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EXPERIMENTA
DISCOVER IS AN ATTITUDE - STEM PROJECT

BOOKLET

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Introduction

Introduction

This Booklet is the main result of the EXPERIMENTA project implemented by 4 organizations in 3 European countries:

Coordinator
Laboratorio di Scienze Sperimentali Foligno
Italy

Istituto Tecnico Economico "Grimaldi - Pacioli"
Italy

Osnovna škola Dobriše Cesarića Zagreb
Croatia

Xano Channel
Asociación para el Desarrollo Comunitario
Spain

This Booklet serves as a tool for introducing the EXPERIMENTA methodology designed in the first months of the project, starting from the research on good practices and possible innovations in the field of STEM education.
Being addressed to teachers, this tool contains the methodology of the project and practical activities (both best practices analysed in the partner countries and authentic material created by the teachers and students involved throughout the project) with the aim to facilitate the experimentation of the EXPERIMENTA methodology in new school across Europe.

The Booklet is available in English and in the languages of the partnership (IT,HR,ES).

The production of the EXPERIMENTA Booklet has been developed in three main steps:

STEP 1

Preliminary research

Desk research aimed to collect 15 innovative STEM practices at European level (5 best practices per country).

STEP 2

Report

Elaboration of a Report on the results of research activities conducted at national level and guidelines for the development of STEM teaching activities and implementation of real-world.

STEP 3

Design and implementation of STEM activities

Design of STEM teaching activities and implementation of real-world tasks with the support of the local communities.

Chapter 1
The EXPERIMENTA project

1.1 STEM Education: definition and benefits

1.2 EXPERIMENTA: a community-based approach to STEM Education

1.3 What has been done in partner countries?

1.STEM Education: definition and benefits

STEM is an acronym for the fields of Science Technology Engineering and Mathematics.
At its core, STEM refers to a **teaching approach** that integrates all four disciplines together into a single, **cross-disciplinary program** which offers instruction in real-world (as opposed to purely academic) applications and teaching methods [1]. STEM indeed integrates the four disciplines into a cohesive learning paradigm based on **real-world applications**.
STEM touches every aspect of our lives and emphasizes on the principle of **learning through experiences.** Such approach is therefore based on the learning-by-doing method (hands on learning). "**Hands-on-approach** is a method of instruction where students are guided to gain knowledge by experience. This means giving the students the opportunity to manipulate the objects they are studying [2]".

Teaching STEM subjects in the most effective way can require non-traditional approaches to learning.
When teaching STEM, teachers have the chance to take a wide set of different approaches, such as Project-Based Learning, Problem-Based Learning and Inquiry-Based Learning.

Interdisciplinary is also a key component of STEM education. "The aim of taking an integrated or interdisciplinary approach to STEM is to advance and synergize the efforts to equip students with a sturdy theoretical foundation that will enable them to propose innovative solutions to the problems of the society and the world [3]".

Figure 1: Relationship between Components of STEM, from "Exploring STEM Competences for the 21stCentury"

When planning an effective and engaging STEM lesson, teachers should focus on creating an environment that encourages students' creativity. According to Future Learn, a good STEM lesson should:

- be **hands on**: practical activities are crucial to stimulate students' interest and motivation
- relate to **real-world scenarios**: this is another reason why hands-on learning is so essential. One of the most important things about STEM is that it helps students learn skills that will be immediately useful in the outside world. So much of traditional schooling teaches impractical skills, and your goal is to prepare your students for real-life.

As highlighted by Future Learn, "STEM activities can be an effective education because teachers can adjust them to suit different age ranges, abilities, group sizes and interests. Their adaptability is part of what makes them so great to use in teaching and learning environments".

When STEM is effectively taught to students, they can acquire/develop some of the following skills:

- Critical thinking
- Learning to learn
- Communication and collaboration

[1] What is STEM? - Pearson
[2] What is hands-on learning and what are the benefits of this type of instruction? - The Knowledge Network for Innovations in Learning and Teaching - KNILT
[3] Exploring STEM Competences for the 21stCentury - UNESCO

- Digital literacy
- Problem solving
- Creativity
- Self-reflection

As it turns out, STEM education is uniquely suited to prepare students for success. According to YETI Academy, the five reasons to focus on STEM education are the following:

1 STEM jobs are the Future of Our Economy.

2 STEM Education promotes critical thinking and Innovation.

3 STEM Education provides unique opportunities for teamwork.

4 STEM helps learners develop project management skills.

5 Covid19 Pandemic has made technology skills even more crucial.

To promote learners' engagement and achievement, STEM education needs to reflect what's happening in STEM's exciting fields outside the classroom [4]. The table below shows the nine principles that teachers should applied in STEM education:

Principle	What is it?	Why is this important?	Examples
1. Use inquiry-based learning	Inquiry-based learning is an education approach that focuses on investigation and problem-solving.	Students learn key STEM and life skills through inquiry-based learning: social interaction, exploration, argumentation, comfort with failure.	Build active learning into teaching practices through problem-based scenarios to encourage students to think critically.
2. Solve real-world problems	Students tackle real-world STEM problems from businesses and the community.	Demonstrates relevance of STEM; can enhance student motivation and interest.	Ask your local council or a local business for a challenging problem they're working on. Take it to your students and see what they come up with.
3. Teach integrated STEM learning	Integrated STEM learning combines the subject matter of two or more STEM subjects into a joint learning experience.	Supports cross-disciplinary STEM skills; can enhance student interest.	You can teach Science using an Engineering process (design-based learning).
4. Equip and empower teachers	Equipping and empowering teachers means providing them with the right resources (e.g. high-quality professional learning opportunities, up-to-date technology) and skills to teach best practice STEM education.	Teachers have the greatest influence on in-school achievement and engagement in STEM.	Connect a STEM teacher with a STEM mentor from a local business.
5. Create partnerships between schools, businesses and community	Schools, businesses and other organisations create STEM education initiatives to improve student outcomes.	Exposes students to the workplace, inspires enthusiasm about STEM and enhances and complements curriculum.	Choose partners to work with on a STEM problem. Reach out to schools, businesses, museums, local councils and government.
6. Engage parents and families	Encourage parents and guardians to be active in their children's education.	Improves enrolment, achievement and belief in importance of STEM education.	Invite parents and families to a STEM exhibition day to show them all the exciting things students are working on.
7. Use technology as an enabler	Selective use of technology to support high-quality teaching and learning.	Accelerates student learning, increases confidence and ability in using technology.	Get students to program a technology instead of showing them what something does.
8. Differentiate for different levels	Learning is tailored to the needs and abilities of individual students.	Supports all students' needs, regardless of starting point.	Assess student capability formally and informally so lessons can be tailored.
9. Link education to 21st century learning	Build in development of 21st century skills such as critical thinking, creativity and collaboration.	21st century skills are highly valuable for students' future careers.	Encourage teamwork and healthy debate. Let students 'play' with the subject matter.

