3	1	13-14	HU Pleksi Plus,	IBL
41	Smart Plant Watering System	Digitalization	4 months	10	5	12--14	ÖÖV	IBL

OSA no.	Name of the OSA	Topic(s)	Duration	Total number of participants	Number of participating females	Age range of the participants	Partners involved [enterprises, etc] Associated partners	Foundational aspects (IBL, RLP, SSI, CDI)
							Association of Agricultural Engineers, Gölbaşı Agriculture, Bilşim Garage	

Annex B

Best Practices Examples-OSA

Report Template

Introduction

This document aims to present a template for reporting the strategies and support measures (Service Package) for Open Schooling Activities (OSA) outlined in Task 2.3 of the ICSE Factory project.

As such, the main objective of this reporting template is to systematically document how the Service Package recommendations from Task 2.3 were implemented in practice. It specifically focuses on collecting data about:

- The application and effectiveness of strategies to engage schools in Open Schooling
- The implementation of support measures provided to schools
- The practical outcomes and lessons learned from applying the Service Package

The report template will focus on the OSA developed and conducted during the implementation phase, and covers the following dimensions:

1. Activity
2. Summary
3. Description of the implementation process of the activity
4. Strategies to win schools
5. Schools support
6. Key-success factors
7. Challenges
8. Reflective remarks
9. Outcomes
10. Additional materials

Report Template: OSA

1. **Activity**

   Name of the activity:

   Topic(s): *Please indicate the topic(s): Green Deal, Digitalization, Health*

   Date:

   Local:

   Duration:

   Partners involved:

   Target group: *(e.g., students, teachers, community members)*

   Number of participants:

   Number of female participants:

   Age of the participants:

2. **Summary**

   Write a brief summary to describe the purpose, scope, and content of the event. Without going into too much detail, but enough detail to understand what OSA is. Information about the implementation process is requested at the next stage.

3. **Description of the implementation process of the activity**

   Describe how the activity was implemented, beginning with the preparation phase and continuing through the execution. Include information about significant milestones reached during implementation, and strategies used to engage participants.

4. **Strategies to win schools**

   Explain the strategies used to engage schools in the activity. This can include your approach to direct outreach, how you utilized existing networks, what professional development opportunities were offered, any marketing or communication methods employed, etc. Provide specific examples of the used strategies.

5. **Schools support**

Describe all forms of support provided to participating schools during the OSA implementation. Include the educational materials, pedagogical resources, and training materials distributed, as well as the ongoing support mechanisms established. Detail how mentoring and communication with schools were maintained.

-

6. Key-success factors

Describe the critical factors that contributed to the activity's success. Consider strategic elements such as planning and coordination, operational aspects including resource management, stakeholder engagement efforts, and innovative approaches that proved particularly effective.

Provide an analysis of which engagement strategies proved most successful. Describe any adjustments made to improve engagement throughout the process.

-

Highlight any particularly effective support strategies that contributed to the activity's success.

7. Challenges

Describe all significant challenges encountered during implementation, including any barriers to implementation, resource constraints faced, issues with stakeholder engagement, technical difficulties experienced, etc. Provide context for each challenge and its impact on the activity.

Explain in detail how each challenge was addressed. Include information about solutions implemented, resources required to overcome obstacles, lessons learned from the resolution process, and preventive measures recommended for future implementations.

8. Reflective remarks

Provide a comprehensive reflection on the activity's impact. This should include an assessment of how well objectives were met, any unexpected outcomes observed, areas identified for improvement, and considerations for long-term sustainability of the initiative.

Present recommendations for future implementations. Address possibilities for scaling the activity, specific improvements to implementation processes, strategies for optimizing resource use, and methods for enhancing stakeholder engagement.

9. Outcomes

Summarize the outcomes, achievements, and participant feedback. This section will be used especially for definitions to be made in structures such as Newsblog etc. and may contain short snapshots from participants.

10. Additional materials

Submit relevant documentation like photographs of the activity, participant worksheets used, educational materials developed, etc.

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Annex C

Best Practice Examples of OSA by Country

Funded by
the European Union
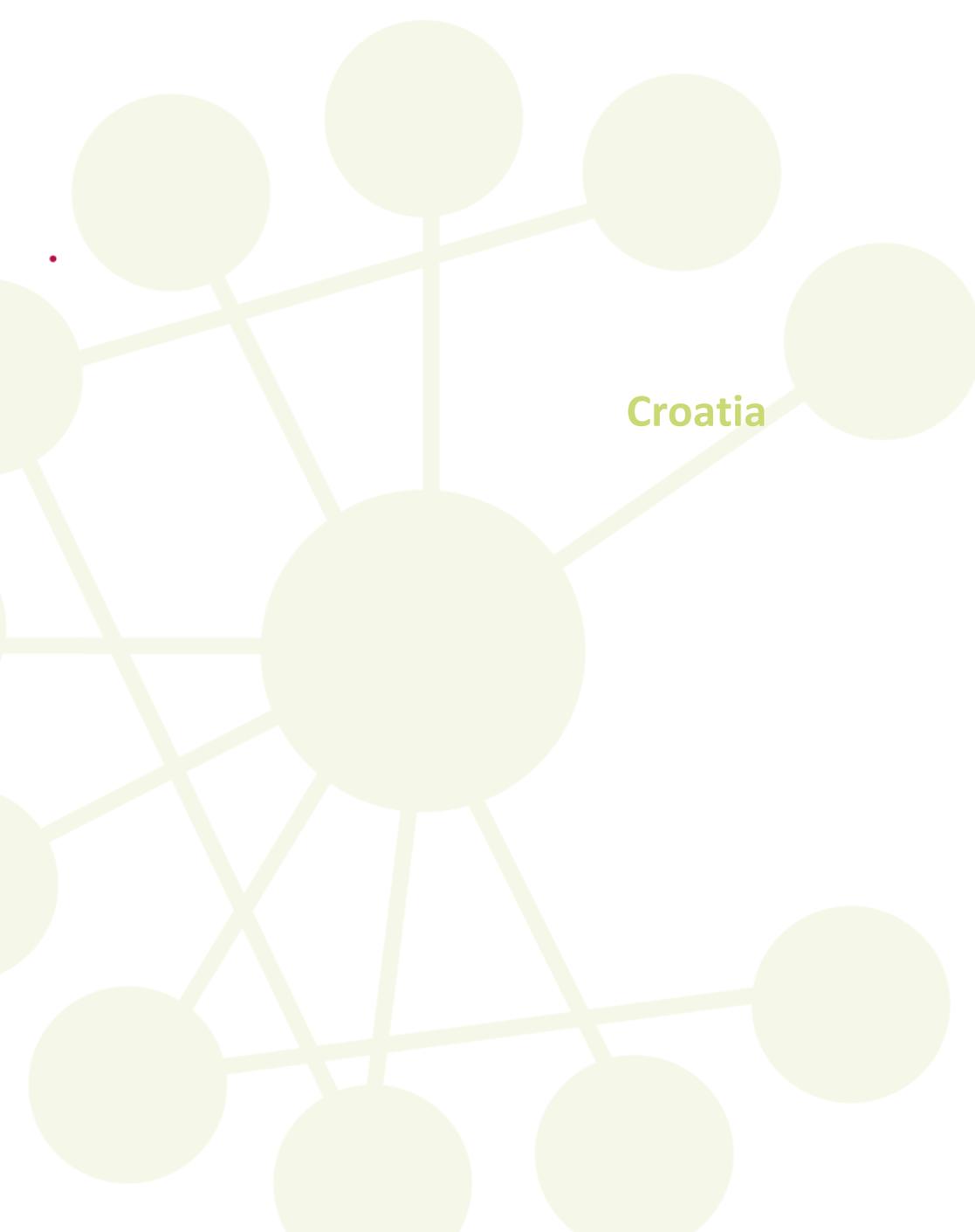
Croatia

Can we ignore microplastics?

11. Activity

Name of the activity: Can we ignore microplastics?

Topic(s): Health, Green

Date: December 2024 – January 2025

Local: Zagreb, Croatia

Duration: 6 weeks

Partners involved: XV. Gymnasium Zagreb

Target group: high school students, university professor in biology Bruno Komazes (Faculty of Science, Zagreb)

Number of participants: 6

Number of female participants: 2

Age of the participants: 16-17

12. Summary

In this activity a group of students, with the support of two math teachers and one biology teacher searched for literature and other information on microplastics and investigated the amount and influence of microplastics in water in their households. Their study was data based, and they have learned various methods for its analysis, as well as ways to represent the results. The project has shown big discrepancies in the level of microplastics in water in different parts of the capital and has raised awareness about the health issues caused by microplastics, not only in the project team, but among all the students to which the project was presented.

13. Description of the implementation process of the activity

The activity has been implemented during six weeks. In the first week, the project team members have looked for literature on microplastics and its impact on human health and the environment. Next they have met with the biology professor and received training in sampling, filtering and analyzing microplastics in water. Microparticles are counted of a filter paper, and their number is estimated based on the exact count on a smaller sample of the paper. Based on the data about average water consumption and the concentration of microplastics in the water, the students have evaluated the amount of microplastics consumed by their peers. Water has been analyzed at several locations, in the

households of team members, which live in different parts of the city. The results of the analysis show that there is no significant difference in microplastics concentration among different parts of the city, but the amount which is consumed is to be taken seriously. The results have been presented during a school event to other students and at the ICSE Science Fair at the Faculty of Science in Zagreb, Croatia.

14. Strategies to win schools

The engagement of the school is based on previous collaboration of the teachers with the partners of the project ICES Science Factory. These teachers participate and organize various projects on the national and European level. The main idea for the project has emerged from student discussion. Initially, the goal of the project was for the students to expand their knowledge in mathematics and biology beyond the regular curriculum and to start to develop skills relevant for research in science. As the project evolved, it has become apparent that the project is gaining more momentum and attention of the students' families and friends as the results of the students' analysis have shown to be relevant to their everyday life and health.

15. Schools support

The school is involved in many projects on different levels, and it is not unusual for the students and the teachers to get engaged in extracurricular activities. The principal supports this kind of projects and encourages teachers to get involved and involve the students. The education happened in the school and made the collaboration easier for all involved students.

16. Key-success factors

The success of this project lies on the experience of the teacher, engagement of external experts and the students' idea that puts the health of their families in the center of their inquiry. It seems very important that the teachers have experience with project-based teaching and value students' ownership in the process of the activity. The students were highly motivated by the project theme and eager to learn new methods in data analysis, such as statistical tests and the influence of microplastics on the human organism.

17. Challenges

The biggest challenge of the project is its scalability and the potential to solve the problem for which awareness is raised. Raising awareness is the first step in the solution, but it is a fact that the microplastics is so widespread that it will take a long time and very concrete actions on the level of society to deal with

this issue. Nonetheless, the students were motivated to learn something relevant and share it with the local community.

18. Reflective remarks

The project has shown that during its duration the focus changes and that a simple school project can attract the attention of students and their families. A relevant societal (environmental and health) topic is engaging and motivates students for learning. The project has shown high level of interdisciplinarity combining data science, biology, environmental and societal questions. The students were very successful in leading and completing the project and very proud to present their work to their peers, families and the audience at the ICSE Science Fair.

19. Outcomes

The project speaks about the bad influence of microplastics to human health and about the level of microplastics in drinkable water. These are important and relevant information for everybody, and the project raises awareness about the topic that is still not familiar enough to the local communities of the involved students. The project managed to involve people beyond the project team – other students and families of project team members. The activity has been recognized as one of the best projects at the national ICSE Science Fair.

20. Additional materials

1. THE APPARTUS AND EQUIPMENT USED BY THE STUDENTS
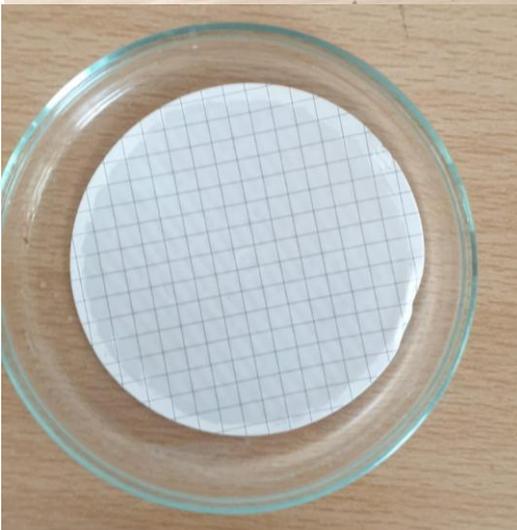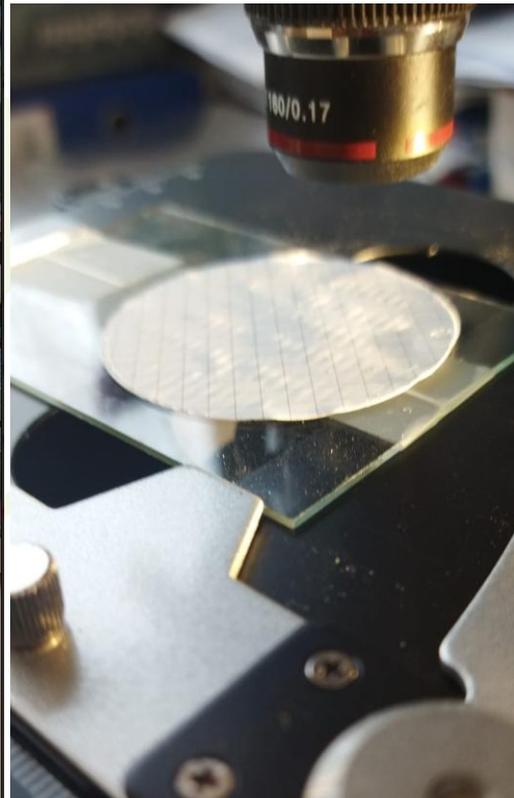
2. GRAPH SHOWING THE CONCENTRATION OF MICROPLASTICS IN WATER IN DIFFERENT PARTS OF THE CITY – SHOWING DATA GATHERED BY THE STUDENTS
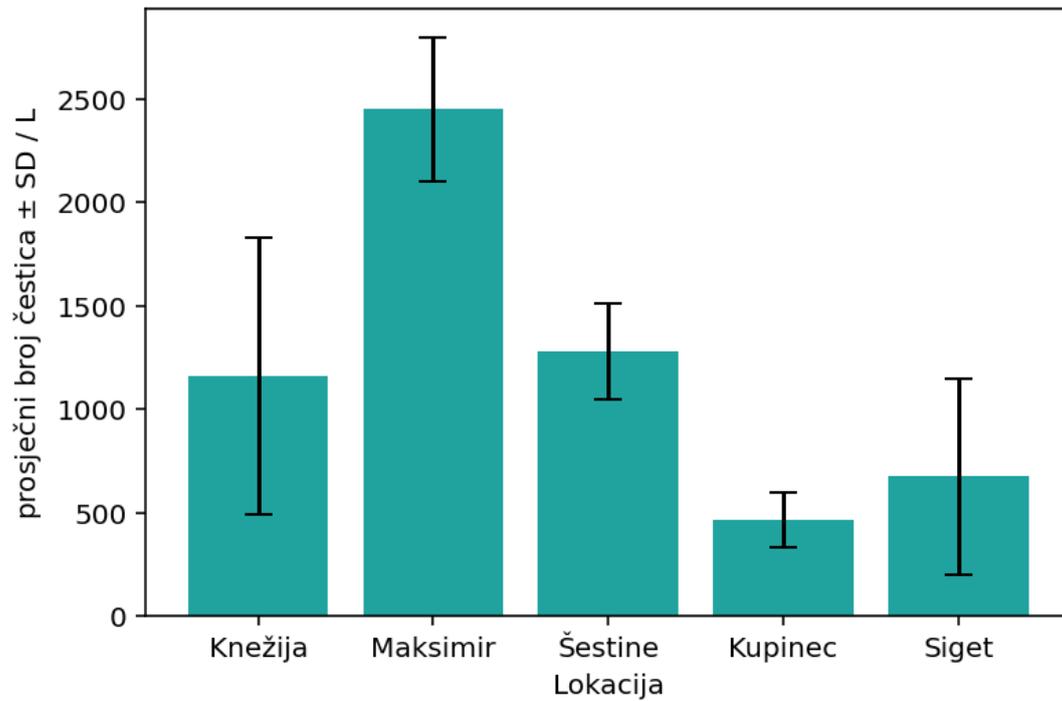
3. IMAGES OF MICROPLASTICS USED IN SHARING THE PROJECT RESULTS
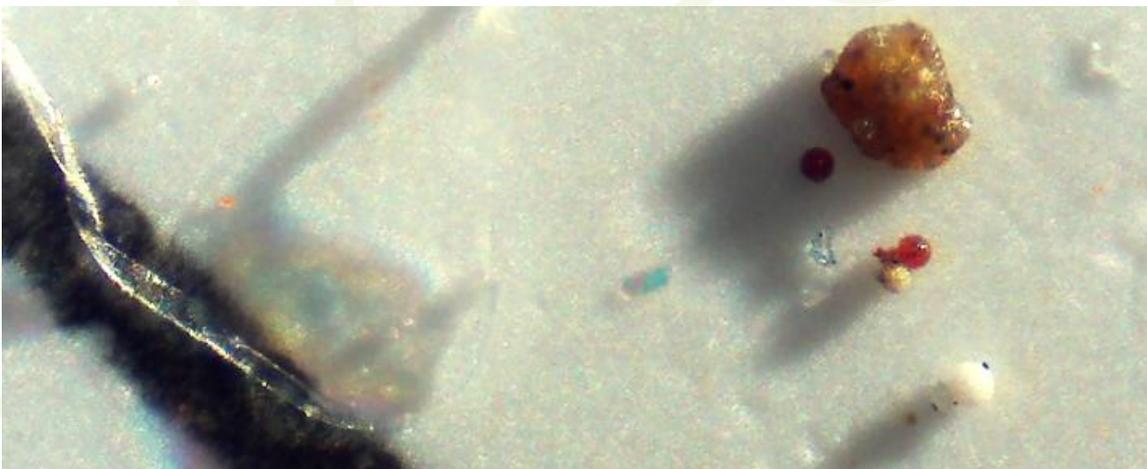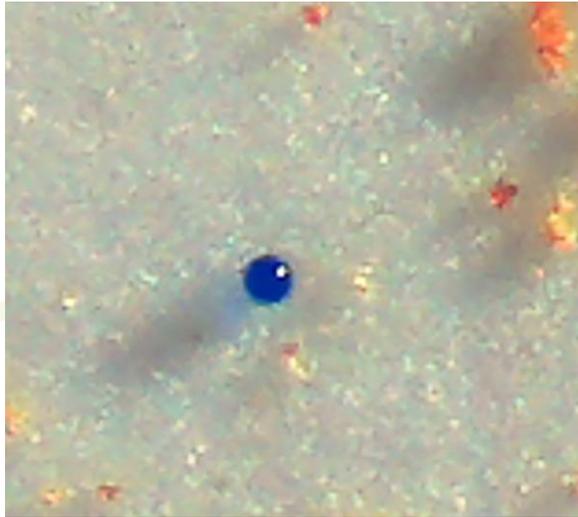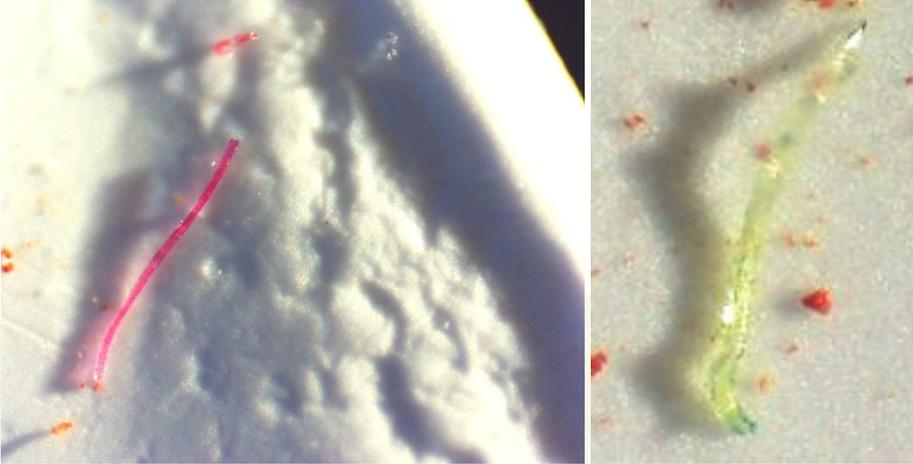
SOS.petagimnazija