[4] Best Practice Guide: Elements of successful school-industry STEM partnerships - Australian Government, Department of Education - Pearson

According to the European Commission, “in a time of fast technological innovation, companies need people with high level skills in STEM subjects. Such skills are necessary to use new technologies, and a high level of STEM skills is crucial to foster innovation in cutting-edge ICT areas such as AI or cybersecurity. However, only one in five young people in Europe graduates from STEM tertiary education, less than two million STEM graduates every. This number needs to increase, which could be achieved by promoting STEM pathways in particular among young women. Currently, only half as many women as men are graduating in STEM fields in the EU, although with huge variations across Member States. […] Beyond technical skills, the labour market increasingly needs transversal skills like working together, critical thinking, and creative problem solving [5]”.

STEM education is therefore crucial to meet the needs of a changing world.
Science gives learners an in-depth understanding of the world around us. It helps them to become better at research and critical thinking. Technology prepares young people to work in an environment full of high-tech innovations. The continual advances in technology are changing the way students learn, connect and interact every day. Skills developed by students through STEM provide them with the foundation to succeed at school and beyond. Employer demand for STEM qualifications and skills is high, and will continue to increase in the future. STEM empowers individuals with the skills to succeed and adapt to this changing world.
As highlighted in the Communication "Making a European Area of Education a Reality by 2025," the EU has not met its goal of reducing the percentage of 15-year-olds with low levels in math and science to less than 15 percent by 2020. Today, more than one out of five 15-year-old student cannot complete simple tasks in these subjects. Furthermore, according to the European skills agenda, in order to promote youth employability, it is necessary to increase STEM skills and graduates while promoting entrepreneurial and soft skills. However, only one out of five young students in Europe graduates in STEM subjects: it is therefore necessary to promote STEM pathways from a young age”.

1.2 EXPERIMENTA: a community-based approach to STEM Education

STEM is different from other subjects from an educational point of view, as it requires a **different learning system.** Traditional learning activities should be replaced by **empirical learning** and knowledge that occurs in **everyday situations**. Therefore, schools must rely on innovative and practical methods, engaging students in challenging activities and matching new educational needs to the teaching curricula.
EXPERIMENTA will combine practical approaches to promote STEM learning based on the principle of "open schooling" [6], which is achieved through collaboration between the school and their local community. According to this principle, the school is connected to the surrounding area and is able to intercept the needs and possible contributions of the local community.
Therefore, students make a vital contribution to the society around them: their projects meet indeed the real needs of the community and at the same time the local network contributes to the education of young people through its own experiences and skills.

[5] European Skills Agenda for sustainable competitiveness, social fairness and resilience - European Commission
[6] "An open school is a more engaging environment for learning and makes a vital contribution to the community: student projects meet real needs in the community outside school and draw upon local expertise and experience. And finally: learning in and together with the real world creates more meaning and more motivation for learners and teachers" - Open Schools

An approach that therefore encourages cooperation between schools and different local actors in the implementation of projects based on **real-life challenges**.

From the Partnership's experience, it also emerges that peer learning can play a key role in transforming STEM classrooms from passive to active learning environments. "Peer educators" can also provide important feedback to teachers, thus enabling pedagogical changes within the school.

Our European project project starts from "Experimenta", a good practice promoted for over 10 years by the Project Coordinator, Laboratorio di Scienze Sperimentali Foligno, based on the use of scientific methodology, in particular the experimental one.
In fact, the activities carried out follow the principles of the **experimental approach** that, starting from the observation of the phenomenon, leads to the formulation of hypotheses, to the collection and processing of data (conducting experiments) until the verification of the hypotheses formulated.
The overall goal of the project is to promote a holistic approach to STEM subjects, based on empirical learning, peer education, and local community involvement.

EXPERIMENTA addresses the following priorities:

1 Promoting interest and excellence in science, technology, engineering, and mathematics (STEM) and the STEAM approach.
EXPERIMENTA wants to promote and test a methodology aimed at bringing the main target group (students 11-15) to STEM subjects, through experiential learning with real-world applications. To this end, new tools will be developed to innovate teaching in STEM subjects, also through the promotion of students' protagonism and the involvement of local communities.

2 Tackling learning disadvantage, early school leaving and low proficiency in basic skills.
EXPERIMENTA aims to promote a holistic approach to STEM education, improving the basic skills of students, which includes the involvement of communities of practice at the local level within the educational process of young students, according to the principle of "Open schooling", which is achieved through collaboration between the school and the community as a whole.

The specific objectives (SOs) of the EXPERIMENTA project will be:

SO1 Improve the educational offer for schools in the field of STEM, through the definition of practical tools and the exchange of good practices from different EU countries

SO2 Provide teachers with tools to facilitate the experimentation of the "Experimenta" methodology within their own school contexts

SO3 Promote students' protagonism, the development of communities of practice on STEM education at the local level, creating a model replicable in all European countries.

In terms of results, EXPERIMENTA intends to pursue the following results:

Booklet: it is the main result of EXPERIMENTA, consisting of a tool containing the methodology designed in the first months of the project, starting from the research on good practices and possible innovations in the field of STEM education.
The Booklet will be addressed to teachers of European schools and will contain the principles, methodology and possible activities to be implemented in the classroom following the experimental methodology.

Pilot Action (Students and Teachers of participating schools).

Report of the experimentation, containing the results of the pilot action in the countries involved.

Transnational training of students in Foligno (Italy) in April 2023.

4 Final multiplier events in each country.

1.3 What has been done in partner countries?

Step 1 - Implementation of desk research

The first task implemented by the Partnership was the **definition of the research framework and tools.**
The research phase has been based on **desk research** aimed to identify initiatives and practices adopted or proposed to encourage the promotion of STEM education in teachers and students - See Annex 1 - List of good practices.

LSS and XANO defined the method and objectives of the research in agreement with the partners providing timeline and template useful to collect the information in a structured way.

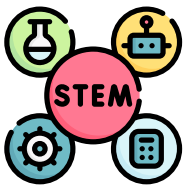
Each country had the task to identify and analyze a set of best practices. Through the desk research, the Consortium collected 17 innovative STEM practices at Europe.

Step 2 - Elaboration of the Report and Guidelines

The second task was the **elaboration of a joint report and guidelines**. In fact, the results collected at the national level have been systematized in a Report that summarizes the findings of the research activities conducted at national level and provides guidelines for the design of STEM teaching activities and the implementation of reality tasks.

The analysis of the three national contexts (Italy, Croatia, Spain) and the delivery of the Report allowed the setting up of a consistent pedagogical and didactic framework for the resulting guidelines for the design of STEM teaching activities and implementation of reality tasks based on the collaboration between the school and its own local community.

To this end, LSS and XANO prepared a set of templates aimed to support partner schools further implement the project activities, with a special focus on:



The design of 10 STEM teaching activities (Annex 2).

List of possible authentic tasks [1] based on the collaboration with the local community (Annex 3).

[7] *Real-world tasks* or *Authentic tasks* are assignments given to students designed to assess their ability to apply standard-driven knowledge and skills to real-world challenges - Authentic Assessment Toolbox

Step 3 - Implementation of authentic tasks

After the elaboration of the joint report and guidelines, the Schools involved were asked to **implement one authentic task** each.
The two authentic tasks implemented at this stage and summarize below will be presented during the Transnational training of students in Foligno (Italy).

Chapter nr.2 provides a short description of the two authentic tasks implemented in Italy and Croatia.

Step 4 - Experimentation in partner countries (Pilot Action)

The main goal of the Pilot Action (PA) is to increase students' interest and skills in STEM subjects and support teachers to become familiar with the EXPERIMENTA methodology based on the principles of Open Schooling and the creation and development of communities of practice at local level.

During the PA students and teachers who took part in EXPERIMENTA will be the protagonists of the educational activities as Ambassadors of EXPERIMENTA.

At the end of the PA in Italy and Croatia, the evaluation of the experimentation will be conducted through satisfaction questionnaires addressed to both teachers and students.
OS CESARICA will be responsible for creating a transnational report on the PA experience.

The transnational report related to the EXPERIMENTA Pilot Action is available here.

The PA in numbers:

15 hrs

6 teachers trained

65 students involved

On the basis of the results obtained from the PA LSS and XANO will take care of the final revision, translation and publication of this Booklet.

Step 5 - Transnational training of students

In April 2023, a group of students and teachers from IIS Grimaldi Pacioli and OS Cesarica will travel to Italy. They will be the EXPERIMENTA Ambassadors, in charge of presenting the project methodology and promoting its use to other schools and stakeholders during the XII edition of the FESTIVAL OF SCIENCE AND PHILOSOPHY, organized by the Project Coordinator to promote scientific culture.
During the Festival, the 1st EXPERIMENTA final event will take place. Students and teachers from partner schools will have the chance to present the EXPERIMENTA methodlogy , as well as the project activities and results.

Step 6 - 4 Final multiplier events in each country

With the final aim to share the project activities and results with a wider audience and further involve the local stakeholders, each partner will organize a final event to showcase the EXPERIMENTA Booklet and the overall methodlogy.
The final events will play a key role in promoting the transferability of the EXPERIMENTA results and methodlofy into different contexts and audiences.

Chapter 2
Collaboration with the local community

2.1 Implementation of authentic tasks

As highlighted in the previous chapter, besides summarizing the findings of the research activities conducted at national level, the EXPERIMENTA Report also provides guidelines for the design of STEM teaching activities and the implementation of authentic tasks (Annexes II and III).

In particular, the Report provides teachers with a list of possible authentic tasks based on the collaboration with the local community.
The document also focuses on the steps to follow for the implementation of the authentic tasks:

01 Translating the authentic task into an educational activity based on the following:
a. STEM subjects
b. involvement of local community (stakeholders needed for the implementation of the task).

02 Identification of the purpose, objectives, methods, tools, resources and timeframe for implementation of the the authentic task.

03 Identification and engagement of local stakeholders.

04 Ongoing evaluation + evaluation of the products produced throughout the implementation authentic task (e.g. elaboration of paper material: leaflets, posters etc.) and/or digital material (QRCodes, webpages, PPT etc.)

05 Public validation of the authentic task through the organisation of an event and the presentation of the results during the Festival of Science and Philosophy - Virtue and Knowledge - Foligno, April 2023.

Both schools involved in the EXPERIMENTA project had the task to select and implement nr. 1 authentic task before the implementation of the Pilot Action.

After the implementation of the reality tasks, partner schools were asked to fill in a Template for collection of information.

For the full description of the authentic tasks, please see Annex 4.

2.3 Implementation of the authentic task in Italy

Authentic task implemented

Task nr.2 "Produce educational material to make one of the tourism organization of your city (e.g. city museum) of your city available to different age groups of visitors".

Number of participants involved

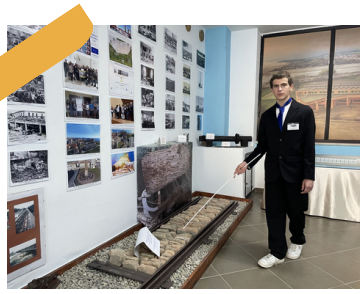
Students: 24
Age: 15
Teachers: 5

STEM subjects

Science
Technology
Engineering

Stakeholders involved

Municipality of Catanzaro (Culture Department; Touristic Department of the city of Catanzaro and the Director of the Department, Mrs. Donatella Monteverdi) The two school museums subject of the authentic task, aren't fully known in the local area.
The production of a multimedia output that promotes the school museums is a self-consciousness action.



Final product delivered

Realization of two promotional videos of the two school museums (See Museum and Historical Museum) that have been published on the official website of the Municipality of Catanzaro, Tourism Department.

Public validation of the authentic task

Organization of an event with the Major of Catanzaro, Mr. Nicola Fiorita, the the Council Member Mrs. Donatella Monteverdi, the School Manager, the press, all the students, teachers and school workers involved in the EXPERIMENTA project and the representatives of every class.

Key competences acquired by the students

- Literacy competence
- Multilingual competence
- Mathematical competence and competence on science, technology and engineering
- Digital competence
- Personal, social and learning to learn competence
- Citizenship competence
- Entrepreneurship
- Cultural awareness and expression competence

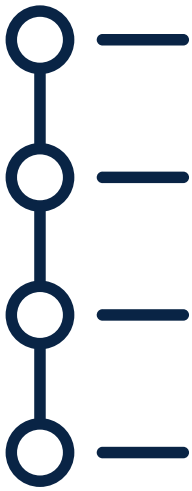
Green/blue competencies acquired/consolidated by the students through the implementation of the authentic task

- Waste management
- Conserving energy

Lifecomp competencies acquired/consolidated by the students through the implementation of the authentic task

- Self-regulation
- Flexibility
- Wellbeing
- Empathy
- Collaboration
- Cooperation
- Growth mindset
- Critical thinking
- Managing learning.

Phases in the implementation of the authentic task



Phase 1
Planning: Using a debate with students, we planned the authentic task.

Phase 2
Investigation: We gave students real material, the access to the instruments in the school museum, and the information on the internet.

Phase 3
Building up: the students were divided in groups to create a promotional video about the school museums to upload on the local community website , on their homepage in the MUSEI CITTADINI section.

Phase 4
Revision and self-evaluation: the final product has been checked by teachers and students and further implemented.

2.2 Implementation of the authentic task in Croatia

Authentic task implemented
Task nr.1 " Equip your school/city with an interactive botanical garden with QR codes in display".