1. Activity

    Name of the activity: SOS.petagimnazija

    Topic(s): Health, Digitalisation

    Date: September 2024 – February 2025

    Local: Zagreb, Croatia

    Duration: 6 months

    Partners involved: Peta gimnazija Zagreb (Gymnasium), professor of psychology Daria Rovan, applied computer science specialist Bjanka Vrljić

    Target group: high school students

    Number of participants: 8

    Number of female participants: 5

    Age of the participants: 16-17

2. Summary

    In this activity a group of students, with the support of one math teacher and two external partners, decided to design an online app (platform) that would help first year high school students in their transition problems during their first grade in high school (age 16). The goal of

the project was to learn and investigate about the relevant psychological aspects that make the transition to high school difficult for the first-grade students and provide support in a form of an app that would give students a possibility for self-reflection (through a quiz) and concrete advice based on their profile and reported problems. The app also provides contact between students and serves as an additional social moment that the students did not have before. The psychological aspects were developed in collaboration with university professor of psychology; data has been analyzed guided by a math teacher and the app was created from scratch with the advice from a computer science expert working at the university.

3. Description of the implementation process of the activity

The activity has been implemented during six months. After forming the team, the students worked on the development of the initial idea to help younger students in adapting to their new environment and responsibilities. Students consulted relevant literature (on motivation and self-regulation of learners) and met with the psychologist. They have identified five dimensions that make their model: feeling pleasant in the school, success expectations, estimation of success, in-depth learning and fear from failure.

In the second phase the team has developed a web app using four different development tools. They had to learn new programming skills and design the app to be user friendly. Next, the questionnaire has been prepared and piloted among students of second, third and fourth year of high school. To analyze the data the students used quantitative methods but also looked into the open answers qualitatively. They used AI to group open answers, to make categories of students and formulate feedback for different profiles of the students. In the end, the project team decided to categorize participants into three categories.

There is also a plan to make enhancements based on the interviews with a focus group of first year students in the upcoming months.

4. Strategies to win schools

The engagement of the school is based on previous collaboration of the teacher with the partners of the project ICES Science Factory. This is an enthusiastic teacher with many activities.

Nonetheless, the main idea for the student project came from the students. We believe this was a successful project because the students worked on something that is very close to them and their friends. It was motivating that they will produce something useful for others. The investigation has been interesting as it touches on many disciplines that are very relevant (digitalization, app design, psychology).

5. Schools support

The teacher has supported their team by finding the external experts that were willing to work with the students. We believe that the external experts were willing to volunteer because they have recognized the students' willingness and the potential of the idea. The education happened in the school and made the collaboration easier for all involved students.

6. Key-success factors

The success of this project lies on the experience of the teacher, engagement of external experts and the students' idea that puts the mental health of their friends and colleagues in the centre of their inquiry. It seems very important that the teachers have experience with project-based teaching and value students' ownership in the process of the activity. It was important that the students have adequate support of experts to be able to implement their ideas timely and the desired level of quality.

7. Challenges

The biggest challenge of the project is its ethical delicacy. The project revolves about helping students that struggle and try to adapt. Hence, the project team need to gain trust of their colleagues in order to get unbiased data. It might be a challenge for some group of students to repeat a similar project, but in this case the group of students was big enough and students had different aspirations and knowledge so they could work well as a team and complement each other in different phases.

8. Reflective remarks

This project has shown that even a social theme (adaptation of learners during their transition in education) requires many activities that belong to the domain of STEM. Mental health is related to many societal, but also biological factors, while developed of the support system is

much easier in a technologically highly development environment. Digitalization opens up new methods of research such as better data analysis methods (clusterization, AI assistance) and students learn a lot of more advanced mathematics and computer science. The social component of the issue engages students into the activity and raises their awareness about the societal issues as well as the role of science to deal with these issues.

9. Outcomes

The project team has developed a platform (web app) that serves first year high school students to reflect on their needs and obtain support during their transition to high school. Each student gets their own psychological profile and personalized feedback with advice for learning. It is remarkable that this product can be equally used by students in other schools, so the outreach is huge. The activity has been recognized as the best project at the national ICSE science fair.

Additional materials

1. MEETING WITH THE PSYCHOLOGIST, PROF. DARIA ROVAN

2. APP DEVELOPMENT TOOLS USED IN THE PROJECT

3. QUESTIONAIRE AND THE PERSONAL PROFILE
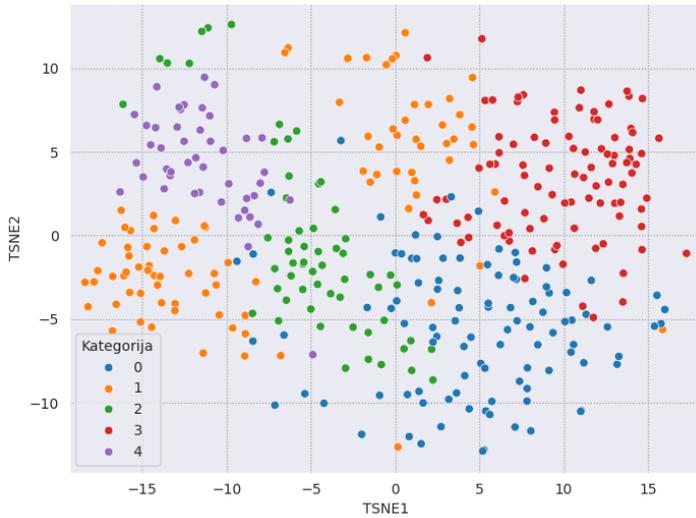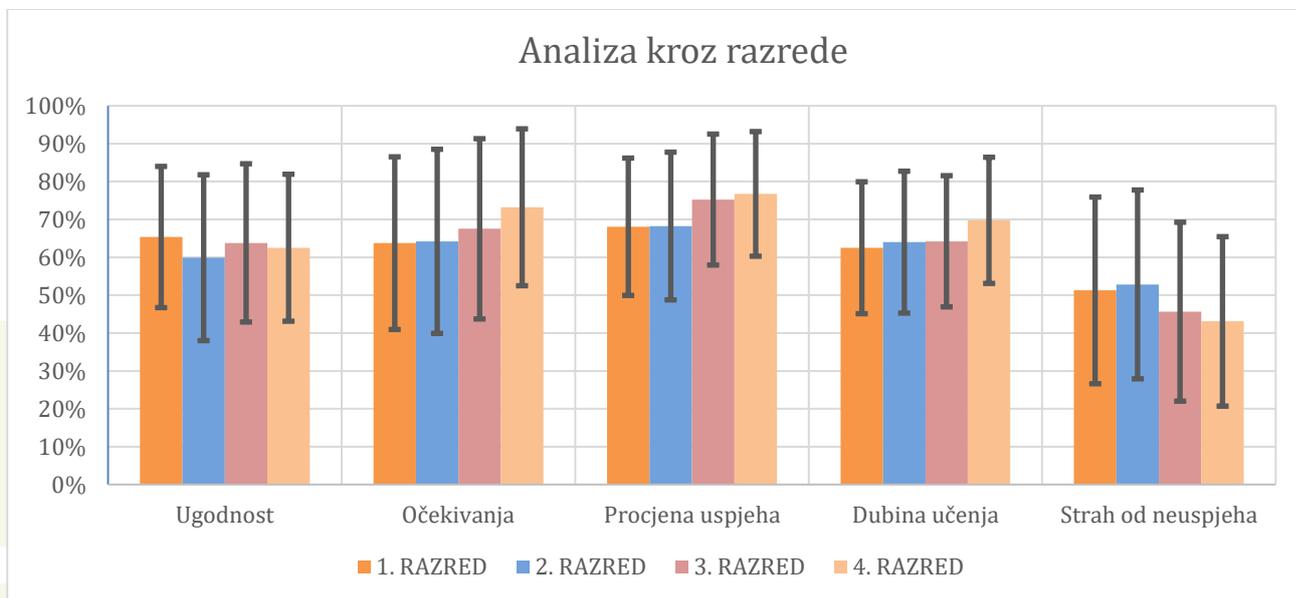

4. CLUSTERING ALGORITHM RESULTS

Dijagram raspršenosti odgovora na anketu s k-means algoritmom (k=5)

5. GATHERING DATA

6. RESULTS COMPARED ALONG DIMENSIONS AND SCHOOL GRADES

Analiza kroz razrede

The sustainable school of the future

1. **Activity**

   Name of the activity: The sustainable school of the future

   Topic(s): Green Deal, Digitalisation

   Date: September 2024 – February 2025

   Local: Omiš, Croatia

   Duration: 6 months

   Partners involved: Elementary School Josip Pupačić Omiš, Centre of excellence Splitsko-dalamtinska county, Communal enterprise Peovica, architect Ivona Buljević

   Target group: students, community members

   Number of participants: 5

   Number of female participants: 3

   Age of the participants: 14-15

2. **Summary**

   In this activity a group of students, with the support of two teachers and external partners, decided to design a vision and a model of a new sustainable building for their school. The goal of the project is to

create a sustainable, green and technologically advanced school that will contribute to the transformation of the town of Omiš and provide concrete suggestions for a new project that is considered by the town municipality. This is an interdisciplinary project through which the students have learner various STEM subjects and have been engaged in the reflection and connection of acquired pieces of knowledge, as well as development of new skills.

3. Description of the implementation process of the activity

The activity has been implemented during six months. First, the project team was formed that included students, teachers, experts on sustainability and ecology, as well as architects. The team has started the activity by setting the goals and defining key milestones. Also, connection to a communal enterprise Peovica and local community environmental associations has been established in the first month of the project. In the second month, the students got themselves introduced to 3D modelling and design using Minecraft. A survey has been implemented among the students and local population living in the vicinity of the school. The students have gathered the material needed for the 3D model and discussed ecological issues that should be addressed in the 3D model (e.g. energetic solutions, shape and the position of the building, building materials, protecting the ecosystem and biodiversity.

In the third month, the students started to build the 3D model and worked on the details. The collaboration with the architects and sustainability experts has led to quality assurance. In the fourth month, a model of the school has been designed in Minecraft. The process has been monitored by taking photographs of the 3D model in each stage and by creating a video. The 3D model has been finished in the fifth months, and the students moved on to the preparation of the presentation of the project. In the sixth month the activity has been first presented in the school (for selected parents and teachers) and at the ICSE Science Factory School Fair.

4. Strategies to win schools

This activity has been initiated by enthusiastic teachers and motivated students. The project idea was jointly created by the students and teachers, and no external motivation has been needed. The project revolves around the pressing issues that students and teachers encounter every day: the schoolwork at two locations, where there is no sufficient infrastructure for all the needs of 21st century education. It is planned that the project is built on the green ideas that are attractive and functional, e.g. that plants are seeded on the school's roof, so that the mediterranean plants and spices that grow there can be also used in the school's kitchen. Smart systems save energy, but also improve the lifestyle of the students,

while smartboards, interactive screens and wireless internet enhance the teaching and learning processes. All of these benefits are of immediate students' interest, and its value is also recognized by the local community (students' families).

5. Schools support

The school has established a strong collaboration with the communal enterprise, local architect and sustainability experts – each of these partners have provided valuable education and advice to students and teachers. The students have learned how to build 3D models, how to model using Minecraft, how to reason about sustainability and functional design. The education took place in the school as the external experts have visited the school team and worked with them on the design.

6. Key-success factors

The success of the project lies also on the experience of the teachers, the support of the school principal, engagement of external experts and local relevance of the idea. It seems very important that the teachers have experience with project-based teaching and value students' ownership in the process of the activity. The experience that the teachers have from their previous projects has been crucial for raising students' interest, planning and coordination. The teachers have helped students in resource management and communication with external partners. The relevance of the project idea has proven to be very important also in winning quality external partners which have agreed to volunteer in this collaboration with the students.

7. Challenges

The biggest challenge of the project is its professional complexity. This has been balanced by taking a longer time for implementation (6 months) and by setting realistic goals (vision presented by a 3D model). Although the students' design might not be used for the development of the new school building, the project was very successful in the aspect that students had the opportunity to learn through a meaningful hands-on experience. The project also raises awareness of the local authorities about the issue and the potential solutions that can be developed (at least partially) even by students.

There were several risks that students might get demotivated or discouraged either by the slowness of the administration system, by lack of understanding from the local authorities, or by the complexity of the task. It is admirable that the students persisted and have implanted a variety of activities showing very different skills (such as abstract reasoning, building of concrete models, presentations etc.).

8. Reflective remarks

The sustainable school of the future was a very successful project that combined many aspects of engineering, science, environmental studies and active citizenship. Such interdisciplinary approach is based on many interactions between the students, STEM teachers and various experts, and hence provides many learning opportunities. The biggest advantage of the project is that the students and teachers are motivated to make research by a problem that is so close and relevant to them. Because of these aspects the ICSE Factory team in Croatia considers this project to be a flagship-activity of open-schooling and has awarded the school team as the best open-schooling activity at the national science fair. We believe that the high quality of the results and the creative presentation will serve to engage other schools.

9. Outcomes

In this project the students have developed a vision, a design, a virtual model and a 3D concrete model for a sustainable school of the future. Through this activity, students have learned how to think about sustainability topics in the context that is very close and important to them. The project results have been presented to the local community (parents and others in the school) and to the Croatian partners in the consortium. The presentation has been subjected to evaluation, and the activity has been recognized as the best project at the national ICSE science fair. This confirms the high quality of the outputs.
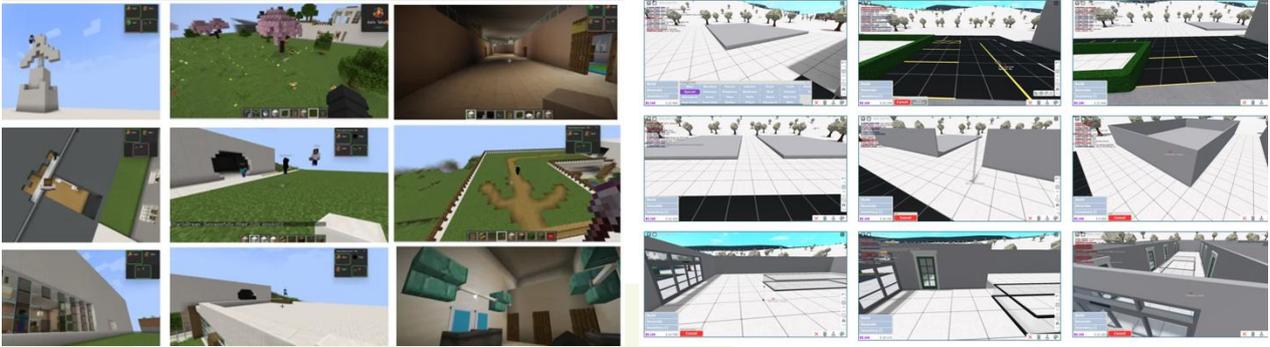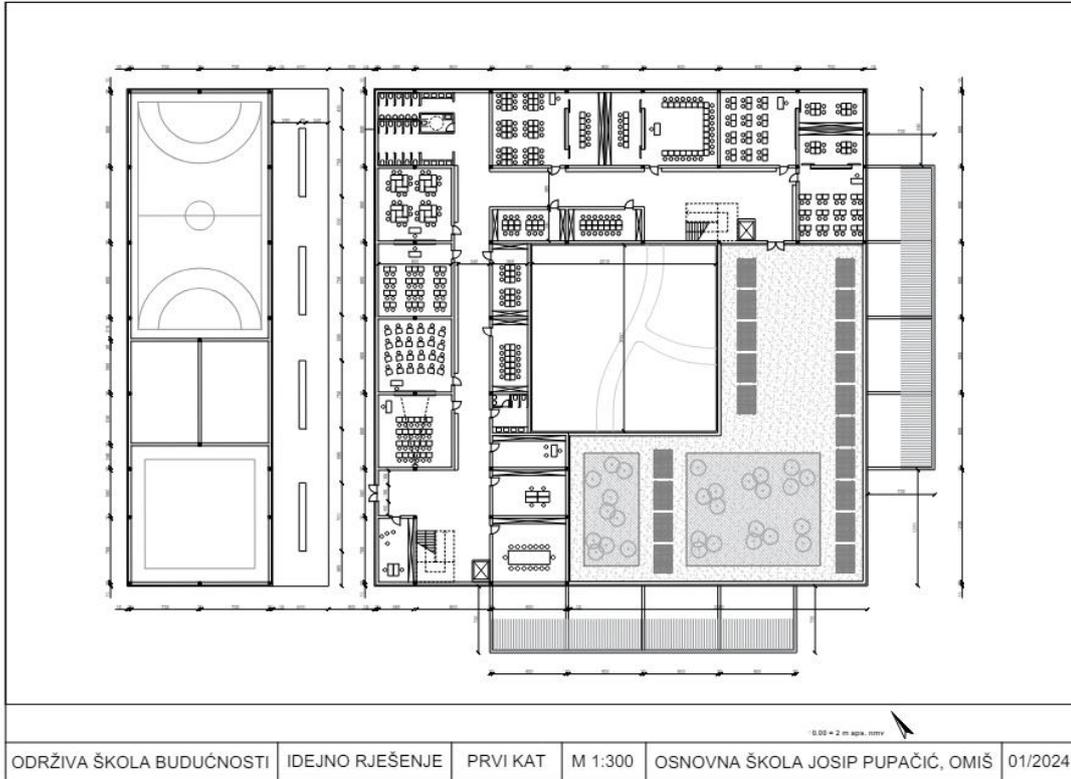
Additional materials