Number of participants involved
Students: 36
Age: 13-15 (students also cooperate with students aged 9-11)
Teachers: 3

STEM subjects

- Science
- Technology

Stakeholders involved
The Maksimir Park public institution gave us its materials used to determine the types of trees and a booklet with the basic characteristics of the most common trees in the Maksimir Park.
The OAZA association helped us in the form of a visit from an expert, a forester who helped the students identify trees that the students could not identify on their own.

Final product delivered
Students studied the trees in the schoolyard and wrote their own description of the trees. Then they created QR codes and placed on the trees.

Public validation of the authentic task
The students presented their multimedia output the to student representatives at the school's Student Council.

Key competences acquired by the students

- Literacy competence
- Mathematical competence and competence on science, technology and engineering
- Digital competence
- Personal, social and learning to learn competence
- Citizenship competence

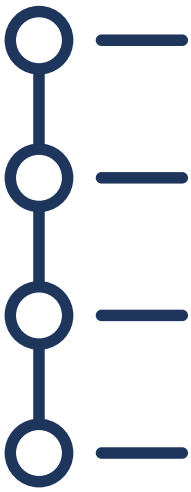
Green/blue competencies acquired/consolidated by the students through the implementation of the authentic task

- Waste management

Lifecomp competencies acquired/consolidated by the students through the implementation of the authentic task

- Wellbeing
- Empathy
- Cooperation
- Critical thinking
- Managing learning.

Phases in the implementation of the authentic task



Phase 1

The Maksimir Park provided the materials needed to classify the types of trees in the park. Using these materials, the students first identified some of the trees in the school yard and then created QR codes for them. We plasticized the codes and placed them on the trees using recycled material.

Phase 2

With the support of OAZA, students identified the remaining trees in the schoolyard.

Phase 3

The students wrote their own texts about these trees based on the example of the mentioned booklet using materials from the web. In doing so, they cooperated, worked in teams and divided tasks according to interests and abilities. Then these codes were plasticized and placed on the trees.

Phase 4

The students presented their project and final product to student representatives at the school's Student Council.

Chapter 3
The EXPERIMENTA methodology

3.1 What is the scientific method?

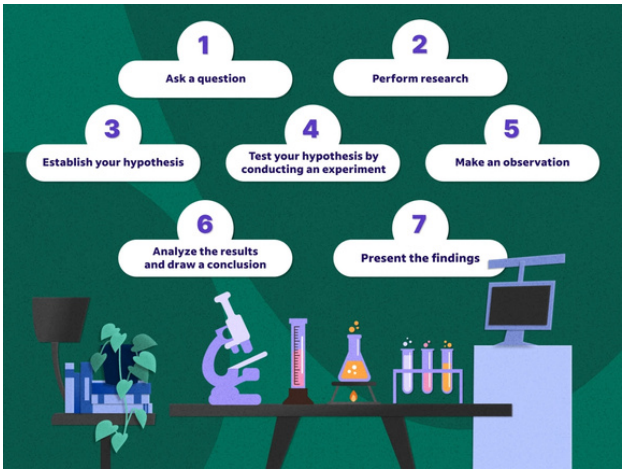
> **The real voyage of discovery consists not in seeking new landscapes but in having new eyes.**
>
> **Marcel Proust**

An approach to STEM is essentially a systemic approach to knowledge that presupposes the integration of common methods of which the scientific method is perhaps the most explanatory, circular and universal.

As mentioned, this project starts from "Experimenta", a good practice promoted for over 10 years by the Project Coordinator, Laboratorio di Scienze Sperimentali Foligno, based on the use of scientific methodology, in particular the experimental one.

The scientific method is the "process of objectively establishing facts through testing and experimentation. The basic process involves making an observation, forming a hypothesis, making a prediction, conducting an experiment and finally analyzing the results" [8].

The scientific method is implemented through the traditional phases summarized below:



Our methodology is based on the principles of the experimental approach that, starting from the observation of the phenomenon, leads to the formulation of hypotheses, to the collection and processing of data (conducting experiments) until the verification of the hypotheses formulated.

The application of this methodology, applicable to all school subjects, allows teachers to promote a flexible teaching path and students to interpret reality in a critical way, challenging themselves with its continuous evolution.

[8] What is the scientific method?

Scientific methodology is also applicable in other fields of knowledge such as the humanities, and it is also for this reason that today we increasingly speak of complexity science and the integration of literary and scientific knowledge (universality).

The term "complex" comes from the Latin cum (together) - plexus (intertwined), "woven together": a complex system is in fact composed of several parts connected to each other and "intertwined" with each other so that the result is different from the sum of the parts.
The behavior of a complex system cannot be inferred from an analysis, however accurate, of its component elements: instead, one must observe the interactions among them. Simple entities interacting with each other and with their surroundings can in fact give rise to uncommon macroscopic behaviors called "emergent behaviors." An emergent behavior is a collective phenomenon: that is, it occurs spontaneously and not as a result of a centralized organization. Systems that seemingly have nothing in common, such as a flock of birds, the Internet and metabolic networks, surprisingly have hidden similarities.

3.2 Keeping learning real and relevant: Project-based learning & open schooling

Providing authentic learning opportunities that make learning meaningful by engaging students in relevant and real-world learning is imperative. Since learning should reflect real life, the implementation of **Project Based Learning** (PBL) [8] activities can play a key role.

So, through the implementation of an authentic task (assignment given to students designed to assess their ability to apply standard-driven knowledge and skills to real-world challenges), based on the cooperation with the actors of the local community, learners have to chance to investigate the complexity of a phenomenon, to construct their own responses at a specific issue and come up with innovative solutions.

The implementation of an authentic task can have multiple advantages:

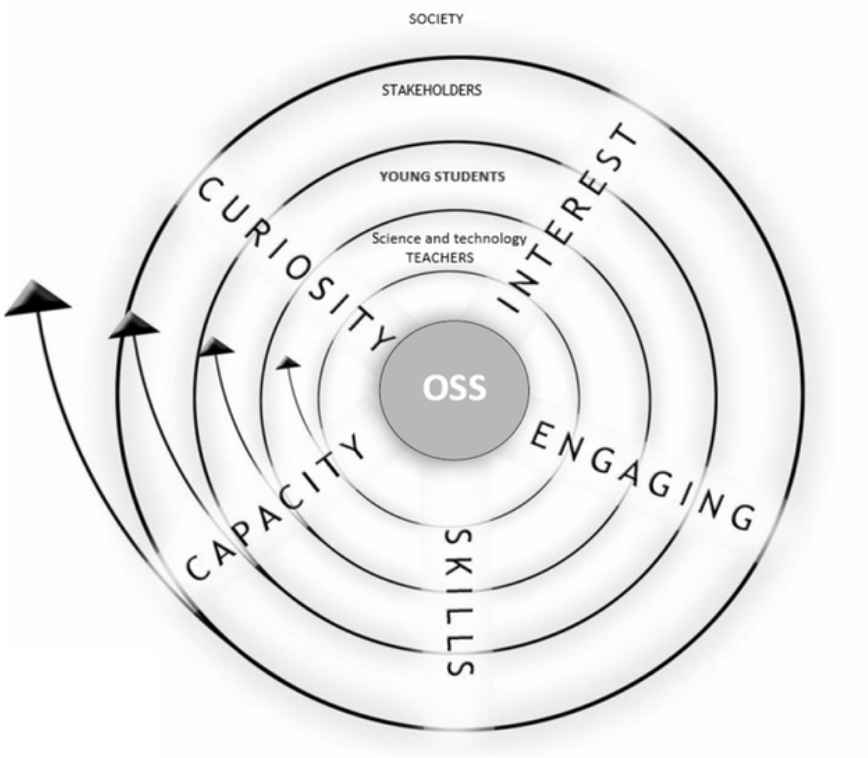
- enhance teamwork
- encourage students to be more motivated and creative
- promote student's critical thinking skills
- create a sense of belong to the local community.

Besides being based on providing authentic learning opportunities, our methodology also revolves around the concept of **open schooling** "where where schools, in cooperation with other stakeholders, become an agent of community well-being shall be promoted; families should be encouraged to become real partners in school life and activities; professionals from enterprises and civil and wider society should actively be involved in bringing real-life projects to the classroom" (European Commission, the Science Education for Responsible Citizenship, 2015).

Open schooling can an exciting opportunity for igniting enthusiasm for STEM among European students and teachers [9].

[8] "Project Based Learning is a teaching method in which students gain knowledge and skills by working for an extended period of time to investigate and respond to an authentic, engaging, and complex question, problem, or challenge" - PBL Works
[9] For further information on open schooling and open science schooling, visit the Open Science Schooling website.

In particular, the concept of open science schooling "tries to contextualise science meaningfully for students, using experiential learning (ideas of constructivism) and practical, hands-on activities with the aim of building or manipulating actual objects in order to generate knowledge (constructionism). The aim is to bridge science learning and students through the practical identification of science as it is used in the students' environment and context (e.g., local community). To achieve this end goal, OSS envisions to engage students in real-life science challenges in society and create a solid link between schools and the community. With that in mind, OSS involves students into cross-subject immersive mission-style learning activities, so that personalised learning is attainable through a variety of practice-oriented work" (Guide to Open Science Schooling in Secondary Schools).



An open school is a "more engaging environment for learning and makes a vital contribution to the community: student projects meet real needs in the community outside school and draw upon local expertise and experience. And finally: learning in and together with the real world creates more meaning and more motivation for learners and teachers" (OSOS).

According to CORDIS, "it is expected that in the short term the development of partnerships between schools, local communities, Civil Society Organisations, universities and industry should contribute to a more scientifically interested and literate society and students with a better awareness of and interest in scientific careers".

On the ground of the above, open schooling can be an effective tool for creating learning opportunities that challenge traditional schools and igniting students' passion for careers in STEM.

3.2 The EXPERIMENTA methodology in a nutshell

As highlighted, our methodology is based on the principles of the **experimental approach** that, starting from the observation of the phenomenon, leads to the formulation of hypotheses, to the collection and processing of data (conducting experiments) until the verification of the hypotheses formulated.

The application of this methodology, applicable to all school subjects, allows teachers to promote a **flexible teaching path** and students to interpret reality in a **critical way,** challenging themselves with its continuous evolution.

However, through the preliminary research implemented during the first months of the project, the EXPERIMENTA Consortium outlined further **key issues** to consider for the effective design and implementation of STEM activities:

Reducing the gender gap in STEM
Considering women's and girls' low levels of engagement in STEM, it is crucial to implement initiatives moving towards gender equality in STEM.

Enhancing active learning
Motivation is key to unlock students' internal drive for learning. In order to enhance students' motivation and attitudes, they should be engaged in the learning process.

Connecting classrooms to the real world
Relevance and real world learning in the classroom is crucial for learners, not only to engage in learning but for them to care about the content.

Fostering deeper collaboration with the local community
The open schooling approach can be an effective tool fo build purposeful collaborations between schools and their wider communities.

Annexes

1. STEM good practices
2. EXPERIMENTA STEM teaching activities
3. EXPERIMENTA list of authentic tasks based on the collaboration with the local community
4. Full description of the authentic tasks implemented in Italy and Croatia

ANNEX 1.
STEM good practices

The desk research implemented by the project partners consisted of the identification and the detailed analysis of 15 best practices (5 per project country) in the field of STEM education.

Italy

In Italy, three best practices were identified by LSS and two by ITE Grimaldi Pacioli.

#1 PRINT STEM - Pedagogical Resources IN Teaching Science, Technology, Engineering and Mathematics

- **Coordinator**

Istituto di Istruzione Secondaria Superiore "A.Berenini"

- **Website/social media**

www.erasmus-plus.ec.europa.eu

- **Type of funding**

European funds (Erasmus+ programme)

- **Objectives and key elements**

To develop, carry out and validate training programs and related tools for transferrable use of 3D printers in secondary schools, in order to foster pedagogical innovation.

- **What can we learn from this example to apply to the EXPERIMENTA project**

Establishment of Teachers Team and familiarization of teachers in the subject areas involved.

#2 L'ESPERIENZA È IL SOLO INSEGNANTE IN CUI POSSIAMO CONFIDARE (EXPERIENCE IS THE ONLY TEACHER WE CAN TRUST)

- **Coordinator**

Direzione Didattica statale II Circolo

- **Website/social media**

www.secondocircolopomigliano.eu

- **Type of funding**

European funds (European structural and investment funds-PON)

- **Objectives and key elements**

To enhance STEM subjects through innovative teaching and learning strategies for better student engagement; to motivate your students (in particular girls) to get interested in STEM.

- **What can we learn from this example to apply to the EXPERIMENTA project**

Implementation of experimental activities and overcoming gender bias in STEM.

#3 LE STEM V.I.V.E DEL GRAMSCI: VIVACI, INCLUSIVE, VERTICALI, ENTUSIASMANTI! (GRAMSCI'LIVING STEM: INCLUSIVE, VERTICAL, EXCITING!)

- **Coordinator**

Istituto Comprensivo "A. Gramsci"

- **Website/social media**

www.icantoniogramsciossi.edu.it

- **Type of funding**

European funds (European structural and investment funds-PON)

- **Objectives and key elements**

To reduce early school leaving, to strenghten social and civic competencies

- **What can we learn from this example to apply to the EXPERIMENTA project**

The practical approach (workshops from the simplest robotics artifacts to the more complex one).

#4 RIDIAMO IL SORRISO (GIVE THE SMILE BACK)

- **Coordinator**

Istituto di Istruzione Secondaria Superiore "Petrucci Ferraris Maresca"

Website/social media

https://www.iispetrucciferrarismaresca.edu.it

- **Type of funding**

National funds

- **Objectives and key elements**

To put in practice the competences, knowledge and skills acquired to meet the needs of the local community; to creates strong partnerships between the local schools, industry and local organisations.