7. THE 3D MODEL
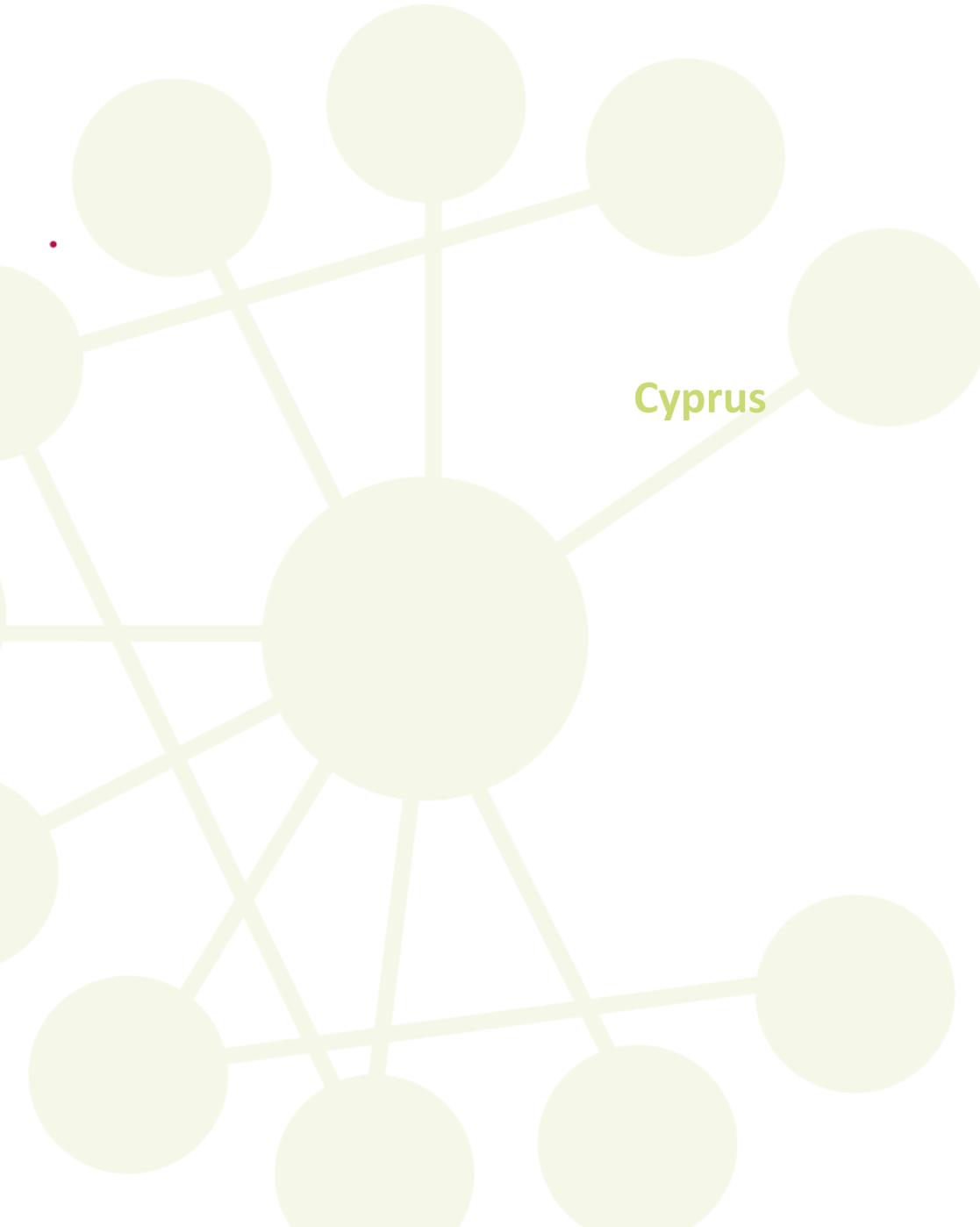

8. MEETING WITH THE ARCHITECT, MRS. IVONA BULJEVIĆ

9. MINECRAFT I ROBLOX

10. AutoCAD

| ODRŽIVA ŠKOLA BUDUĆNOSTI | IDEJNO RJEŠENJE | PRVI KAT | M 1:300 | OSNOVNA ŠKOLA JOSIP PUPAČIĆ, OMIŠ | 01/2024 |

Cyprus

Green City

1. **Activity**

   Name of the activity: Green City

   Topic(s): Green Deal, Health

   Date: June 2024

   Local: UNIC

   Duration: 5 days

   Partners involved: UNIC

   Target group: students

   Number of participants: 15

   Number of female participants: 6

   Age of the participants: 11-14

2. **Summary**

   The Green City activity was conducted as part of a summer school hosted at the University of Nicosia (UNIC), where students explored the principles of sustainable urban planning and environmental responsibility. The activity centered around the concept of designing cities that prioritize green spaces, renewable energy, and low environmental impact. With the support of two visiting physicists, students engaged in hands-on learning, collaborative discussions, and creative problem-solving. The outcome of the activity was the construction of a detailed model of a sustainable "green city," which reflected students' understanding of eco-friendly technologies, urban systems, and climate-conscious living. The project successfully combined science, engineering, and design in a dynamic, informal educational setting.

3. **Description of the implementation process of the activity**

   The Green City activity was implemented during a summer school program hosted by the University of Nicosia (UNIC), offering students a unique opportunity to engage with sustainability concepts in an informal yet structured educational environment. The activity was designed to introduce students to the principles of green urban planning, including energy efficiency, smart infrastructure, public transport, renewable resources, and the role of nature in urban environments.

   At the beginning of the activity, students were introduced to the key features of a sustainable city through presentations, brainstorming sessions, and guided discussions. They explored topics such as

solar energy, green roofs, recycling systems, pedestrian-friendly design, and urban biodiversity. Students worked in teams to research existing green cities and identify best practices that could inspire their own design.

- A key feature of the activity was the involvement of two visiting physicists, who collaborated with the project team and offered scientific support throughout the process. These scientists introduced students to the physics behind renewable energy systems, energy consumption, and urban microclimates, providing real-world relevance and depth to the scientific content. Their presence helped demystify scientific careers and offered role models for the students.

Following the research phase, students moved on to designing and constructing a physical model of their "Green City." This phase emphasized teamwork, engineering design, spatial planning, and creative
- thinking. The students used recycled and craft materials to represent green infrastructure elements such as solar panels, public transport systems, parks, vertical gardens, and water-saving technologies.

The model served not only as a visual product but also as a communication tool for students to present their ideas to peers, educators, and invited guests. Throughout the process, the emphasis remained on inquiry-based learning, practical application of scientific concepts, and fostering a vision of sustainable living.

The activity concluded with a group reflection session, where students shared what they learned, discussed challenges, and suggested improvements to their city model. This reflection deepened their understanding and highlighted the importance of science and engineering in building more sustainable futures.

4. Strategies to win schools

In the case of the Green City activity, there was no need to directly engage or "win" schools, as the activity was embedded within a summer school program hosted by the University of Nicosia (UNIC) under the project. Participation was open to students who voluntarily enrolled in the program, which was designed to provide interdisciplinary, hands-on STEM learning experiences during the summer break.

5. Schools support

Although the *Green City* activity did not involve formal collaboration with schools during the academic year, structured support was provided to students within the framework of the summer school program. The support system focused on mentoring, resource accessibility, and scientific guidance throughout the activity's implementation.

1. Scientific Mentorship

A key element of support was the active involvement of two visiting physicists, who worked directly with the students during the activity. These scientists provided expert input on energy efficiency, renewable resources, and the physical principles underlying sustainable technologies (e.g., solar panels, wind energy, thermal insulation). Their presence enriched the learning experience, clarified scientific concepts, and served as an inspiration for students to explore STEM careers.

2. Facilitator Guidance

The summer school facilitators, including members of the ICSE Science Factory team, provided ongoing coordination and educational support. They guided students through the stages of inquiry, model design, construction, and reflection. Facilitators ensured that the activity remained student-centered while offering help where needed in team organization, problem-solving, and presentation preparation.

3. Access to Materials and Creative Tools

Students were given access to a variety of craft materials, recycled resources, and visual aids to help construct their physical city model. This practical support allowed students to bring their ideas to life and visualize the real-world implications of their designs.

4. Encouragement of Peer Collaboration

The facilitators encouraged collaboration and supported team dynamics throughout the project. Students worked in mixed groups, sharing ideas and distributing tasks in a way that fostered communication, cooperation, and mutual learning.

6. Key-success factors

The success of the Green City activity stemmed from a combination of strategic design elements, a supportive learning environment, expert involvement, and high student motivation. Several key factors contributed to the effectiveness and impact of the activity:

1. Informal Learning Context

Conducting the activity within a summer school program allowed for a focused and immersive learning experience. The informal setting removed many of the constraints of the regular school timetable.

2. Participation of Real Scientists

The involvement of two visiting physicists played a critical role in enriching the educational experience. Their guidance gave students access to authentic scientific knowledge, particularly in areas like

renewable energy and energy-efficient technologies. They also served as approachable role models, helping students envision themselves in future scientific or engineering roles.

3. Student-Centered, Project-Based Approach

Students were at the heart of the activity—responsible for researching sustainability concepts, proposing design solutions, and building their model. This inquiry-based, creative process fostered ownership, engagement, and deeper learning. The hands-on construction of the city model enabled students to visualize and apply abstract concepts in a concrete, collaborative task.

7. Challenges

Although the summer school format allowed more flexibility than traditional schooling, the activity was still constrained by the short duration of the program. This limited the time available for in-depth exploration of some scientific and engineering aspects (e.g., detailed calculations for energy use, urban climate modeling).

8. Reflective remarks

The Green City activity demonstrated how informal learning environments—such as summer schools—can serve as powerful spaces for interdisciplinary exploration, creativity, and student empowerment. By engaging with sustainability challenges through hands-on design and scientific inquiry, students developed not only knowledge but also a sense of agency and responsibility toward their environment and communities.

One of the most striking outcomes of the activity was the students' enthusiasm for envisioning a better future. Given the freedom to create their ideal city, they approached the task with imagination, and collaboration. The construction of the physical model was more than a creative exercise, it became a platform for expressing values such as equity, environmental care, and innovation.

The presence of real scientists was especially impactful. Their involvement grounded the project in authentic science, provided mentorship, and helped students connect abstract concepts with real-world applications. Many students shared that this was their first experience working directly with scientists, which made science feel more approachable and attainable.

At the same time, the activity underscored the importance of time, flexibility, and differentiated support in open schooling. While not all ideas could be fully developed within the limited duration of the summer program, the activity laid the foundation for deeper inquiry and future learning.

9. Outcomes

The Green City activity produced a range of positive outcomes that extended beyond content knowledge, fostering student creativity, scientific reasoning, and civic engagement. Conducted in an informal summer school setting, the project provided a meaningful learning experience that blended environmental science, design, and collaboration.

Scientific Engagement through Real Experts:

The participation of two physicists created meaningful interaction between students and scientists. Students received guidance on technical aspects (e.g., how solar panels work, or how cities absorb and radiate heat), and some showed increased interest in science careers as a result.

Peer Learning and Collaboration:

Working in teams encouraged students to negotiate ideas, divide responsibilities, and value diverse contributions. These interpersonal dynamics were especially valuable in a summer school context, where many students were meeting for the first time.

Increased Environmental Awareness:

Many students reported a deeper awareness of how everyday decisions—such as energy use, transportation, and city planning—affect the environment. They left the program with a clearer understanding of what makes a city sustainable and how they, as future citizens, could contribute to more livable urban environments.

10. Additional materials

Submit relevant documentation like photographs of the activity, participant worksheets used, educational materials developed, etc.

Interactive Botanical Garden

1. **Activity**

   Name of the activity: Interactive Botanical Garden

   Topic(s): Green Deal, Digitalization

   Date: February 2025

   Local: Nicosia

   Duration: 3 months

   Partners involved: UNIC, CPI, PAGKYPRION GYMNASION

   Target group: students, community members

   Number of participants: 7

   Number of female participants: 4

   Age of the participants: 14

2. **Summary**

   The Interactive Botanical Garden activity engaged students in exploring the properties of aromatic plants and examining how climate change impacts their growth and sustainability. Blending scientific research with digital tools and entrepreneurship, students conducted investigations into plant characteristics, created QR codes linking to digital content about each plant, and designed a model of their envisioned garden. The activity also encouraged students to think creatively about how their project could be linked to real-world applications, including entrepreneurial ideas such as product development or community use. This Open Schooling Activity connected science with technology, environmental awareness, and business thinking in an interdisciplinary, student-driven learning experience.

3. **Description of the implementation process of the activity**

   The Interactive Botanical Garden activity was implemented over several months and offered students the opportunity to explore the relationship between science, nature, and entrepreneurship. The project was introduced to teachers through the ICSE Science Factory network, and participating educators initiated the activity within their classrooms with ongoing support from the project team.

   The activity began with students investigating a selection of aromatic plants, focusing on their properties, uses, and ecological requirements. Working in teams, students conducted research supported by their teacher, on the medicinal, culinary, or cosmetic value of these plants and examined how climate change

might affect their growth and sustainability. This scientific inquiry connected the curriculum with real-world environmental challenges.

To bring a digital dimension to their project, students created QR codes for each plant. These codes linked to multimedia content, explaining the plants' characteristics and benefits. This step encouraged students to think about how scientific information can be effectively communicated to the public.

Students then built a physical model of their envisioned botanical garden, showcasing both the spatial layout and the selection of plants. The model was used for presentations within the school and at external events, acting as a tangible output of their research and teamwork.

In the final phase, the activity incorporated entrepreneurial thinking. Students were encouraged to imagine how their garden could evolve into a real-world initiative. Ideas included producing and marketing herbal products, creating a learning space for younger students, or promoting their garden as an eco-tourism site. This component helped students understand how science can lead to innovation and social impact.

The activity was characterized by high levels of student creativity and initiative, supported by structured guidance from the participating teacher. Students progressed through the stages of research, design, digital production, and business planning, resulting in an interdisciplinary experience that combined science, technology, and creativity.

4. Strategies to win schools

In the case of the Interactive Botanical Garden, the activity was initiated internally by a motivated school team committed to interdisciplinary, project-based learning. Rather than requiring external outreach, the project emerged organically from teacher-led initiatives that aligned with both student interests and curriculum goals.

Key strategies that contributed to successful school engagement included:

Teacher Leadership and Professional Development: The teacher who facilitated the activity had previously participated in the training programs provided at the beginning of the ICSE Science Factory project. These trainings helped build the necessary pedagogical and methodological foundation for implementing open schooling approaches, and gave the teacher confidence to design and carry out the activity independently within the school setting.

Strong Internal Motivation and School Vision: The school demonstrated a proactive approach by integrating the activity into its broader vision for creative and interdisciplinary education. Teachers took an active role in guiding and mentoring students throughout all stages of the project.

- **Local and Cultural Relevance:** The focus on aromatic plants, widely known in the local context, made the activity especially engaging for students. By researching the plants' medicinal, culinary, and traditional uses, students connected science learning to their heritage and everyday experiences.

Interdisciplinary and Practical Framing: The activity combined science, technology (QR codes), environmental awareness, and entrepreneurship, offering multiple points of engagement. This interdisciplinary structure appealed to a wide range of student interests and strengths.

- **Public Engagement and Recognition Opportunities:** Students developed a physical model (μακέτα) of their botanical garden and created QR codes linked to digital content describing each plant. These outputs were showcased during school events, giving students an authentic audience and reinforcing the real-world value of their work.

Student Ownership and Active Participation: Students played a central role in designing the garden, selecting and researching plants, producing content, and proposing entrepreneurial ideas. This high degree of involvement fostered autonomy, creativity, and a sense of ownership over their learning.

5. Schools support

While the *Interactive Botanical Garden* activity was initiated and implemented primarily through the initiative of the school, it was supported by the ICSE Science Factory project through a combination of early training, pedagogical resources, and ongoing encouragement.

1. Teacher Training and Capacity Building

The teacher leading the activity had participated in the initial professional development sessions offered at the beginning of the project. These training programs introduced open schooling principles, interdisciplinary design approaches, and examples of successful student-led activities. This early preparation equipped the teacher with the knowledge and confidence to design and facilitate the activity independently.

2. Access to Pedagogical and Methodological Resources

The project provided educators with open schooling frameworks, planning templates, and sample activity formats, which helped in structuring the activity to align with both educational standards and

student interests. These resources were adapted by the teacher to suit the theme of aromatic plants and climate change.

3. Ongoing Communication and Mentoring

Although the activity was school-driven, the ICSE Science Factory team maintained regular communication with the teacher, offering feedback and support as needed. This included answering questions, sharing ideas from other schools, and helping identify opportunities for student presentation and dissemination.

4. Visibility and Dissemination Support

The project encouraged the documentation and sharing of the activity's outcomes. The students' creation of a poster, physical model, and digital QR codes were supported with guidance on how to present their work to peers, educators, and the community. This strengthened the outreach dimension of the project and provided recognition for the students' efforts.

5. Flexibility and Trust in Educator Leadership

One of the most important forms of support was the space and flexibility given to teachers to implement the activity in a way that fit their school context. The trust placed in teacher autonomy was essential in allowing the project to grow organically while still aligning with the broader goals of the ICSE Science Factory.

6. Key-success factors

The success of the Interactive Botanical Garden activity can be attributed to several interrelated factors, including strong educator leadership, student ownership, local relevance, and an interdisciplinary approach. These elements worked together to transform a school-initiated idea into a vibrant Open Schooling Activity that combined science, culture, digital tools, and entrepreneurship.

1. Empowered and Trained Educator

A key success factor was the teacher's active role in designing and facilitating the activity. Having participated in the initial ICSE Science Factory training, the teacher was equipped with both the pedagogical tools and the confidence needed to lead an open, student-centered project. Their ability to guide the students through inquiry, creativity, and presentation phases ensured a coherent and impactful learning experience.

2. Local Relevance and Cultural Connection

Focusing on aromatic plants grounded the activity in local tradition and everyday knowledge. Students

were naturally curious about the plants' uses in Cypriot culture (culinary, medicinal, and aromatic) which increased their engagement and made the scientific investigation more meaningful.

3. Integration of Disciplines and Real-World Applications

The activity successfully blended environmental science, digital technology (QR codes), sustainability, and entrepreneurship. This interdisciplinary framework appealed to a wide range of student interests and helped them see how science is connected to both everyday life and future opportunities.

4. Student Ownership and Creativity

Students were involved in every stage of the activity, from researching plants and creating digital content to designing a physical model of the garden and proposing entrepreneurial applications. This high level of student agency fostered motivation, creativity, and a sense of pride in their work.

5. Visibility and Community Engagement

The development of a public-facing output, including QR codes and a poster presentation, encouraged students to think beyond the classroom. This gave them a platform to share their knowledge and helped strengthen the connection between the school and the wider community.

7. Challenges

While the *Interactive Botanical Garden* activity was successfully implemented and well-received by students, several challenges emerged during the process. These challenges primarily related to interdisciplinary collaboration, time constraints, and the complexity of balancing innovation with formal school structures.

1. Limited Interdisciplinary Support Among Staff

Context and Impact:

Although the lead teacher envisioned the activity as an interdisciplinary project (combining science, technology, environmental education, and entrepreneurship) efforts to engage other subject teachers were largely unsuccessful. Despite seeking support to enrich the project through cross-curricular collaboration, colleagues were unwilling or unavailable to participate. This limited the breadth of perspectives and skills that could have enhanced the overall implementation.

Response and Resolution:

The lead teacher proceeded independently, adapting materials and guiding students through all phases of the project. While this ensured continuity, it placed a considerable workload on a single educator and reduced the interdisciplinary depth that could have been achieved.

Lesson Learned:

For future implementations, more emphasis should be placed on fostering a shared culture of collaboration within schools. Presenting interdisciplinary projects as opportunities for professional visibility and innovation could encourage broader staff involvement.

2. Time Constraints Within the School Year

Context and Impact:

As with many Open Schooling Activities, time constraints posed a challenge. The activity had to be implemented alongside ongoing school responsibilities, exams, and other activities. This sometimes slowed progress and placed pressure on both teacher and students.

Response and Resolution:

The flexible nature of the project allowed the teacher to pace the activity across several weeks. Students also demonstrated strong commitment by working on parts of the project outside of class time. This voluntary engagement was a positive outcome of the activity's relevance and appeal.

Lesson Learned:

Building time for open schooling into the school calendar from the beginning and integrating such activities into core subject areas could ease pressure and support sustainability.

8. Reflective remarks

The *Interactive Botanical Garden* activity demonstrated how Open Schooling can empower students to connect science with their environment, culture, and community in meaningful ways. By investigating aromatic plants, using digital tools, and engaging in entrepreneurial thinking, students experienced science as a creative, interdisciplinary, and socially relevant field.

One of the most powerful aspects of the activity was the high level of student ownership. From selecting and researching the plants to designing the garden model and creating QR content, students showed commitment, creativity, and curiosity.

The experience also underlined the importance of teacher agency and preparation. The participating teacher, equipped through the initial training, was able to independently plan and implement the activity. However, the lack of engagement from other staff revealed a common challenge: while individual educators may embrace interdisciplinary work, broader school collaboration does not always follow. This suggests a need to build stronger interdisciplinary cultures within schools, supported by leadership and shared planning time.

Ultimately, the activity proved that when students are given the freedom to explore science in context and are supported by motivated educators, they can produce meaningful work that bridges the gap between school and society. It also reminded us that systemic support and team-based approaches are essential for sustaining such initiatives in the long term.

9. Outcomes

The *Interactive Botanical Garden* activity resulted in multiple educational and personal outcomes for students, while also showcasing the potential of Open Schooling to foster creativity, sustainability, and entrepreneurial thinking.

Student Learning and Engagement:

Students developed a deeper understanding of biodiversity, climate change, and the properties of aromatic plants. They strengthened their skills in collaboration, digital literacy, and creative communication by designing QR codes, preparing a model of their garden, and presenting their ideas visually and verbally.

Connection to Real-World Issues:

By exploring how climate change affects plant ecosystems and proposing ways to use plant-based products (such as teas and essential oils), students connected science learning to local traditions, environmental concerns, and sustainable economic practices. This real-world framing gave their work purpose and relevance beyond the classroom.

Entrepreneurial Awareness:

Through brainstorming potential uses for their garden and related products, students were introduced to the principles of social entrepreneurship and eco-innovation, helping them see how science can lead to meaningful contributions to their community and local economy.

Thermal Heat Island

1. Activity

Name of the activity: Thermal Heat Island

Topic(s): Green Deal, Digitalization

Date: October 2024

Local: Limassol

Duration: 6 months

Partners involved: Lanitio High School/CPI/UNIC

Target group: students, teachers, community members

Number of participants: 40

Number of female participants: 22

Age of the participants:15-17

2. Summary

The "Thermal Heat Island" activity aimed to engage students in investigating the environmental phenomenon of urban heat islands through real-world data collection and analysis. By using digital sensors to measure temperature variations across different locations such as urban, suburban, and rural areas, students explored how the different location characteristics influence local climate conditions. The activity encouraged active participation, scientific inquiry, and critical thinking, while also promoting environmental awareness. It was designed as a collaborative initiative between educators from a public school, and external partners, with students sharing their findings at a science fair, conferences, and school exhibitions.

3. Description of the implementation process of the activity

The implementation of the "Thermal Heat Island" activity spanned a period of six months and began with an introductory phase led by the project team. During this phase, the team visited the participating schools to present the overall aims and scope of the ICSE Science Factory project. These visits served as a foundation for relationship-building and created a shared understanding of the project's goals among students and teachers.

As part of the co-design approach, students were given the opportunity to brainstorm and propose themes related to science and their local environment. Through guided discussions, they selected the

Funded by
the European Union

topic of Urban Heat Islands as a meaningful and relevant area to explore. This participatory element increased their sense of ownership and engagement from the outset.

Following the preparation phase, students were introduced to the objectives of the activity and organized into small working groups. They identified specific locations in their communities (urban areas, schoolyards, parks, and rural surroundings) where they would measure and compare temperature variations using portable sensors and data loggers. Measurements were taken at various times of day, over multiple days, to ensure reliable data.

As a key milestone, students analyzed their collected data by creating visual representations such as charts and graphs. These were used to draw conclusions about the factors contributing to urban heat accumulation and to reflect on potential mitigation strategies. Discussions were facilitated by teachers, helping students connect their findings to broader environmental and societal challenges.

The final months focused on preparing students to share their results in public forums, including science fairs, school events, and local environmental conferences. This phase emphasized communication skills and fostered a sense of scientific contribution and civic engagement.

Throughout the process, student engagement was maintained through hands-on exploration, the relevance of the topic to their own communities, and the opportunity to showcase their work to authentic audiences. The use of digital tools and active inquiry proved particularly effective in sustaining interest and deepening understanding.

4. Strategies to win schools

To successfully engage the school in the activity, a multi-pronged strategy was employed, combining personal outreach, targeted communication, and practical support. The following approaches were particularly effective:

1. Direct Outreach and School Visits

At the start of the project, the ICSE Science Factory team organized in-person visits to participating schools. These visits were crucial for introducing the project's aims and scope, establishing trust, and initiating dialogue with school leaders, teachers, and students. By engaging schools early in the planning phase, the team created a sense of shared ownership and enthusiasm for the activity.

2. Co-Design with Students and Teachers

Rather than imposing a predefined activity, the project allowed students and teachers to co-develop the theme based on their interests. This participatory approach was presented as a key feature during

outreach, which made the offer more appealing to schools by emphasizing flexibility, creativity, and student agency.

3. Support Through Equipment and Training

A major incentive for the school was the provision of technological equipment (e.g., temperature sensors).

4. Visibility and Recognition Opportunities

The school was informed that students would have the chance to present their findings at science fairs, conferences, and local community events. This opportunity for public recognition was a strong motivator for school participation, as it aligned with their goals for student achievement and visibility.

6. Communication and Promotional Materials

Clear, well-designed informational materials were distributed to the school, explaining the purpose, timeline, and benefits of the project. These materials included examples, of activities from our partners in the project.

5. Schools support

Throughout the implementation of the Thermal Heat Island activity, a structured and multifaceted support system was established to ensure that participating schools had the necessary resources, knowledge, and guidance to successfully carry out the Open Schooling Activity.

1. Provision of Technological Equipment

Each participating school was equipped with digital temperature sensors and data loggers. These were essential for conducting accurate and meaningful environmental measurements. Instructions for safe and effective use were provided alongside the equipment.

2. Ongoing Mentoring and Communication

Continuous communication between the project team and the schools was maintained throughout the six-month duration. This included:

- Scheduled check-ins (via email and video calls)
- A designated contact person from the project team for each school
- Troubleshooting technical or logistical issues as they arose
- Sharing progress updates
- Mentoring was individualized and responsive to the school's pace and specific needs. Teachers were encouraged to share feedback regularly, which helped refine the support provided.

3. Recognition and Motivation

Schools were supported in preparing students for public dissemination of their results. The project team helped coordinate their participation in science fairs and events, providing logistical assistance and visibility for their efforts. This recognition motivated students and validated teachers' work.

4. Post-Implementation Support

After the conclusion of the activity, schools were given suggestions for follow-up activities and ways to further integrate environmental science themes into their curriculum. Opportunities for continued collaboration with the ICSE Science Factory network were also offered.

6. Key-success factors

The successful implementation of the Thermal Heat Island activity can be attributed to a combination of well-planned coordination, meaningful stakeholder engagement, and hands-on, student-centered learning. Several strategic and operational elements were particularly critical:

1. Early and Transparent Planning

The project team's proactive approach (beginning with in-person school visits and a clear presentation of the project's aims) laid a strong foundation of trust and mutual understanding. Early involvement of both teachers and students in the brainstorming and topic selection process gave participants a sense of ownership that significantly enhanced their motivation.

2. Co-Design and Relevance of the Topic

Allowing students to contribute to the design of the activity, and ultimately choose the theme of Urban Heat Islands, ensured that the topic was meaningful and contextually relevant. This student-driven approach enhanced engagement and supported deeper learning by linking science to real-life experiences.

3. Effective Resource Management and Support

The provision of technological tools (sensors and data loggers), ensured that schools were well-equipped and confident to carry out the activity. The balance between independence and structured support enabled schools to adapt the activity to their own context without losing direction.

4. Ongoing Mentoring and Responsiveness

A continuous mentoring model, with dedicated points of contact, regular check-ins, and prompt troubleshooting, ensured that any emerging challenges were addressed swiftly. This responsive communication helped build strong relationships with teachers.

5. Public Presentation Opportunities

Providing students with the opportunity to share their results at conferences, science fairs, and public events added an authentic purpose to their work. This visibility not only motivated students but also reinforced the value of the activity to school leaders and parents, strengthening school commitment.

7. Challenges

The main challenge encountered during the implementation of the *Thermal Heat Island* activity was related to **time constraints** within the formal school schedule.

Context and Impact:

Due to tight academic calendars, marked by exams, holidays, and curriculum demands, it was often difficult for techers to allocate sufficient time within regular lessons for the full implementation of the open schooling activity. This occasionally delayed certain phases, such as data analysis and preparation for dissemination events.

Response and Resolution:

To manage this, the project adopted a flexible timeline, encouraging the participants to adapt the activity based on their availability. However, a notable and encouraging response came from the students themselves: many were willing to extend their involvement beyond regular school hours, working on data collection, analysis, and presentation preparation during after-school sessions. This voluntary engagement highlighted their strong interest in the topic and sense of ownership over the project.

Lesson Learned:

While time constraints remain a structural barrier to integrating open schooling into formal settings, this experience revealed that when science activities are meaningful and connected to students' interests and real-world contexts, engagement increases to the point that students are willing to invest their personal time. Future open schooling initiatives, could build on this by creating optional after-school or hybrid models and by initiating earlier discussions with school management to secure time blocks during the school year.

8. Reflective remarks

The *Thermal Heat Island* activity offered valuable insights into both the potential and the challenges of implementing open schooling approaches within formal education settings. One of the most significant reflections emerging from this activity is the power of student agency and contextual relevance in driving

engagement. By allowing students to participate in the decision-making process and select a topic closely connected to their environment, the project fostered a sense of ownership, curiosity, and responsibility. Another key takeaway is the importance of flexibility in both design and implementation. While structural constraints such as limited curriculum time posed real challenges, the willingness of students to extend their participation beyond school hours demonstrated that when science speaks to students' realities, they are motivated to engage deeply and meaningfully. This reinforces the need for future initiatives to remain adaptable and responsive to school contexts while maximizing opportunities for voluntary, interest-driven learning.

The collaborative dynamic between schools and the project team proved essential. Regular communication, personalized mentoring, and timely support ensured that educators felt supported throughout the process, while students benefited from a structured yet open learning environment.

Moreover, the activity highlighted the value of bridging school science with the broader community. Opportunities for students to present their findings publicly not only elevated the quality of their work but also contributed to a wider dialogue around environmental issues, positioning students as active contributors to community knowledge.

In summary, the *Thermal Heat Island* activity demonstrated that open schooling can thrive when rooted in student interests, supported by flexible structures, and enriched by collaboration. It serves as a reminder that meaningful science education extends beyond the classroom and that young people are eager to participate when given the chance to explore real-world issues through hands-on inquiry.

9. Outcomes

The *Thermal Heat Island* activity resulted in several meaningful outcomes for both students and schools. Through active participation in real-world scientific inquiry, students not only developed research and data analysis skills but also gained a deeper understanding of environmental issues affecting their own communities.

Students expressed their gratitude for the opportunity to participate in a project that allowed them to take on the role of young researchers. Many reflected on how the experience made science feel more accessible, relevant, and empowering. In their own words, they appreciated "doing real science that matters" and "getting to work like scientists outside the classroom."

One of the most significant indicators of success was the students' desire to extend their work beyond the initial scope of the activity. Several groups expressed interest in using their data for a potential

publication or school-based report and proposed further collaboration with scientists from the Biology Department to explore the implications of urban heat islands for human health such as heat stress, pollution exposure, and vulnerable populations.

- Teachers also reported increased student engagement, especially among those who do not typically identify with science subjects. They observed improved teamwork, communication, and critical thinking skills.

  The presentations held at public events and science fairs were well received and gave students a platform to share their findings with the wider community, reinforcing their confidence and their role as contributors to public knowledge.

- **10.** Additional materials

  Submit relevant documentation like photographs of the activity, participant worksheets used, educational materials developed, etc.

Germany

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Dysphagia-Cooking

1. Activity

Name of the activity: Dysphagia-Cooking

Topic(s): Health

Date: 28.11.24-05.12.24

Local: Wolfach

Duration: 2 Weeks

Partners involved: ICSE, vocational schools Wolfach, nursing home Hausach

Target group: Students

Number of participants: 8

Number of female participants: 8

Age of the participants: 15-18

2. Summary

The pupils at BS Wolfach were given an introduction to the topic of "dysphagia" and cooked an adapted menu in the school's teaching kitchen and later prepared it for residents of a care home. Due to their consistency, these dishes were also suitable for people with swallowing difficulties (dysphagia). They used the methods and means of molecular cuisine for this purpose. The event and the recipes were documented and also presented at the ICSE Science Factory trade fair in Freiburg.

3. Description of the implementation process of the activity

The two-year vocational school for home economics at the vocational schools in Wolfach consists of only eight students this school year. Practical food preparation is an important part of their school education. As "special forms of nutrition" are also part of the curriculum, the teacher, Ms. Haas, was able to integrate the project well into the lesson plan. The main part of the project therefore took place on two Thursday mornings, but some of the pupils already had prior knowledge as they had already taken part in a project on molecular cuisine during the project days in July 2024. The students were able to work in a well-equipped school kitchen at professional kitchen level. The components of the meal were divided up among the pupils. These components were essentially

Cauliflower soup

Bratwurst

Rösti

Vegan gravy

- Soft chocolate

Cinnamon foam

The students prepared these ingredients in groups of two, depending on the amount of work involved. Essentially, all the ingredients were pureed in intermediate steps and then bound back into silicone molds with suitable texturizers. The aim was to create a visually appealing menu that conformed to the requirements of the disease.

- After the test cooking on the first date, the quantities were increased on the second date. At the same time as cooking, a beautiful table was set so that the senior citizens, who were brought by minibus, also had an attractive setting. The students made every effort to prepare and serve the food as attractively as possible.

The students presented their designs to the public at the ICSE Science Factory fair on 14.2.25. In addition to a poster with pictures and recipes from the project, visitors were also able to see a sample plate that was frozen while cooking.

4. Strategies to win schools

Contact was made via personal contacts. BS Wolfach is the home school of one of our employees, who made contact with the specialist teacher. In our experience, it is easier to convince teachers on a content-related level by talking about what a project could look like in terms of content, and not about the general concept of Open Schooling. We also promoted the same project via posters, flyers, our newsletter, at a convention with the partner schools and at a public science festival, but nothing came of it. The underlying problem here could be that the majority of grammar schools were approached, whereas home economics and health topics are much more strongly represented at vocational schools and also at Werkrealschulen and Realschulen through subjects such as "Home Economics".