- **What can we learn from this example to apply to the EXPERIMENTA project**

To increase students' awareness about the real-world connections and the authenticity of the learning.

#5 ROBOCUP JUNIOR

- **Coordinator**

Istituto Tecnico Industriale "A.Monaco" (The School won ROBOCUP JUNIOR 2014, the robotics world cup held in Brazil and organized by RoboCup Federation)

Website/social media

https://youtu.be/rN_purVsFHg

- **Type of funding**

Private funds

- **Objectives and key elements**

To share the experience of meeting peers from abroad; to support the integration of technologies and subjects (STEM); to develop technical abilities through hands-on experience with electronics, hardware and software.

- **What can we learn from this example to apply to the EXPERIMENTA project**

The project showed the use of low-cost but high-functionality open hardware material and, from an educational point of view, the first-person passionate involvement of students.

Croatia

OS CESARICA identified the following 5 best practices:

#6 CROATIAN MAKERS

- **Coordinator**

IRIM Institute for Youth Development and Innovativity

- **Website/social media**

www.croatianmakers.hr/en

- **Type of funding**

European funds

- **Objectives and key elements**

To improve skills and competencies in the field of digital Literacy, robotics and creativity.

- **What can we learn from this example to apply to the EXPERIMENTA project**

Activities are divided in 5-6 cycles during the school year. It means that both students and teachers can plan and choose the level of knowledge/skills they want to develop. They start with easier tasks and in the next cycle the tasks become more complex. Problem solving tasks should be solved by programming and using robots. Best solutions are awarded and every student or a team has the opportunity to learn by doing.

#7 MAKER FAIRE

- **Coordinator**

Maker Faire Zagreb

Website/social media

www.zagreb.makerfaire.com

- **Type of funding**

National/regional/local funds

- **Objectives and key elements**

To support teachers and learner's creativity; To make them enthusiastic about learning.

- **What can we learn from this example to apply to the EXPERIMENTA project**

Implementation of workshops that are connected to students' everyday life and have a surprise effect.

#8 STEAM SCHOOL OF JOY

- **Coordinator**

Croatian Association of Technical Culture CATC

- **Website/social media**

www.hztk.hr

- **Type of funding**

National/regional/local funds

- **Objectives and key elements**

Through this good practice we can learn how to promote STEM education in collaboration with the local companies that co-fund a Mentor Training Program.

During the educational activities and workshops, the role of the mentors was to encourage team work and mutual support of the participants, supporting the teachers in the successful implementation of the activities.

- **What can we learn from this example to apply to the EXPERIMENTA project**

Implementation of engaging workshops.

#9 GRADIONICA

- **Coordinator**

Gradionica Association

- **Website/social media**

Gradionica - LEGO Edukacija

- **Type of funding**

European funds

- **Objectives and key elements**

To bring scientific knowledge closer to students through play and fun.

What can we learn from this example to apply to the EXPERIMENTA project

The popularization and increase of engaging workshops can play a key role in bringing young students closer to the STEM culture.

#10 CENTER NATURA SMŽ

- **Coordinator**

Public Institution for the Management of Protected Nature Values of the County of Sisak-Moslavina with partners

- **Website/social media**

www.natura-smz.com

- **Type of funding**

European funds

- **Objectives and key elements**

To enhance the learning the connection between nature, everyday life and science.

- **What can we learn from this example to apply to the EXPERIMENTA project**

to bring young learners closer to the STEM culture and help them master the knowledge and skills to develop their core competences.

Spain

#11 GO SCIENCE

- **Coordinator**

Zinev Art Technologies – ZAT

- **Website/social media**

www.facebook.com/gosciencepro ject

- **Type of funding**

European funds (Erasmus+ programme)

- **Objectives and key elements**

Students are asked to work on the creation of variety of pedagogical tools using their creativity and fantasy.

- **What can we learn from this example to apply to the EXPERIMENTA project**

With the project teachers around Europe has developed different concept models in Science, Physics, Maths, Biology and chemistry. Go Science results are a way to develop a new methodology and pedagogical tools for science teaching and learning focused on coherence of the educational content with the comprehension model of students.

#12 INCLUMETH

- **Coordinator**

IES La Canal

Website/social media

www.ieslacanal.wixsite.com

- **Type of funding**

European funds (Erasmus+ programme)

- **Objectives and key elements**

To bring schools to a new level in terms of teaching methodologies, knowledge and contact.

- **What can we learn from this example to apply to the EXPERIMENTA project**

The importance of schools promoting a constant flow of in-service training for their teachers.

#13 COEXISTENCE AND INNOVATION: CHALLENGES FOR IMPROVEMENT

- **Coordinator**

IES Santa Pola

Website/social media

www.portal.edu.gva.es/iessantapola

- **Type of funding**

European funds (Erasmus+ programme)

- **Objectives and key elements**

To improve students and teachers' STEAM and linguistic competences.

- **What can we learn from this example to apply to the EXPERIMENTA project**

The importance of the Job Shadowing for the teaching staff in order to acquire new competencies.

#14 DESIGNING BRIDGES AMONG EUROPEAN CITIZENS THROUGH STEAM

- **Coordinator**

IES Mestre Ramón Esteve

- **Website/social media**

www.sites.google.com/iesmestreramonesteve.com

- **Type of funding**

European funds (Erasmus+ programme)

- **Objectives and key elements**

To promote equity and inclusion in transnational activities.

- **What can we learn from this example to apply to the EXPERIMENTA project**

How to use innovative practices using STEAM (Science, Technology, Engineering, Art and Mathematics) subjects and to promote equity and inclusion in transnational activities, encouraging the participation of female students to contribute towards gender equality in science and research.

#15 INCLUSIVE ENVIRONMENTAL STEAM EDUCATION WITH ONLINE LABS

- **Coordinator**

Universidad de la Iglesia de Deusto

- **Website/social media**

www.facebook.com/groups/golab.project

- **Type of funding**

European funds (Erasmus+ programme)

- **Objectives and key elements**

To offer guidance and training to teachers on how to implement, adapt and even create lessons based on the principles of students' self-regulation.

- **What can we learn from this example to apply to the EXPERIMENTA project**

The use of new tools to create, adapt and implement lesson plans adapted to the student's educational needs. It is a new teaching model where the student is the protagonist of the learning process.

#16 VIDEOGAMES FOR TEACHERS

- **Coordinator**

Universidad de Valencia

- **Website/social media**

www.v4t.pixel-online.org

- **Type of funding**

European funds (Erasmus+ programme)

- **Objectives and key elements**

The main objective is to promote innovation of didactic methods through the use of videogames and ludic apps and to provide future teachers with the necessary skills and competences to make effective use of videogames and ludic apps in education.