5. Schools support

The teacher in Wolfach, Ms. Claudia Haas, is a trained home economist herself and has worked in care homes for several years. As we were able to draw on her knowledge and contacts, ICSE's contribution in

this case was limited to procuring the special ingredients and utensils (binding agents, silicone molds, precision scales, specialist literature). Although one person from ICSE was present at times during the two sessions, they only contributed to the teaching process at the beginning with advisory comments.

- Arrangements were made with the teacher in advance regarding the menu. Communication took place via email and private telecommunication contacts. Afterwards, Ms Haas and a person from ICSE attended a dysphagia cooking course with a professional chef specializing in this field.

The students' transportation costs to the trade fair in Freiburg were covered.

6. Key success factors

- The decisive factor for the success of the project was that the topic was well suited to the type of school and that there was enough time and excellent facilities available thanks to the integration into lessons. Thanks to the existing contact with the subject teacher, very efficient and smooth communication was possible. The visit from the residents of the nursing home made the cooking a real event, where each of the students understood the purpose.

- The students were highly motivated, the integration into the lessons and the contact with the senior citizens meant that there were many different aspects to the project and both more practical and more theoretical students were able to get involved. The visit to the fair was perceived and accepted as exciting.

- The teacher, with whom the project was carried out, found the topic so exciting due to her professional background and previous work in nursing homes that she subsequently took part in a corresponding dysphagia cooking course and brought the pupils to the trade fair in Freiburg as a class, despite the relatively long journey (approx. 100 km).

-

7. Challenges

- The questionnaires at the beginning of the project are long, repetitive and too complex for weaker students. This makes the students suspicious of the Open Schooling project at first, as they suspect that the project content may be similarly boring and poorly thought out. We therefore apologized when we handed out the questionnaires and promised that it would be more interesting afterwards. Of course, shorter questionnaires with fewer pointless questions would be better. It's really shameful to put the students through this!

- Since, at the end of the practical project, really old people with health problems were being cooked for, the work had to be done carefully. Under no circumstances should there be any risk of these people swallowing the food. For this reason, we had already prepared the individual ingredients once in the previous week and eliminated any problems.
- As the pupils tended to be less able young people, the theoretical explanations, e.g. on a chemical basis, had to be kept at a basic level so as not to frighten the pupils. At the same time, of course, they had to understand the basics.
- The visit to the trade fair posed a cost problem, which we solved by taking over the event.

8. Reflective remarks

The project worked very well overall, mainly due to the commitment and expertise of the teacher, who managed to involve the local retirement home.

A further test is already planned at a vocational college (vocational training) for nursing, where samples of the individual binders will also be tested in advance in order to avoid a problem caused by deviating batch properties.

The fair was very well received by the students, probably also because such events seem to be reserved for the grammar school sector, and they were pleased to see that they did not have to lag behind with their results.

The questionnaires are not acceptable in this form; it is not really justifiable to issue them.

9. Outcomes

- The students were committed to their work, both in cooking and hosting and at the fair.
- Posters were made for the fair, some of the students were available for interviews at the fair and presented their project there for the ICSE social media channels
- A report on the project was published on the school's homepage
- A report on the project was published in the official gazette of the town of Wolfach
- A report was published in the regional daily newspaper, another report on the trade fair visit will follow.
- ICSE submitted an article on the project, including recipes, to the German magazine for STEM teachers "MINT-Zirkel".

- The teacher is definitely interested in further cooperation.

10. Additional materials

We upload the following materials:

- Photos (of the cooking, the dishes and the seniors eating and presenting at the fair)
- Powerpoint slides from ICSE
- Poster at the trade fair
- Newspaper article Wolfach
- Article MINT Circle (German)

Designing Jigsaw Lamps

1. **Activity**

   Name of the activity: Designing Jigsaw Lamps

   Topic(s): Digitalization

   Date: 23.11.24-14.02.25

   Local: Kirchzarten

   Duration: 3 months

   Partners involved: ICSE, Marie-Curie-Gymnasium Kirchzarten

   Target group: Students

   Number of participants: 9

   Number of female participants: 3

   Age of the participants: 14-16

2. **Summary**

   In groups of 1-3, students from a math club developed their own new designs for "puzzle lamps", i.e. spherical lampshades that are assembled from many identical parts without gluing. The basis for this was the mathematical analysis of existing commercial designs. The tool they used was a plotter, which can be used to digitize and edit hand-drawn shapes and cut them out in large quantities.

3. **Description of the implementation process of the activity**

   The math club at the Marie-Curie-Gymnasium Kirchzarten meets on Saturday mornings throughout the year. The main part of the project therefore took place on two consecutive Saturday mornings. As the plotter was a bottleneck, the number of participants was actually limited to 8, but another pupil was keen to take part, so there were 9 pupils. The mathematical basics and analysis of the existing designs took about 90 minutes, and the students spent the rest of the first morning developing their first prototypes. In a first step, it was enough to plot just a few parts to see if the basic shape and the connections between the parts worked. These were then adapted and decorative elements were added and optimized. It usually took about 3-4 iterations from prototypes to the final design. In order to avoid congestion at the plotter at , mass production of the parts mainly took place not on the two Saturday mornings, but in the time in between and afterwards. The groups then completed their designs during

the second Saturday. For the following 3 months, the plotter was at the school and always accessible to the students so that they could make further copies of their lamps.

The students presented their designs to their parents, classmates and the public at the ICSE Science Factory fair on 14.2.25. In addition to the finished lamps, visitors were also able to see how the plotter works and understand the mathematical principles of the designs on a poster.

4. Strategies to win schools

Through personal contacts, we learned that there is a math club at this school and then wrote to the teacher in charge of this club to ask if he could imagine the topic for the math club. As he found the topic exciting, he agreed and advertised the project in his math club and easily found enough young people who wanted to take part. In our experience, it is easier to convince teachers and students on a content level by talking about what a project could look like in terms of content, rather than about the general concept of open schooling. We also promoted the same project via posters, flyers, our newsletter, at a convention with the partner schools and at a public science festival, but nothing came of it.

5. Schools support

A scientist from ICSE visited the math club on two consecutive Saturdays for one morning each. She explained to the students what Catalan solids are and brought lots of pictures of different puzzle lamps which the students analyzed (looking at the aspects of underlying solids, connections and ornamentation). She also brought a plotter that can be used for scanning and cutting and showed the students how to use it. The plotter remained at the school for three months from the start of the project. In addition to the plotter, ICSE also provided all the necessary materials (thick paper, lamp blanks, pens). On the two Saturdays, the young people received support with the iterative design of their lamps on request, but they actually worked very independently and hardly needed any help. On the second morning, the ICSE employee brought some input on the mathematical background, which was not absolutely necessary for the development of the design, but in which the students had shown a particular interest on the first Saturday. After that, hardly any support was needed, only organizational preparation for the fair and the subsequent extraction of the files from the plotter in order to use them later with the school's laser cutter. The students created the poster for the fair independently without the help of ICSE. During a break caused by a bottleneck at the plotter, a group of students asked themselves how to distribute lamp parts in three different colors so that parts of the same color are not next to each other and the colored lamp has as much symmetry as possible. Afterwards, the mathematician analyzed the

colored lamp developed by the group and gave the students the feedback that they had indeed found the best solution for such a coloring.

6. Key success factors

- It was crucial for the success of the project that enough time was set aside for it. Through the existing math club, it was already established that students take several Saturday mornings for something like this. It would probably also be possible to implement it as part of project days, for example. It would be inconceivable to implement this in the normal classroom.
- The students were highly motivated. If they hadn't chosen the topic themselves, they certainly wouldn't have been.
- The teacher in charge of the math club found the topic so exciting that he was willing to organize the project (including a visit to the trade fair), even though he had not worked with us before

7. Challenges

- The questionnaires at the beginning of the project are long and repetitive. This makes the students suspicious of the Open Schooling project at first, as they suspect that the project content might be similarly boring. We therefore apologized when we handed out the questionnaires and promised that it would be more interesting afterwards. However, shorter questionnaires would of course be better.
- As the students have a lot of freedom, they may not end up with a working design. In fact, the teacher in charge of the math club was a little worried at the beginning about whether they were up to the project. We responded to this in two ways: Firstly, it was important for us to emphasize that it is normal in projects (just like in research) that you don't know at the beginning whether it will work or what the end result will be. We invited them to take this risk and, in the event that their own design could not actually be made to work with the effort they could justify , to plot an existing design at the end. Secondly, we have pointed out that they can manage the risk of failure themselves: A relatively safe way to create your own working design is to simply make variations in the decorative elements on an existing design. Even small changes can create major visual variations. In addition, the selection of the basic body, which determines the number of parts, can be used to determine how complex it is to assemble the final lamp, as well as the respective prototypes beforehand. In fact, one student opted for a basic body with a large number of parts and a design that was not related to the ones we had already analyzed. Although

he developed a working design, he lost the desire to finish assembling the final version along the way. However, as he seemed satisfied overall, we saw no reason to intervene. Everyone else completed at least one of their own designs.

8. Reflective remarks

We think that the project was an experience of self-efficacy for the students, in which they independently created something beautiful with the help of mathematics that did not exist before. The fact that success was not guaranteed at the beginning enhanced this experience.

However, the conditions were very good: the students were highly motivated right from the start and the organizational framework of the math club provided sufficient time and a pleasant working atmosphere. It is not clear how well the success of the project could be repeated in more difficult conditions.

It turned out that the topic offers plenty of scope for students to find and work on mathematical questions spontaneously, such as possible distributions of colors, for which the young people received no input at all and still developed their own questions, hypotheses and solutions. This is certainly a great advantage of this topic and was surprising for us to this extent.

It would certainly have been nice to use the project to introduce the young people to the maker community. We didn't manage to show the young people platforms such as Thingiverse, where designs such as the cut files of their lamp parts can be shared, in the time we had available as part of the working group. It would also have been nice to use the lamps at a larger celebration or an Advent bazaar or another event at the school, for example. However, this would have been an additional organizational effort for the supervising teacher , who has already invested many hours of his free time in the project and the subsequent visit to the fair.

Through the two publications on the topic (see below), we hope that motivated teachers will be able to carry out similar projects in the future without our help - either as part of a working group, as in our case, or as a project by individual students, as is the case in Germany, for example, in many grades and types of schools, where all students work on a freely chosen topic.

9. Outcomes

- One pupil said after the first Saturday session: "I'm very glad I didn't go to my confirmation preparation instead

- When a student learned that ICSE cannot run the Open Schooling project at the school every year from now on because the ICSE Science Factory only lasts 3 years, he said "Tell the EU that this project should be continued. It's a good project!"

- The poster that the students created for the fair has been hanging in the school ever since. The teacher who runs the math club says he is often asked about it.

- The school recently acquired a laser cutter. It was purchased by a teacher who is not involved in the math club. So far, however, it has not been used. At the moment, the plan is to use the laser cutter to convert the lamp designs into plastic, which is not possible with the plotter.

- A report on the project is planned for the school's homepage.

- ICSE presented a poster session on the project at the international conference "Creative Mathematical Sciences Communications".

- ICSE contributed an article and a presentation to the international conference "Bridges" in which the design process and results were presented, which can be found here: https://archive.bridgesmathart.org/#gsc.tab=0

- ICSE submitted an article to the German magazine for STEM teachers "MINT-Zirkel" on what puzzle lamps have to do with mathematics and how they can be used in the classroom.

10. Additional materials

We upload the following materials:

- Photos (of the project, the finished results and the presentation at the trade fair)
- Powerpoint slides from ICSE (German)
- Poster at the "Creative Mathematical Sciences Communications"
- Article in Bridges Conference Proceedings 2025
- Article MINT-Zirkel (German, preliminairy version)

School Garden at IKG

1. **Activity**

   Name of the activity: School Garden at IKG

   Topic(s): *Green Deal*

   Date: 2022 to now

   Local:

   Duration: 2 years and ongoing

   Partners involved:

   - Holzbau Bambusch
   - City of Tuttlingen
   - J. Friedrich Storz (stone supplier)
   - Musikhochschule Trossingen
   - Multiple teachers and students from all disciplines at IKG

   Target group: *Students, teachers, and the whole school community*

   Number of participants: n>100

   Number of female participants:

   Age of the participants: 11

2. **Summary**

   The project "Our Dream School Garden of the Future" at Immanuel-Kant-Gymnasium emerged after the original school garden had to be demolished due to a complete renovation of the school. Initially, plans were made for a minimal replacement — a simple lawn — but students and teachers jointly advocated for a vibrant, multifunctional school garden. Supported by several awards, as Schulhofträume prize from Deutsche Kinderhilfswerk, the school developed a comprehensive outdoor learning space. The garden now includes a green classroom, a pond, bee colonies, experimental installations, digital learning environments, and artistic exhibits. Nearly all school subjects are involved in its use and ongoing development

3. Description of the implementation process of the activity

The project began with the initiative of students and teachers to reclaim a meaningful outdoor learning space. After winning a major funding prize, the school community collaboratively designed and constructed the new garden.

The implementation included:

Designing and building a greenhouse and garden house (with professional support and student CAD planning)

Creating insect habitats in the shape of historic landmarks

Constructing experiment boxes for natural science use

Developing interactive digital environments with CoSpaces

Producing a school song and logo

Designing artistic mosaics (e.g., *Metamorphoses* by Ovid)

Creating a sculpture of Immanuel Kant

Sourcing local materials like stones and willows for ecological installations

The process was interdisciplinary, hands-on, and included phases of research, planning, material procurement, creative production, and digital programming.

4. Strategies to win schools

This was a single-school initiative. However, internal engagement strategies were strong:

- Empowering student voice (e.g., student council co-deciding plans)
- Integrating the garden project into many subjects
- Using existing school structures (e.g., working groups, subject-specific classes)
- Public recognition through media and awards reinforced participation

5. Schools support

Internal support mechanisms were extensive:

- Continuous coordination by key teachers (notably Frau Kaltenbach)
- Subject-integrated project tasks
- Artistic and technical mentoring from staff
- External collaborations for building and recording
- Equipment, tools, and spaces provided by the school
- There is no indication of formal educational kits or external training materials.

6. Key-success factors

- A clear motivation: reclaiming a meaningful school garden
- Cross-disciplinary involvement and ownership by all subjects
- Tangible results (buildings, installations, digital outputs)
- Community recognition through prizes
- External partnerships that respected student design ideas
- The most successful engagement strategies included combining subject-specific goals with real-world application (e.g., Latin class creating mythological mosaics; science classes building experiment boxes).
- The most effective support strategy was likely the embedding of the project in many subjects, ensuring that all students had an entry point.

7. Challenges

It was a long-term project and required a long-term planning, coordinating the different stakeholders was challenging, also time constraints made it difficult. Also, the school board hat to be convinced that everything will work out.

8. Reflective remarks

This activity had a strong long-term impact on the school culture and learning environment. Objectives were met and exceeded: instead of a minimal green space, the school now has a lively, multi-use garden that continues to grow and evolve. The integration across almost all school subjects ensures long-term sustainability and relevance. Unanticipated outcomes include the high degree of ownership by students and the widespread curricular use.

For future implementations, scaling the model could be achieved by:

Developing toolkits for other schools

Sharing best practices through videos or workshops

Strengthening documentation and assessment of learning impact

The project could serve as a blueprint for school transformation through co-creation, sustainability, and digital innovation.

9. Outcomes

- Full restoration and expansion of the school garden
- Active, ongoing use in biology, geography, physics, ethics, Latin, art, interdisciplinary subjects
- Creation of a school identity song and logo
- Development of interactive digital learning spaces
- Strong student participation and public visibility
- Awards and recognition from national institutions
- Feedback from participants is not directly cited on the website, but the level of involvement suggests a high degree of enthusiasm and ownership.

10. Additional materials

Photographs, project updates, and descriptions are available on the official project page:

☞ Unser Traumschulgarten der Zukunft (BNE am IKG)

Materials include:

- Photos of mosaics, construction stages, and artistic installations
- Student programming projects in CoSpaces
- Articles about materials and partnerships

Here a press release: https://www.schwaebische.de/regional/tuttlingen/ikg-startet-ein-open-schooling-projekt-fuer-neuen-schulgarten-1633245

Portugal

Estuary water quality

1. **Activity**

   Name of the activity: Estuary water quality

   Topic(s): Digitalization/ Green Deal

   Date: March-May 2025

   Local: School Alfredo da Silva/ Tagus River Estuary

   Duration: more than 500 minutes

   Partners involved: IE-ULisboa, AE Alfredo da Silva

   Target group: Students, teachers, community members

   Number of participants: 20

   Number of female participants: 14

   Age of the participants:16-20

2. **Summary**

   This OSA aimed to help students understand environmental monitoring through hands-on scientific investigation, AI-assisted research, and laboratory analysis techniques. Students explored water quality parameters including temperature, pH, salinity, nitrites, and ammonia by collecting samples from the Tagus River estuary adjacent to their school in Barreiro. Using artificial intelligence tools like ChatGPT, Perplexity, and Machine Learning platforms with decision tree models, they researched reference values, validated analytical methods, and classified water samples as "healthy" or "polluted." The activity promoted critical thinking about AI reliability, environmental awareness, and professional laboratory skills while integrating Physics and Chemistry, Chemical Analysis, and Chemistry Safety and Environment curricula across 11th and 12th grade levels of the vocational course of Laboratory Analysis Technician.

3. **Description of the implementation process of the activity**

   Planning: The activity was designed following a training session on AI applications in scientific education led by a member of the IE-ULisboa. Three teachers collaborated to integrate content from Physics and Chemistry, Chemical Analysis, and Chemistry, Safety and Environment subjects across 11th and 12th grade classes.

Research Phase: Students worked in groups of 3-4 elements to research reference values for estuarine water parameters using AI tools including ChatGPT and Perplexity. Initial research covered pH, nitrates, nitrites, chlorides, salinity, temperature, dissolved oxygen, and conductivity. Based on research findings and available laboratory equipment, the scope was refined to focus on temperature, pH, salinity, nitrites, and ammonia.

Field Work: Due to the school's proximity to the Tagus River, water sampling and in-situ parameter measurement (pH and temperature) were conducted during QSA classes. Students collected samples directly from the estuary surrounding the school.

Laboratory Analysis Phase: In AQ classes, students performed various analyses on collected water samples using volumetric and potentiometric techniques, including acid-base, oxidation-reduction, and precipitation titrations.