- **What can we learn from this example to apply to the EXPERIMENTA project**

New innovative didactic methods through the use of videogames and apps in daily lessons. The project website has list of didactic and commercial videogames and apps evaluated by different teachers and researches in STEAM (Science, Technology, Engineering, Art and Mathematics) that can be used to provide students with key competences in the area, even a guideline can be used for teachers to create in an autonomous way their own videogames and apps.

#17 EU HACHATHON

- **Coordinator**

IES LLuis Simarro

- **Website/social media**

www.erasmusplus.itis.biella.it/hackathon

- **Type of funding**

European funds (Erasmus+ programme)

- **Objectives and key elements**

To enable VET students to understand ESTEAME (Entrepreneurship Science Technology Engineering Arts Mathematics Ecology) challenging subjects, encourage them to develop

transversal skills and key competences such as digital competences, innovation, critical thinking, problem solving learning to learn, etc.

- **What can we learn from this example to apply to the EXPERIMENTA project**

The project provides teachers with a new tool to motivate students in ESTEAME. Educational Hackathons allow the students to develop their ideas and make their own creations through playful learning experiences applying ESTEAME concepts in order to promote gender equality, personal fulfilment and development, social inclusion and active citizenship

ANNEX 2.
EXPERIMENTA STEM teaching activities

During the research phase, partner schools were asked to design 10 STEM teaching activities (5 per School). addressed to students 11-15.

Italy

#1 IF SOCIAL NETWORK HAD EVER BEEN EXISTED- ANCIENT ROME EDITION

1. Description of the activity

Duration (hrs)	25
Context	The activity consists in a social challenge, a play/context in which students use social networks to create contents on different topics. It is a way to allow the students about a responsible use of social networks. Among the research carried out by the students in this activity, a large space is given to the technological and engineering creations of the ancient Romans, such as water mills for grinding grain, metals and cutting wood; the aqueducts that used the natural slope of the land and the force of gravity; the hypocaust which was a heating system that provided for the circulation of hot water in pipes placed in the floor and in the walls.
Aim & description of the activity	The main aim of the activity is to combine real life and teaching activity, far away from students' experience, by using their favourite social network, through using innovative survey tools to do research on young people, combining skills strictly related to the discipline with the practical ones of companies that work with technology. It is an excellent way to make students protagonists through a tool they master perfectly, a new way and to help them say what they think in a social language.
Key competencies	• Literacy competence • Mathematical competence and competence on science, technology, and engineering • Digital competence • Personal, social and learning to learn competence • Cultural awareness and expression competence
Learning outcomes	1. To understand the change and diversity of historical times 2. To place personal experience in a system of rules based on the mutual recognition of the rights guaranteed by the Constitution 3. To use the lexicon and the interpretive categories of the historical discipline 4. To recognize the key characteristics of the socio-economic system 5. to obtain information on historical facts independently also using digital resources 6.To use digital technologies as an aid to active citizenship and social inclusion 7. To search and filter data, information, and digital content 8. To interact with others through digital tools 9. To create digital content
STEM subjects	• Technology • Engineering
Other subjects (if applicable)	• History • Italian Language
Methodology	• Brainstorming • Role playing • Workshop • Lecture • Peer to peer

2. Phases

Phase nr. 1	**Introduction to the activity**
Subjects / contents	History, information technology, Italian language.
Activities and teaching strategies	The teacher, after having dealt with Late-Antiquity, exposes the content of the activity to the students. Then she reviews the social profile of the main characters of the Italian political scene and the political language is analysed. The students are involved in a debate about the linguistic changes due to the spread of social media language.
Tools	History book, Word Wide Web, social media (as Instagram, Twitter).
Assessment methods	Participation in educational dialogue. Knowledge of historical contents.
Duration	2 hrs

Phase nr. 2	**Operational phase: working group**
Subjects / contents	History, information technology.
Activities and teaching strategies	The teacher invites the students to choose one (or more) historical character of the Late-Antiquity and to suppose how he would use a social network. According to the principle of cooperative learning, the class is subdivided in heterogeneous groups, in which students work on the creation of social contents that are uploaded on Google Classroom.
Tools	History book, Word wide web, social media networks etc.
Assessment methods	Participation in educational dialogue, commitment expressed during the lessons and by homeworking; collaboration between classmates and the ability to put into practice the Knowledge acquired. Use of information technologies.
Duration	18 hrs

Phase nr. 3	**Feedback**
Subjects / contents	History
Activities and teaching strategies	Socialization of products and by sharing of contents.
Tools	Multimedia interactive whiteboard, google workspace.
Assessment methods	Participation in educational dialogue, commitment expressed in class and at home, collaboration between classmates and the ability to put into practice the Knowledge acquired. Use of information technologies. Metacognitive reflection of what has been learned and how it has been done.
Duration	5 hrs

3. Authentic task

Problem/ challenge of the authentic task	To combine real life and teaching activity, far away from students' experience, by using their favorite social network, through using innovative survey tools to do research on young people, combining skills strictly related to the discipline with the practical ones of companies that work with technology.
Stakeholders needed for the implementation of the real-world task	Identify at least three stakeholders (e.g. Municipality, local associations, SME etc) needed for the implementation of the task
Role of each stakeholder	Support to research activities.
Product	Creation of social media contents
Validation methods	The Final product will be exposed during history class.. The teacher will evaluate the Participation in educational dialogue, commitment expressed during the lessons and by working at home, collaboration between classmates and the ability to put into practice the Knowledge acquired. Use of information technologies. The project will be displayed during a visit to Parco Scolacium to students of different schools of the province of Catanzaro. The product will be used by the Parco Scolacium as own advert published on local administrations web sites.

#2 ACHIEVING EUROPEAN ICDL LICENCE

1. Description of the activity

Duration (hrs)	30
Context	The activity allows the students to obtain by national exams the international computer licence. computer science today is a subject that applies to all sectors of education and human life, being by now the basis of any analysis or presentation of data in various fields. Computer science for which it can come into contact with STEM subjects in epidemiological analyses. statistical analyses, air and water analyzes in pollution studies, to name a few. Obtaining a European driving license in computer science cannot be separated from the use of computer systems for data analysis and presentation.
Aim & description of the activity	The activity aims to strengthen the use of new languages in the students, to provide knowledge of the use of the most widespread computer equipment and applications. The students will acquire knowledge and skills regarding the ability to use the computer and the network as tools for individual productivity, communication, sharing and collaboration.
Key competencies	• Literacy competence • Mathematical competence and competence on science, technology, and engineering • Digital competence • Personal, social and learning to learn competence
Learning outcomes	1. To raise awareness of social and legal norms 2.To ppromote a positive and responsible use of the digital tool 2.To evaluate the integrity of the information 3. To be able to contrast of the use of violent languages 4. To be able to collaborate in the digital environment 5. To use ICTs
STEM subjects	• Technology • Mathematics
Other subjects (if applicable)	• English Language • Italian Language
Methodology	• Brainstorming • Workshop • Peer to peer