AI Integration: Students used Machine Learning platforms with decision tree models, training algorithms to distinguish between "polluted" and "healthy" water based on parameter studies from estuarine waters.

Assessment: The project concluded with AI-assisted evaluation of water quality from samples collected in the Tagus estuary near the school.

Communication: The OSA culminated with student participation in a final school exhibition where they presented their findings to the remaining students, teachers, and parents, demonstrating their research process, laboratory techniques, and AI-powered analysis results.

4. Strategies to win schools

The project leveraged several key engagement strategies to ensure successful school and teacher participation. Initially, teachers were offered a professional development program on OSA, providing them with theoretical foundations and practical implementation strategies, along with ongoing support throughout the OSA implementation process to ensure successful execution.

This professional development approach was complemented by strategic curriculum integration, as the activity seamlessly aligned with existing curriculum requirements across multiple subjects including Physics and Chemistry, Chemical Analysis, and Chemistry, Safety and Environment, making participation valuable for students, while supporting their preparation for professional internships and final assessments.

The choice of studying Tagus estuary water quality created strong local relevance that resonated with students due to the school's location and the area's remarkable environmental transformation. Students could personally relate to the improving water quality that now allows recreational activities like swimming, contrasting sharply with the historical pollution from nearby industrial facilities such as the former Quimigal chemical plant.

This local connection was enhanced through technology integration that incorporated AI tools including ChatGPT, Perplexity, and Machine Learning platforms, appealing to students' interest in digital technologies while developing critical digital literacy skills.

Rather than isolated subject learning, the project employed a genuine interdisciplinary approach where students experienced authentic horizontal and vertical curriculum articulation, seeing practical connections between theoretical concepts and real-world applications. This was supported by an active learning methodology that employed inquiry-based learning with real socioscientific questions, moving decisively away from traditional lecture-based instruction to engage students as active knowledge constructors in their own learning process.

5. Schools support

Comprehensive support was provided to participating schools throughout the OSA implementation. The support began with a structured professional development program on OSA, providing teachers with theoretical foundations, pedagogical approaches, and practical implementation strategies for OSA. This initial training was complemented by ongoing mentoring support throughout the project duration.

Technology support formed a crucial component of the assistance provided, including training on artificial intelligence tools and platforms. Teachers received guidance on integrating ChatGPT and Perplexity for research activities, along with instruction on Machine Learning platforms utilizing decision tree models for water quality classification.

Ongoing communication and mentoring were maintained through regular sessions with project members, who provided specialized expertise in AI tool applications for scientific education. This mentoring relationship proved essential when students encountered research challenges, particularly in finding appropriate reference values for estuarine water parameters. Communication channels remained open throughout the project, allowing teachers to seek guidance on pedagogical challenges, technical difficulties, and implementation adjustments as needed.

6. Key-success factors

The success of the implemented activity resulted from several factors that worked together to create an engaging and effective learning environment. Strategic curriculum integration proved fundamental, as the seamless connection of multiple subjects into a unified objective created genuine interdisciplinary learning experiences that motivated students across both 11th and 12th grade levels. This integration allowed students to experience authentic horizontal and vertical curriculum articulation, seeing practical connections between theoretical concepts and real-world applications rather than learning subjects in isolation.

The local environmental connection provided exceptional engagement through the project's focus on Tagus estuary water quality, which created profound personal relevance for students. The transformation of Barreiro from an industrially polluted area where the former Quimigal chemical plant had degraded water quality to a location where students can now safely swim during lunch breaks provided meaningful context and ownership of the learning experience. This connection to their immediate environment made abstract scientific concepts tangible and personally significant, driving sustained student motivation throughout the project duration.

Technology integration was carefully balanced to enhance rather than replace critical thinking skills, with the thoughtful incorporation of AI tools, developing sophisticated digital literacy while maintaining analytical skepticism. Students learned to question and validate AI-generated responses, transforming from passive consumers to critical evaluators of digital information. The collaborative teaching approach involving three coordinating educators across multiple subjects enabled efficient progress and comprehensive student support, while the shift from traditional teacher-centered instruction to student-centered inquiry-based learning significantly increased engagement and motivation. The connection to authentic professional preparation through internship readiness and final assessment skills, combined with adaptive problem-solving that allowed scope adjustments based on research findings and available equipment, maintained project momentum despite implementation challenges while ensuring educational value remained high throughout the process.

7. Challenges

The implementation encountered several significant challenges that required adaptive solutions and strategic problem-solving throughout the OSA duration. Research difficulties emerged as the most prominent initial obstacle, as students struggled to find appropriate reference values for estuarine waters when conducting their AI-assisted investigations. Search queries typically returned drinking water

quality standards or upstream/downstream monitoring data rather than the specific estuarine ecosystem parameters required for the OSA. Even when using familiar tools like ChatGPT, students found that obtaining relevant reference values demanded multiple search strategies, varied terminology, and sophisticated query refinement techniques that exceeded their initial digital research capabilities.

Equipment limitations presented another substantial challenge, as the school's laboratory resources constrained the number of water quality parameters that could be reliably analyzed compared to the project's initial scope. While students had initially planned to examine a comprehensive range of parameters including pH, nitrates, nitrites, chlorides, salinity, temperature, dissolved oxygen, and conductivity, the available analytical equipment necessitated focusing on a more limited set of measurable parameters. Time management emerged as the third major challenge due to the compressed implementation timeline, with students beginning internships in mid-May, Easter break occurring from April 7-21, and the project commencing in mid-March, leaving an extremely limited window for comprehensive implementation.

These challenges were systematically addressed through collaborative problem-solving and adaptive pedagogy. The research difficulties were resolved through the intervention and collaboration of project members, who introduced Perplexity as a more effective AI research tool and provided guidance on advanced search strategies and terminology refinement. Equipment limitations were managed by strategically narrowing the project scope to focus on temperature, pH, salinity, nitrites, and ammonia - parameters that could be accurately measured with available resources while maintaining educational value and scientific rigor. The time constraints were overcome through intensive collaborative teaching involving three coordinating educators working simultaneously across multiple integrated subjects and two class groups, enabling accelerated progress and maximizing weekly advancement. This collaborative approach, combined with careful project management and flexible scheduling, allowed successful project completion by mid-May despite the compressed timeline, demonstrating that strategic adaptation and teamwork could overcome significant logistical challenges.

8. Reflective remarks

The OS activity's impact exceeded initial expectations in developing both disciplinary knowledge and transversal competencies. Students successfully acquired targeted learning outcomes in chemical equilibrium, acid-base chemistry, oxidation-reduction processes, and analytical techniques while simultaneously developing crucial digital literacy skills that transformed their relationship with artificial

intelligence tools. The project demonstrated that students could move beyond passive consumption of AI-generated information to become critical evaluators who actively validate sources, question responses, and maintain analytical skepticism. This transformation proved particularly valuable given the increasing prevalence of AI in educational and professional contexts.

Environmental awareness emerged as a significant outcome, with students developing genuine ownership of their local ecosystem's health through direct engagement with the Tagus estuary's environmental transformation. The connection between historical industrial pollution and current water quality suitable for recreational use provided powerful context for understanding environmental recovery and stewardship responsibilities. Students demonstrated increased environmental consciousness that extended beyond the classroom, evidenced by their continued interest in local water quality monitoring and broader sustainability issues.

For future implementations, several key recommendations emerge from this reflective analysis. Beginning implementation at the academic year's start would provide better time management flexibility and allow for more comprehensive community engagement, potentially including partnerships with local environmental monitoring agencies and municipal authorities. The AI literacy development component should be expanded and formalized with specific assessment rubrics that can evaluate students' critical evaluation skills alongside traditional academic outcomes. The interdisciplinary methodology proved highly transferable and should be adapted to other environmental topics, educational levels, and geographic contexts while maintaining the core elements of local relevance, technology integration, and authentic scientific investigation. Long-term sustainability requires institutionalizing this approach within the school's permanent curriculum structure, ensuring that future student cohorts can benefit from similar integrated learning experiences that connect academic content with real-world applications and emerging digital technologies.

9. Outcomes

The implementation of this OSA yielded comprehensive educational and personal development outcomes that exceeded initial expectations across multiple domains. Students successfully completed all academic learning objectives related to chemical equilibrium, acid-base reactions, oxidation-reduction processes, precipitation reactions, and analytical laboratory techniques while simultaneously developing advanced digital literacy capabilities that transformed their approach to information validation and artificial intelligence utilization. The integration of AI tools throughout different project phases enabled

students to experience critical analysis perspectives they had not previously encountered, moving from an initial conception of AI as an unquestionable information source to recognizing it as a useful but fallible tool requiring continuous critical oversight and validation.

- Student feedback consistently highlighted the transformational nature of the learning experience, with participants expressing appreciation for discovering that "AI doesn't always give the right answers and we need to think critically", understanding how "seeing our own river's water quality improve made the chemistry real", and recognizing that "working across different subjects helped us understand how everything connects". These insights demonstrate the project's success in developing both analytical thinking skills and personal environmental consciousness. The practical application of Machine Learning

- platforms with decision tree models provided students with hands-on experience in data classification and algorithmic thinking, while the comprehensive analysis of five water quality parameters using professional laboratory techniques enhanced their technical competencies and preparation for professional internships.

Measurable outcomes included 100% student completion of water quality assessments using Machine Learning platforms, successful field sampling and laboratory analysis of temperature, pH, salinity, nitrites, and ammonia parameters, and demonstrated improvement in collaborative problem-solving and scientific communication abilities. The final school exhibition where students presented their findings to peers, teachers, and parents showcased their enhanced confidence in public presentation and their ability to communicate complex scientific concepts to diverse audiences. The project's interdisciplinary nature successfully connected theoretical classroom learning with authentic environmental investigation, creating transferable skills applicable across academic and professional contexts while fostering genuine environmental stewardship attitudes that extend beyond the immediate educational experience.

10. Additional materials

Fig. 1. Alburrica's Beach, Barreiro.

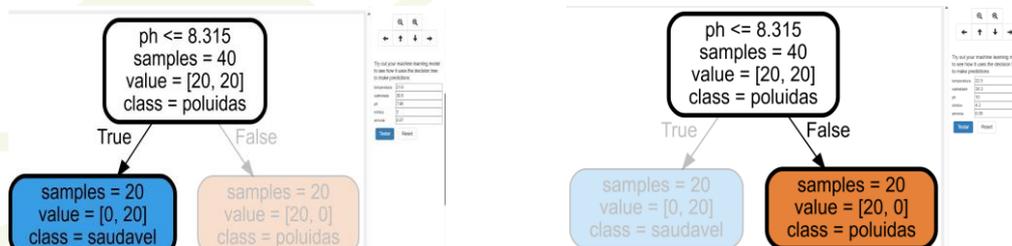Fig. 2. Water sampling and monitoring.

Fig. 3. Water analysis.

Fig. 4. Decision tree training on the Machine Learning platform.

Classroom Environment. Effects on Student Well-Being

1. Activity

Name of the activity: Classroom Environment. Effects on Student Well-Being.

Topic(s): Digitalization, Health

Date: May- June 2025

Local: AE Fragata do Tejo

Duration: 540 minutes

Partners involved: IE-ULisboa, AE Fragata do Tejo

Target group: Students, community members

Number of participants: 12

Number of female participants: 11

Age of the participants: 13-15

2. Summary

This OSA aimed to analyze how classroom environmental conditions- specifically temperature, humidity, and CO_2 concentration- influence student well-being and performance. The activity also sought to develop scientific investigation skills, promote technology use, and raise awareness about indoor air quality in school environments.

Students used Arduino-based sensor systems to monitor environmental parameters in real-time across different classrooms while conducting surveys about student perceptions of comfort and well-being. Through an interdisciplinary approach integrating Physics and Chemistry, Mathematics, Natural Sciences, Geography, ICT, and English, students developed competencies in scientific investigation, data analysis, digital literacy, and environmental awareness.

The activity incorporated supervised use of Artificial Intelligence tools for research and data analysis, promoting critical thinking about ethical technology use. Students presented their findings through scientific communication formats, demonstrating enhanced scientific literacy and civic engagement skills.

3. Description of the implementation process of the activity

<u>Preparation</u>: Activity preparation involved defining objectives, selecting sensors for temperature, CO_2, and humidity monitoring, and preparing Arduino kits and computers. Students received initial training

on sensor operation and basic environmental monitoring principles. Small groups conducted guided research on environmental effects on well-being and school performance, developing research and critical analysis skills.

- Implementation: Implementation occurred over several sessions of Clube Ciência Viva (Live Science Clubs). Students assembled sensors and programmed Arduino systems for real-time environmental data collection with teacher support. Sensors were installed in different classrooms, allowing students to monitor environmental conditions over several days and record temporal variations. Students organized and analyzed collected data, identifying patterns and relating results to scientific literature. Each group presented conclusions to club members and the school community, promoting knowledge sharing and communication skills development.

- Data Analysis and Focus Refinement: Due to extensive results obtained, students focused their study on specific environmental parameters. They selected comprehensive datasets across different classrooms, allowing meaningful comparative analysis and deeper investigation of environmental impacts on student well-being.

Communication Phase: The activity ended with student presentations not only to the school community but also to the general public during a dedicated day for family reception at schools, where they communicated findings through scientific formats and engaged with various audiences to share knowledge about classroom environmental quality and its effects on learning.

4. Strategies to win schools

Various strategic approaches ensured successful school engagement and participation. Teachers received training through the ICSE Science Factory Project partnership, providing access to expert mentorship. The activity was carefully aligned with existing academic requirements, particularly through interdisciplinary articulation across multiple subjects including Physics and Chemistry, Mathematics, Natural Sciences, Geography, and ICT. The project's focus on environmental conditions and student well-being created strong motivation through immediate personal relevance, as students could directly connect their daily classroom experiences with scientific investigation, making abstract environmental concepts tangible and meaningful. The Clube Ciência Viva provided necessary resources, time, and appropriate space for project implementation, while teachers from different areas provided technical support and promoted critical reflection throughout all activity phases.

5. Schools support

Multiple support tools were used to ensure successful project outcomes. ICSE Science Factory members from IE-ULisboa provided ongoing support through regular sessions to address emerging challenges. Interdisciplinary pedagogical support was maintained through ICSE Science Factory teacher training and coordination frameworks, ensuring coherent integration of project activities with curriculum requirements across multiple subjects. Teachers received ongoing professional development support while assessment strategies were developed within ICSE Science Factory guidelines. Technical support was organized through practical sessions oriented by teachers (Physics & Chemistry and ICT) allowing acquisition of knowledge about circuit assembly, programming, and sensor use, with individualized support helping overcome technical obstacles. Communication support included preparation for scientific presentation formats, assistance with scientific writing, and guidance on public presentation skills needed for community engagement, ensuring students could effectively communicate their research findings to both academic and general audiences.

6. Key-success factors

Students remained highly engaged throughout the project because they were investigating their own daily learning environment, making scientific principles directly applicable to their personal experiences of comfort and academic performance. The integration of multiple academic disciplines - from physical sciences and mathematics to information technology and communication - illustrated how real-world problems require knowledge from various fields working together. This coordinated approach, with teachers from different subjects collaborating alongside external experts, fostered an educational experience that developed both specific technical skills and broader capabilities in research design, data interpretation, and presenting findings to diverse audiences. Additionally, the thoughtful integration of artificial intelligence tools as research aids introduced students to emerging technologies while encouraging critical evaluation of digital resources and ethical considerations in their use.

7. Challenges

Several obstacles emerged during the OSA that demanded adaptive responses and continuous support strategies.

Many students lacked prior experience with electronic circuit assembly or Arduino programming, creating insecurity and delays in the initial activity phase, which was addressed through organized practical sessions oriented by teachers (Physics & Chemistry and ICT), allowing acquisition of knowledge

about circuit assembly, programming, and sensor use, with individualized support helping overcome technical blocks.

- Interpreting collected data required mathematical and statistical competencies not all students possessed, making pattern identification and evidence-based conclusion elaboration difficult, leading to specific sessions conducted in regular classroom work (Mathematics) to work on statistical analysis and graphical representation competencies, promoting data comprehension and clear results communication capacity.

- Efficient time management proved demanding, especially because part of the work occurred near the end of the school year with calendar and assessment limitations, which was resolved by conducting part of the developed work directly in classes, articulating with programmatic content from different involved disciplines, allowing better time management and contributing to interdisciplinary learning through the articulation between the Clube Ciência Viva and classroom work. Teachers closely accompanied the research process, guiding students in selecting reliable sources and verifying information obtained through AI, with credibility criteria and ethics in digital tool use being discussed to ensure responsible technology use throughout the investigation process.

8. Reflective remarks

The activity's impact demonstrated how authentic scientific research transforms student understanding of academic content and their role as informed citizens. Students successfully acquired environmental monitoring knowledge while developing critical thinking skills that challenged assumptions about indoor environmental quality. The interdisciplinary approach created meaningful connections between multiple subjects, showing how scientific knowledge integrates across traditional academic boundaries to address real-world problems.

For future implementations, beginning the OSA earlier in the academic year would provide more flexible timing, expanding partnerships would increase access to advanced equipment and expertise, and enhanced assessment frameworks should recognize scientific research skills alongside traditional academic content. The activity's success in connecting academic learning with authentic scientific investigation should be replicated across other environmental and health topics.

9. Outcomes

Students successfully mastered environmental monitoring concepts and practical understanding of sensor technology and data analysis typically reserved for higher education levels. The investigation

revealed that while environmental parameters generally remained within acceptable ranges, student perceptions of comfort varied significantly, confirming the importance of considering both objective measurements and subjective experiences in environmental quality assessment. Students developed sophisticated research competencies including literature review techniques, experimental design, statistical analysis, and scientific communication abilities transferable across academic disciplines and future professional contexts. The supervised integration of AI tools enhanced digital and informational literacy while promoting critical thinking about ethical technology use and source verification importance. Students successfully presented their research findings to both academic and general audiences, demonstrating enhanced scientific communication skills and confidence in engaging with the broader community. The project integrated scientific knowledge acquisition with citizen education, fostering collaborative skills, scientific writing abilities, and critical analysis competencies while developing lasting understanding of the intersection between scientific research and civic responsibility.

10. Additional materials

Recycling Robot

1. Activity

Name of the activity: Recycling Robot

Topic(s): Green Deal, Digitalization

Date: May-June 2025

Local: Escola Básica/JI José Tagarro and Escola Básica D. António de Ataíde

Duration: 2 months

Partners involved: Agrupamento de Escolas Marcelino Mesquita and Agrupamento de Escolas D. António de Ataíde

Target group: Students, parents

Number of participants: 41

Number of female participants: 21

Age of the participants: 8-11

2. Summary

The "Recycling Robot" activity was conducted with 41 primary school students (3rd and 4th grade) across two schools, focusing on promoting environmental awareness through exploration of recycling and responsible consumption concepts. The activity aimed to enable students to mobilize knowledge in situations involving human intervention on Earth and problem-solving for sustainability.

Students acquired essential learning outcomes, becoming capable of identifying environmental or social problems in their community (solid urban waste) and proposing solutions, becoming aware of the importance of acting at the Earth System level to avoid imbalances and contributing to regulated management of existing resources, and recognizing the quantity of solid waste produced in their class/school.

The practical activity had the main objective of raising students' awareness about the impact of their consumption habits and the importance of each person's contribution to environmental preservation.

3. Description of the implementation process of the activity

The activity was developed in four sequential moments, with the first three using active methodologies centered on students' effective participation in constructing the learning process in a flexible, practical,

and interconnected way: complex real-world problem-solving and gamification, integrating digital tools and robots in the teaching-learning process. The fourth moment extended learning to the broader school community.

- 1st Moment - Initial Theme Exploration: Students watched the video "Identifying and solving a problem in my community" about the impact of population increase and waste production as a starting point for environmental awareness. A collective discussion followed based on questions such as: "What is the impact of population increase on the planet?", "What problems were identified in the video?", "How much waste do we produce at home and at school?". The discussion was oriented toward waste production at school, selecting school milk cartons as the study focus.

- 2nd Moment - Problem-Question Exploration: How much waste (milk cartons) do we produce at school? Students weighed an empty school milk carton and recorded the data. They calculated the estimated total weight of milk cartons per day, week, month, and year at class, school, and national scales, recording calculations on a worksheet. Following results discussion, students answered the problem-question and were challenged to reflect on: "Do we produce a lot or little waste?"; "What can each of us do to solve this problem?". After reflection, students responded with keywords or expressions using the Mentimeter tool, building a word cloud representative of their intentions. Results were read and the most frequent words identified.

- 3rd Moment - Robot Programming: Students watched the video "Advantages of recycling" as an introduction to practical robot programming activities in virtual and tangible environments. In groups, students rotated through three stations following a previously distributed activity guide:

  - Station 1: Using tablets, students programmed a garbage truck in the Garbage Truck game to collect garbage bags by creating arrow sequences corresponding to the truck's necessary movements.
  - Station 2: Students programmed the mBot robot to travel from the recycling bin to the respective waste.
  - Station 3: Students solved challenges through programming a robot in the virtual Open Roberta Lab environment using their computers from the Digital Kit.

- 4th Moment - Community Presentation and Engagement: To extend the impact beyond the classroom and promote Open Schooling principles, students prepared and delivered presentations of their learning and findings to the broader school community, including parents, other classes, and school staff.

An interactive exhibition was set up in the school common area where students demonstrated the robots in action, displayed their calculation worksheets and graphs, and explained the recycling process to visiting classes throughout one school day.

4. Strategies to win schools

The engagement of schools was achieved through a combination of direct outreach and leveraging existing professional networks. A key strategy was positioning the activity within the context of the ongoing training workshop "STEM Education and its role in developing Scientific Literacy of primary school students" offered through IE-ULisboa, which provided institutional credibility and demonstrated that facilitators had received high-quality preparation.

5. Schools support

Support provided to participating schools was primarily delivered through mentorship and training of teachers, along with assistance in activity design and implementation. The IE-ULisboa elements worked closely with classroom teachers through direct mentorship, providing guidance on activity implementation, classroom management strategies, and techniques for integrating STEM and environmental education.

Training support included sharing methodologies for active learning centered on student participation, demonstrating effective use of educational robotics and programming tools, modeling strategies for facilitating student-led community presentations, and providing coaching throughout all four moments of the activity. The facilitators collaborated with teachers in the conception and adaptation of the activity to fit specific classroom contexts, curriculum requirements, and student needs, co-designing materials such as worksheets, activity guides, presentation templates, and assessment tools.

6. Key-success factors

Several important factors contributed to the activity's success:

- Topic addressed - represents a very interesting subject that captured students' attention and promoted their involvement;

- Work methodology - was diversified and chosen according to the learning objective and tasks to be completed, promoting peer collaboration where students interacted with each other, working independently from teachers, individually or in small groups, followed by collective discussion, which enhanced the development of student autonomy;

- Resources - the materials created and used, from worksheets to robots, were very appealing and favored the acquisition/comprehension and mobilization of knowledge and connections between different disciplines. Learning benefited from the use of diverse resources that enabled, among other things, the efficient use and exploration of multiple representations and the use of technology. Technological tools are considered indispensable and highly powerful resources for engaging all participants. Here, the fact that words written on the tablet appeared projected on the board in real time caused excitement/enthusiasm in the classrooms due to students' amazement. The simulator and robot also represented an innovative and very effective strategy for stimulating critical reflection, active student involvement, and the development of computational thinking skills;

- Time - it is essential to provide opportunity and time for students to think, share, and discuss among themselves the discoveries they make during task exploration and to systematically consolidate, collectively, the learning that emerges;

- Active strategies - centered on students' effective participation in constructing the learning process in a flexible, practical, and interconnected way; the use of pedagogical techniques that enable student protagonism, fostering discovery and discussion among them about their opinions and justifications presented;

- Planning - the group planned the activity in a coordinated manner, taking into account curriculum reference documents and the management of available resources. Content was presented with clarity and scientific rigor, always developing partnership and sharing work among facilitators, valuing individual and group potentials.

7. Challenges

There were some difficulties in scheduling the implementation of the activity. Coordinating the schedules of the involved teachers proved challenging, requiring significant effort to align the availability with the two teachers who kindly made themselves available to host this activity and share their classes with us.

Some constraints in accessing the Internet were experienced, but the challenge was easily overcome.

8. Reflective remarks

The implementation of the "Recycling Robot" activity was highly positive for student learning and development, demonstrating strong alignment with STEM objectives and training program goals. The activity successfully met its primary objectives: students demonstrated clear understanding of waste production impacts through mathematical calculations scaling from individual to national levels; computational thinking objectives were achieved through successful engagement with programming in virtual and tangible robot environments; and environmental awareness was evidenced by student commitments and reinforced through community presentations. The Open Schooling dimension proved particularly successful, with approximately 120 community members engaged and 15 families implementing new recycling practices.

Unexpected positive outcomes included students who had never interacted with robots showing remarkable engagement and capability, with deep emotional connections to learning. The community presentation component generated powerful results: students who typically struggle with public speaking flourished; peer influence created organic demand from other classes; and intergenerational dialogue emerged between parents and children about environmental responsibility.

Areas for improvement include extending time allocation for presentation preparation (2-3 additional sessions), developing mechanisms for follow-up activities to reinforce learning, implementing structured pre/post assessment to capture behavioral change, creating video documentation of presentations, and establishing earlier coordination with partner schools. For long-term sustainability, building teacher capacity for independent facilitation through "train the trainer" programs, establishing parent-teacher-student partnerships for ongoing environmental action, connecting to broader school sustainability programs, and organizing follow-up community events are essential.

Recommendations for Future Implementations:

Resource optimization strategies include identifying minimum viable resources for under-resourced contexts, developing low-tech alternatives, creating equipment-sharing arrangements between schools, producing reusable materials, and partnering with community organizations for resources and expertise. Enhancing stakeholder engagement requires creating extension activities and

recognition systems for students, maintaining communities of practice and ongoing professional development for teachers, developing family challenge activities and multilingual materials for families, and establishing partnerships with local environmental organizations for broader community involvement. This activity, emerging from three years of training workshop participation, demonstrates the value of maintaining strong connections between professional development and classroom practice while building collaborative learning communities across facilitators, teachers, trainers, and families.

9. Outcomes

The "Recycling Robot" activity achieved significant outcomes in environmental awareness, STEM skill development, and community engagement. Through mathematical calculations, 41 students discovered that their two schools produce thousands of kilograms of milk carton waste annually, leading to genuine surprise and commitment to behavioral change. Students successfully completed programming challenges across three stations (Garbage Truck game, mBot robots, and Open Roberta Lab virtual environment), demonstrating computational thinking skills including algorithm design, pattern recognition, and debugging.

The word cloud created through Mentimeter revealed students' top commitments: "recycle," "separate," and "reutilize." The community presentation component amplified impact significantly, with approximately 120 parents, family members, and school staff attending exhibition and presentation events. Community members contributed 87 environmental commitments to a collective word cloud, and 15 families (37% of participants) reported implementing new recycling practices at home. Three additional teachers requested similar activities after observing student presentations.

Student voices captured the impact:

"I loved it because I had never done anything like this. I learned to work with robots, tablets, computers, and games. And I learned a lot about separating and recycling."

"I was nervous at first but then I felt proud explaining the robots to my parents. They didn't know I could do programming!"

"We have to take care of our Planet because our Planet gives us things we can never waste."

10. Additional materials

Peso dos pacotes de leite vazios por turma (em gramas)

Turkey
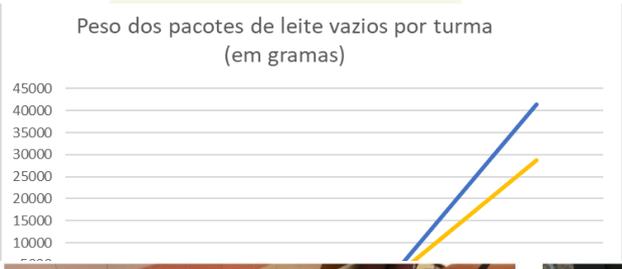
Wet Road Warning System – Mini Smart Road

1. Activity

Name of the activity: Wet Road Warning System – Mini Smart Road

Topic(s): Digitalization, Green Deal

Date: April-May 2025

Local: Kastamonu/Kayı Middle School

Duration: 2 months

Partners involved: HU, Parents, Students, Expert about IT

Target group: Middle school students, teachers, and parents

Number of participants: 10

Number of female participants: 6

Age of the participants: 12-14

2. Summary

In this Open Schooling activity, students developed a model system capable of detecting road slipperiness using sensor technology and Arduino. The aim was to simulate a smart infrastructure that can alert drivers when the road is wet, thereby helping prevent accidents. Through this process, students explored topics such as digitalization, sensor integration, and road safety. The activity engaged students in all stages of the project cycle—from identifying the problem to presenting their final solutions—and was supported by mentors from the university.

3. Description of the implementation process of the activity

The implementation began with students discussing environmental and local safety problems. Following these discussions, the issue of accidents caused by slippery roads emerged as a relevant and tangible problem. The idea of creating a warning system was then developed. In the preparation phase, students received a short introductory workshop on Arduino and sensor systems. A road model was constructed using cardboard or foam base materials.

Students programmed the Arduino microcontroller so that when the sensor detected wetness above a certain threshold, a warning system would be activated—either through a flashing LED or a buzzer. Throughout the activity, students tested different moisture levels, modified their codes, and refined their

physical designs. Code support and troubleshooting were assisted by ChatGPT, helping students debug and understand the logic behind their programs. The project culminated in a school-wide demonstration event where students presented their working models to teachers, peers, and families.

4. Strategies to win schools

To engage schools, existing networks and prior collaborations between university staff and science teachers were utilized. Teachers were informed about how the activity aligns with national curriculum objectives and fosters digital competencies. Additionally, the activity was framed as an innovative STEM learning opportunity, which encouraged participation. The promise of project visibility through university events and support in the form of materials also played a key role. The possibility of participation in dissemination events such as science days or fairs further attracted school interest.

5. Schools support

During implementation, comprehensive support was provided to schools. All necessary materials, including Arduino kits, sensors, and other electronics, were supplied by the university. Prior to the project launch, teachers were invited to a short training and orientation session. Continuous mentoring was offered via email and online video meetings to ensure that teachers and students could ask questions and receive feedback. Examples of working code were shared, and guidance on using digital tools such as ChatGPT was given to help with programming. Support was also extended for the final presentation phase through printed posters and visual aids.

6. Key-success factors

One of the key success factors was the relevance of the problem to students' local contexts, which increased engagement and motivation. The tangible application of science and technology helped students understand how digital tools can be used to solve real-world challenges. Involving students in every step of the process—ideation, coding, assembling, testing, and presenting—allowed for deeper learning. The collaboration between schools and university mentors was crucial in ensuring quality guidance and sustained momentum. Additionally, the use of AI-based support tools like ChatGPT enabled students to troubleshoot and understand coding logic more effectively, which enhanced the quality of the final outcomes.

7. Challenges

Several challenges emerged during implementation. Initially, many students were unfamiliar with Arduino or electronics, which slowed down the early phases. Writing the code and configuring sensor

thresholds involved a steep learning curve, and some technical difficulties arose regarding sensor placement and signal stability.

These challenges were addressed through targeted support. The mentoring team simplified initial code structures and provided students with structured templates. Collaborative group work helped distribute tasks and leverage peer learning. The technical issues with sensor positioning were resolved through iterative testing and teacher supervision. Furthermore, using ChatGPT to assist with programming and debugging proved especially helpful in resolving logical errors efficiently.

8. Reflective remarks

This activity provided students with a hands-on experience in applying scientific knowledge to solve local issues. It successfully demonstrated how Open Schooling can integrate real-world relevance, technology, and community awareness. The activity showed strong potential for replication in other schools and communities. It highlighted the importance of planning teacher training and scaffolding complex technical content into age-appropriate formats. Future implementations could expand the project by integrating additional environmental sensors (e.g., temperature, humidity) or solar-powered systems. Sustainable impacts may be achieved by embedding such projects within the broader science curriculum and establishing longer-term school-university partnerships.

9. Outcomes

Student feedback indicated a noticeable increase in interest toward science and engineering. Several students mentioned they were surprised to see how coding could directly impact real-life situations. Teachers reported increased student participation and enthusiasm. Parents appreciated the practical focus and the opportunity to see their children's work during the sharing event. The project received coverage on the school website and local press. As a next step, a more advanced version involving renewable energy is under consideration by the participating students and teachers.
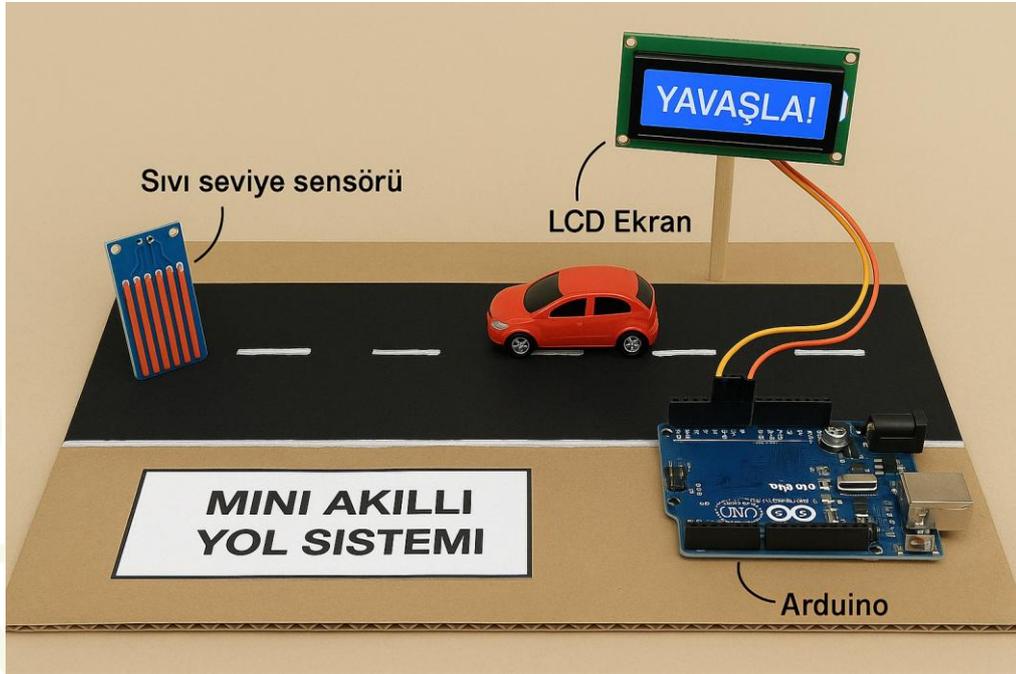
10. Additional materials

Figure 1. The design used for design purposes by the participants in the mini smart road project

Figure 3. Prototype study of the project made by students

Figure 2. Smart road project poster

Coding generated using AI for Ardunio micro controls:

```
//Su seviyesini LCD Ekranda gösterme
#include <LiquidCrystal_I2C.h>
LiquidCrystal_I2C lcd(0x27,16,2);
int seviye = 0;
int buzzer = 7;

void setup() {
Serial.begin(9600);
lcd.begin();
pinMode(buzzer, OUTPUT);
}

void loop() {
Serial.print("Su Seviyesi Değeri: ");
Serial.println(seviye);

seviye = analogRead(A0);
if (seviye<=350)
{
  lcd.clear();
  lcd.setCursor(0,0);
  lcd.print("Yol guvenli");
  lcd.setCursor(0,1);
  lcd.print("Devam et");
```

```
}
if (seviye>351 && seviye<=450)
{
 lcd.clear();
 lcd.setCursor(0,0);
 lcd.print("Zemin islak");
 lcd.setCursor(0,1);
 lcd.print("Dikkat Et");
}
if (seviye>451 && seviye<=500)
{
 lcd.clear();
 lcd.setCursor(0,0);
 lcd.print ("cok Su var");
 lcd.setCursor(0,1);
 lcd.print ("Hizi azalt");
}
if (seviye>501)
{
 lcd.clear();
 lcd.setCursor(0,0);
 lcd.print ("Sel seviyesi");
 lcd.setCursor(0,1);
 lcd.print("Dur");
}
if (seviye>501)
{
 digitalWrite(buzzer, HIGH);
 delay(100);
 digitalWrite(buzzer, LOW);
 delay(100);
}
delay(1000);
}
```

From tea pulp to compost

1. **Activity**

   Name of the activity: from tea pulp to compost

   Topic(s): Green Deal

   Date: 2024-2025 academic year 2nd term

   Local: Maya Schools Oran Campus

   Duration: One term

   Partners involved:

   - Primary school 1st grade students
   - Teachers in the project team
   - Parents
   - School administration
   - Cafeteria staff
   - School canteen staff
   - Çiğdemim Foundation

   Target group: Primary school 1st grade students

   Number of participants: 10 participants

   Number of female participants: 6

   Age of the participants: 6-7

2. **Summary**

   The aim of this project is to raise awareness on reducing and preventing food loss and waste, and to collect and compost the resulting waste. This project is carried out with 1st grade students of Maya Schools Oran Campus and teachers in the project. In addition, parents, school administrators, school cafeteria staff, school canteen staff, and the foundation to which the compost fertilizer will be donated are other participants of the project. This project covers the second term of the 2024-2025 academic year. After the information and awareness activities about the project were carried out, an information meeting was held for the parents and the project was introduced. Then, nitrogen and carbon content wastes were collected. The collected wastes were divided into small pieces. It was turned into a compost

pile in a one cubic meter compost box located in the Maya Schools Environmental Laboratory. The mixing and moistening processes of the compost are ongoing. It is expected to be compost after 2-3 months.

3. Description of the implementation process of the activity

- Our first-grade students increased their awareness by learning about the tea plant, recycling and composting as part of the project. They carried out activities on the journey of tea from the garden to the pulp, the place of organic waste among recyclable waste, and types of organic waste, and increased their knowledge and skills on the subject. It was stated that not only tea will be used when making compost. It was stated that 1/3 nitrogenous waste and 2/3 carbonous waste will be used when creating a compost pile.

- The information letter of the project was sent to the 1st grade parents via "k12". Our school administrators held meetings with Çiğdemim Association to which the compost would be donated. Then, what will be done within the scope of the project was planned. These steps are as follows:

  - Holding an online notification meeting within the scope of the project,
  - Collecting nitrogen-containing tea and various organic wastes under the roof of the school,
  - Collecting carbon-containing waste under the roof of the school,
  - Separating the collected wastes into small pieces,
  - Composting process,
  - Compost formation process.

4. Strategies to win schools

1. Online Parent Meeting

We organized an online meeting with parents to introduce the project. During the meeting, we explained the project's goals, how it would be implemented, and how parents could support their children throughout the process.

2. Poster Announcement in the School

To inform and engage the school community, we designed a promotional poster for the project and the parent meeting. These posters were displayed in various areas around the school to attract attention and raise awareness.

3. Sharing the Meeting Link with Parents

The link for the online meeting was shared directly with parents. This ensured easy access and helped increase participation.

5. Schools support

During the implementation of the Open Schooling project under the ICSE Science Factory framework, our school received various forms of support from the Önce Öğretmen Foundation and the project organizers. Educational and pedagogical materials, including lesson plans, composting guides, activity sheets, and visual aids tailored to the "From Tea Waste to Fertilizer" project were provided to support our teachers in delivering environmental education to 1st-grade students.

Teachers participated in training sessions focused on composting techniques, sustainability education, and student engagement strategies. These sessions equipped educators with the necessary knowledge and tools to implement the project effectively.

To ensure continuous support, regular communication channels were established through email and instant messaging groups. Project mentors maintained close contact with the school, providing guidance, answering questions, and helping with the organization of classroom activities. Online and in-person meetings were conducted to monitor progress and offer feedback.

This comprehensive support structure helped ensure the smooth execution of our project, while also fostering collaboration and capacity-building among educators.

6. Key-success factors

Several key factors contributed to the success of the "From Tea Waste to Fertilizer" project, implemented at our school during the second term of the 2024–2025 academic year in cooperation with the Önce Öğretmen Foundation under the ICSE Science Factory program.

Strategic planning and early coordination among teachers and project mentors helped establish a clear timeline and set of responsibilities. The hands-on nature of the project—collecting used tea waste and transforming it into compost—made it engaging and age-appropriate for 1st-grade students. The use of real-life examples from students' daily lives increased relevance and interest.

Resource management was also a strength; materials such as compost bins, containers, and visual aids were prepared and used effectively. All activities were designed to be simple, safe, and educational for young learners.

Stakeholder engagement played a crucial role. Teachers actively guided students through each step, and parents were encouraged to contribute used tea waste

7. Challenges

During the implementation of the "From Tea Waste to Fertilizer" project, we were fortunate to encounter very few challenges. The project ran smoothly, and all processes went according to plan.

Resource Availability: One of the main reasons for the smooth execution was the strong support from our school, which provided all necessary resources, including compost bins, materials, and educational tools. The school's commitment to the project ensured that all logistics were well-organized and readily available, preventing any significant resource-related issues.

Stakeholder Engagement: We also had a high level of engagement from both students and parents. The communication between teachers, students, and parents was very effective, and all parties were enthusiastic about contributing to the project. As a result, we did not face any significant barriers related to participation.

Smooth Process and Planning: The project's timeline was carefully planned, and all activities were executed as scheduled. Teachers were well-prepared to guide students through the composting process, and no technical difficulties arose during implementation.

8. Reflective remarks

The "From Tea Waste to Fertilizer" project is an ongoing process, and it has already started to create significant impacts on both students and the school community. The project has successfully achieved its initial goals of raising environmental awareness, teaching composting, and promoting sustainability. However, since the composting process is still not completed, the full outcomes of the project are yet to be seen.

Assessment of Objectives:

The main objectives of the project have been largely met. Students have gained awareness about environmental issues and have learned the basics of composting. Currently, they are actively involved in mixing and moistening the compost materials as part of the process. However, since the composting process is not yet complete, it is too early to claim that all objectives have been fully achieved. The compost still needs time to mature and turn into usable fertilizer.

Unexpected Outcomes:

One unexpected outcome was the level of interest shown by both students and parents in the project.

Students have shown great enthusiasm for collecting tea waste and participating in the composting process. Additionally, the environmental awareness generated by the project has extended beyond the classroom, with students discussing composting at home and sharing their experiences with their families.

Areas for Improvement:

At the start of the composting process, it became clear that the mixing and moistening stages are time-consuming. To improve efficiency, we could consider adding more variety of materials to speed up the process. In future iterations, sourcing additional local materials to enhance the composting could be considered. Furthermore, students expressed interest in using technology to track and monitor the composting process. Adding a digital platform or tracking tool could increase engagement and improve learning opportunities.

Long-Term Sustainability:

Since the composting process is not yet complete, it's difficult to assess long-term sustainability at this stage. However, integrating composting practices permanently into the school's curriculum will be essential for fostering a long-lasting environmental impact. This could involve creating a dedicated composting program or collaborating with local environmental organizations to ensure the practice continues beyond the project's initial timeline. Involving the broader community, including local businesses, could also help secure resources and support for ongoing sustainability efforts.

9. Outcomes

The "From Tea Waste to Fertilizer" project has made significant progress, with positive outcomes already visible, despite the composting process still being ongoing. Although the compost has not yet fully formed, key achievements have been made in terms of raising awareness, engaging students, and fostering a sense of community around sustainability.

Achievements:

- Environmental Awareness: Students have gained a deeper understanding of environmental issues, particularly waste reduction and sustainability, through the ongoing process of composting. The hands-on approach has allowed them to directly engage with the topic of waste management.
- Active Participation: Students are actively involved in mixing and moistening the compost, and they show great enthusiasm for the project. Although the composting process is still in its early stages, the continuous involvement of students indicates their growing interest in sustainability.

- Community Involvement: Parents and the local community have been supportive by providing tea waste, helping the school to continue its composting efforts. This collective participation has helped build stronger ties between the school and its community.

Short Snapshot:

The project is still in progress, with students continuously participating in the composting process. While the compost has not yet matured, the students are learning valuable lessons in waste reduction and sustainability through hands-on activities. The excitement and curiosity about the end result are palpable, and it has sparked further discussions at home, with many families interested in starting their own composting practices.In conclusion, while the composting process is still ongoing, the project has already achieved significant outcomes in terms of student engagement, environmental awareness, and community involvement. The feedback from students, teachers, and parents has been overwhelmingly positive, demonstrating the project's success in raising awareness about sustainability.

10. Additional materials

As part of the "From Tea Waste to Fertilizer" project, various educational materials and resources have been developed and used throughout the activity. However, the composting process is still ongoing, and the compost has not yet fully formed. Currently, the process of mixing and moistening continues as we wait for the compost to mature.

Photographs of the Activity:

Photographs have been taken to document different stages of the project. These photos capture students actively participating in mixing and moistening the compost. The images reflect the students' engagement and enthusiasm for the project.

Participant Worksheets:

Students are using worksheets to track the progress of the composting process. These worksheets allow students to record their observations, note any changes they see, and reflect on their learning at each stage. Simple diagrams are also included to help students better understand the composting process.

Educational Materials Developed:

Various educational materials on composting and sustainability have been developed to support student learning. These materials explain the basics of composting, the importance of waste

management, and the environmental benefits of creating organic fertilizer. Additional resources have been provided for students to further engage with the topic at home and school.

Open schooling project implementation stage:

<u>KNOW</u>

- 1st class doors were labeled with project stickers. Within the scope of the project, our students increased their awareness by learning about the tea plant, recycling and composting. They increased their knowledge and skills about the journey of tea from the garden to the pulp, the place of organic waste in recyclable wastes, and the types of organic waste. In this context, documentaries and informative videos about tea, recycling and compost were watched in our classrooms. Our class teachers shared information about tea, recycling and composting and various activities were carried out. It was stated that not only tea will be used while composting. When creating a compost pile, 1/3 of nitrogen-containing waste and 2/3 of carbon-containing waste will be used.

- An information letter about the project was sent to 1st grade parents via "k12". Our school administrators held meetings with Çiğdemim Association where the fertilizer will be donated.
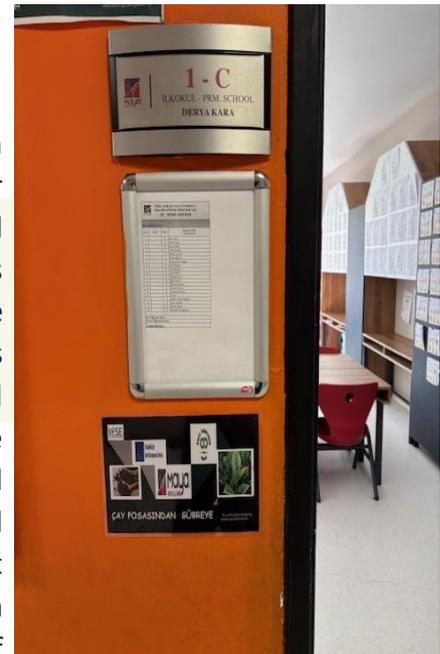
<u>PLAN</u>

- After the students increased their knowledge and awareness on the subject, the implementation steps of the project were planned and explained to the students. Within the scope of the project, the process was planned as online notification meeting, the process of collecting nitrogen-containing tea and various organic wastes under the roof of the school, the process of collecting carbon-containing waste under the roof of the school, the process of separating the collected waste into small pieces, the process of composting, and the formation of compost.

<u>EXECUTE</u>

- In line with the plan, organic wastes such as eggshells and apple peels were collected by the school cafeteria staff. Tea pulp collection process was carried out with the school canteen staff. Families were sent a message and asked to collect tea pulp at home over the weekend and bring it to school. It was also stated that they could also bring wastepaper from home. The tea pulp brought by the students was added to the tea pulp collected from the school. Thus, nitrogen-containing waste was collected for composting.

- Our school WhatsApp group was informed that there are wastepaper collection boxes in the classrooms and teachers' room. It was requested that the wastepaper generated at school be collected within the scope of our project. Thus, an important step was taken for the carbon-containing wastes required for composting.

Figure 1. Waste collection box

- Our 1st grade classes 2-3-4-5. Classes were matched with each other. Class 1-A went to Grade 2, Class 1-B went to Grade 3, Class 1-C went to Grade 4 and Class 1-D went to Grade 5 and made an informative presentation about the project. 1st grade students asked their elders for wastepaper for compost.

Figure 2. Informative presentation preparation processes

- Forest wastes such as bushes, twigs, dry branches, leaves, etc., which are carbon-containing wastes, were collected by the students from the school garden and used in composting.

Figure 3. Collecting material for composting in the school garden

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- The collected carbon-containing paper waste was cut into small pieces by teachers and 1st grade students to be used in compost.

Figure 4. Cut the ingredients for the compost into small pieces

- After the wastes were collected and cut into small pieces, the compost pile process was applied by the teachers in the project to the 1 cubic meter compost bin placed in the Environmental Laboratory in our school by the project teachers. Mixing and moisturizing the compost pile is still ongoing. We think that the compost will be ready at the end of 2-3 months.

Figure 5. Mixing and moistening the compost heap

SHARE

- When the compost is ready, it will be donated to Cigdemim Association. The compost will be used in a place deemed appropriate by the association. Our students will take a big step in creating a sustainable environment within the scope of the project by seeing that the journey of the tea pulp they bring from home, the waste paper in the classroom, the dry branches or leaves in the school garden, the pulp of the tea at home, the apple peel in the dining hall is compost. In addition, the active involvement of students in many steps of the project will develop their sense of responsibility and awareness and help them internalize the issue of waste prevention and waste utilization. In addition, this project, which is carried out within the scope of Open Schooling, go beyond a school activity for all participants in the project and will become a social environmental education awareness.

EVALUATE

- When the compost is ready, it will be donated to Cigdemim Association. The compost will be used in a place deemed appropriate by the association. Our students will take a big step in creating a sustainable environment within the scope of the project by seeing that the journey of the tea pulp they bring from their homes, the wastepaper in the classroom, the apple peel in the dining hall is compost. In addition, this project, which is carried out within the scope of Open Schooling, go beyond a school activity for all participants in the project and will become a social environmental education awareness.

Open Schooling: Healthy Nutrition Assistant - Scratch Project

1. **Activity**

   Name of the activity: Healthy Nutrition Assistant - Scratch Project

   Topic(s): Digitalization, Health

   Date: February-April 2025

   Local: Kastamonu/Kayı Ortaokulu

   Duration: Approximately 3 months

   Partners involved: HU, Healthy nutrition centre

   Target group: Middle school students, teachers, and families

   Number of participants: 9

   Number of female participants: 8

   Age of the participants: 11-13

2. **Summary**

   The "Healthy Nutrition Assistant" project aimed to help students understand the nutritional value of foods through research, data organization, and a Scratch-based digital application. Students explored essential food groups, caloric values, and nutritional components by analyzing commonly consumed meals. Using Scratch, they designed an interactive menu where users could click on a dish and view its detailed nutritional information. The activity promoted algorithmic thinking, healthy living awareness, and digital creativity.

3. **Description of the implementation process of the activity**

   The activity began with an awareness session in which the teacher guided a class discussion on the meaning of healthy eating. Posters, short videos, and presentations were used to inform students about major food groups and daily nutritional needs. Each student or group was then tasked with selecting 3-5 commonly consumed meals either from their homes or the school cafeteria.

   Students conducted online research using reliable sources, such as the national health database, to compile data on calories, protein, fat, and carbohydrates for each meal. This information was tabulated and later used in their Scratch projects. Using a simplified approach, students developed an interface where selecting a food item triggered a display of its nutritional values. After peer feedback sessions, the

apps were refined for functionality and design. The final phase included a school-wide fair where students presented their projects to peers, teachers, and parents.

4. Strategies to win schools

Schools were invited to participate through established teacher networks and direct communication emphasizing the interdisciplinary nature of the project. The integration of health, ICT, and science within a single activity was highlighted as an innovative educational opportunity. The Scratch platform, being free and student-friendly, helped ease initial concerns. The project was presented as an opportunity to enhance 21st-century skills, including digital literacy and critical thinking.

5. Schools support

Support was provided through teacher guides, nutrition data templates, and example Scratch projects. Online mentoring sessions were offered during the coding phase, and students received structured handouts explaining how to create variables and menu interfaces in Scratch. Feedback opportunities were provided through peer-testing phases, and the university mentor team offered debugging support and improvement suggestions throughout the activity.

6. Key-success factors

One key success factor was the personal connection students had to the subject matter—they analyzed meals they actually consumed, making the learning context authentic. The use of Scratch allowed creative digital expression and engaged even those with little prior coding experience. Integrating science, mathematics, ICT, and social skills created a multidimensional learning experience. Sharing the final projects during a school science fair enhanced students' motivation and helped build communication confidence.

7. Challenges

The primary challenges included varying digital skill levels among students and limited prior experience with Scratch for some. This was addressed by grouping students strategically and offering template-based guidance. Access to nutritional databases was also a challenge for some; therefore, a curated list of reliable resources was provided. A few technical difficulties with variable usage in Scratch were resolved during mentoring sessions with the help of screenshots and walkthroughs.

8. Reflective remarks

The project successfully met its objectives by combining digital competence with health awareness. Students gained insights into their eating habits while learning coding and data visualization. The

activity's success suggests high potential for replication. Future implementations could include app extensions that recommend meals based on daily calorie limits or gamification features for younger learners. To scale this project, integration with platforms like App Inventor could allow for mobile-friendly versions.

9. Outcomes

Participants reported increased awareness of healthy eating habits and greater interest in coding. Teachers noted improvements in teamwork and problem-solving. Parents appreciated the practical relevance of the project. The project was featured during a school technology day, generating positive feedback from school administrators and visitors. Students suggested adding more meals or integrating voice and animation features in future versions.

10. Additional materials

Figure 1. Scratch working screen of the project

Figure 2. Completed healthy nutrition assistant display

🥄 **Pilav Sprite'ı**

```scratch
[When this sprite clicked]
say [Pilav: 250 kalori, 40g karbonhidrat, 3g protein, 5g yağ] for 3 second
change [ToplamKalori v] by (250)
say [Toplam Kalori: (ToplamKalori)] for 2 seconds
```

🍗 **Tavuk Sprite'ı**

```scratch
[When this sprite clicked]
say [Tavuk: 200 kalori, 0g karbonhidrat, 30g protein, 8g yağ] for 3 second
change [ToplamKalori v] by (200)
say [Toplam Kalori: (ToplamKalori)] for 2 seconds
```

🥣 **Yoğurt Sprite'ı**

```scratch
[When this sprite clicked]
say [Yoğurt: 60 kalori, 4g karbonhidrat, 5g protein, 3g yağ] for 3 seconds
change [ToplamKalori v] by (60)
say [Toplam Kalori: (ToplamKalori)] for 2 seconds
```