2. Phases

Phase nr. 1	**Introduction to the activity**
Subjects / contents	Maths, English, Information technology
Activities and teaching strategies	The teacher exposes the content of the activity to the students. Then he reviews the maths content to be the starting point of the activity. The students are involved in an entry test about the previous competences and the specific technical language.
Tools	Teacher's notes, a written test, computers and on line exercises.
Assessment methods	Individual work. Checking the answers with the help of the teacher.
Duration	25 hrs

3. Authentic task

Problem/ challenge of the authentic task	To combine real life and teaching activity, far away from students' experience, by using their digital competences, , combining technological skills strictly related to the world of information technology and give a real application in order to achieve professional and cultural skills.
Stakeholders needed for the implementation of the authentic task	1.AICA, the national network of computer examination 2.Indire 3. Assessorato alla cultura del comune di Catanzaro
Role of the stakeholders	Validation of the activity.
Product	• Creation of a digital museum archive in the school museums • Creation of a QR code linked to the objects and items in the museums to obtain the information by a mobile phone. • Issuing of the International Computer Driving Licence (ICDL)
Validation method	Workshop with the Municipality and organizations active in the field of tourism.

#3 VIRTUAL TOUR OF SCHOOL MUSEUM (GRIMALDI HISTORICAL MUSEUM AND SEE MESEUM)

1. Description of the activity

Duration (hrs)	30
Context	The activity allow the students to use CSM tools.
Aim & description of the activity	• Creation of a website by using a CMS to promote the museum of educational tools available at the school. • Creation of a Virtual Tour the school website.
Key competencies	• Mathematical competence and competence on science, technology, and engineering • Digital competence
Learning outcomes	1. to use CMS software 2. to use digital tools (online photography, 360° virtual toors etrc) raise awareness of social and legal norms 3. to publish post (news on the website)
STEM subjects	• Technology • Engineering
Other subjects (if applicable)	N/A
Methodology	• Brainstorming • Peer to peer

2. Phases

Phase nr. 1	Use of CMS software
Subjects / contents	• Creation of a WEB domain • Loading the Wordpress CMS software • Creation of the various parts of the school museum website • 360 image acquisition of the school premises used as a museum • Creation of a virtual tour with the acquired images • Loading virtual tour in the created site
Activities and teaching strategies	Design and development of a website.
Tools	Computers, smartphones, web software.
Assessment methods	Direct observation + test on CMS
Duration	2 hrs

3. Authentic task

Problem/ challenge of the authentic task	To combine real life and teaching activity, far away from students' experience, by using their digital competences, , combining technological skills strictly related to the world of information technology and give a real application in order to achieve professional and cultural skills.
Stakeholders needed for the implementation of the authentic task	1. Municipalities 2. Other educational institutions
Role of the stakeholders	They can support the promotion of the webiste/digital content created by the students.
Product	Design and development of a website on a free domain where the students can customize it and upload the data of the school museum and the page for the virtual tour.
Validation method	Meetings at school to showcase the final products,

#4 FOOD DELIVERY FAST MERCURIUS SAVE

1. Description of the activity

Duration (hrs)	30
Context	The activity Mercurius has a vision: to cure the past to be the future. Mercurius has set itself a goal, to satisfy one of the primary needs of a specific population group. From group of guys with a business idea, you want to move on to a concept concrete. By conducting careful market and service analysis, the need emerged dissatisfied with an important portion of the population. This is why Mercurius was born, a start-up that has as its mission the delivery of meals, with particular attention to any health needs of the individual, dedicated to the band aged over 65.
Aim & description of the activity	You are in a market where services are similar and customers less encourage you to choose one institution over another. From this comes the need to involve various elements such as respect for the environment and the increase in ratio between silver economy (the silver economy is the production system, distribution and consumption of goods and services aimed at using the potential of purchase of older people) and digital transformation (set of changes mainly technological, cultural, organizational and social, associated with the applications of digital technology, in all aspects of human society). The service includes the delivery of meals during all days of the year, taking into account any specific diets and therefore in accordance with basis, so that the most appropriate menus can be identified. In order to work professionally and distinctively it was decided to adopt an organization that provides for a very precise scheduling of activities. Orders will be recorded on a spreadsheet within a given time, the latter will be transmitted electronically to affiliated restaurants. As soon as the meal preparation is completed, our riders (initially 3) divided respectively into 3 zones will begin their work shift. In this way they will travel only once to the affiliated restaurants and will distribute the requested orders. All this in order to ensure the service in short time. If the order is placed at a secondary time, the delivery will be less efficient as priority will be given to orders placed in the reference time.
Key competencies	• Mathematical competence and competence on science, technology, and engineering • Digital competence • Entrepreneurship
Learning outcomes	1. to respect the environment 2. to increase of ratio of silver economy and digital transformation 3. to satisfy one of the primary needs of a specific population group.
STEM subjects	• Technology • Mathematics
Other subjects (if applicable)	N/A
Methodology	• Brainstorming • Role Play • Workshop

2. Phases

Phase nr. 1	**Research**
Subjects / contents	Marketing, market research
Activities and teaching strategies	Following the performance of market analysis carried out on the web, face-toface interviews and compilation of a questionnaire administered to a sample of population, the target has been identified. This is the population over 65 which covers, from ISTAT data, a percentage of 23.7% (about 10,000 people) of the inhabitants of the city of Catanzaro.
Tools	Internet
Assessment methods	Several statistics and analyses conducted over the years, have highlighted how the method was the most effective and excellent for the promotion of a particular product or service. This has shown that the promotion of better performance and to maximise the reputation of the start-up. They are the word of mouth and the leaflet. The ordering mode is managed by an application disposed of a layout easy and easily usable, also is given the possibility to order via telephone contact. The app will present very intuitive and easy controls, in the main interface there will be colored stickers that will be associated with the different diets, after which you can proceed to the order through an additional interface in which with a simple confirmation, the order will be sent. The development of a very simple application aims to ensure that two parallel lines how old age and advanced technology can become accidents. One of the corevalues of Mercurius is respect for eco-sustainability. For this reason it was decided to use cars with hybrid power with a low impact on the environment, and always because of the latter parameter the meals will travel in isothermal containers that have an eco-sustainable percentage of 38% less CO2.
Duration	6 hrs

3. Authentic task

Problem/ challenge of the authentic task	Points of weakness: - a limited action area within 10 km of the head office; - a low number of human resources; - Need for more financial resources. - Indirect competitors offering a cheaper service or located in more favourable geographical locations.
Stakeholders needed for the implementation of the authentic task	1. Chamber of Commerce. 2. Business and Industry Associations.
Role of the stakeholders	Supporting the creation of the start up
Product	Creation of a startup.
Validation method	Final workshop with others schools, Chamber of Commerce, Business and Industry Associations.

#5 WE TALK SPANISH!

1. Description of the activity

Duration (hrs)	30
Context	Preparation of students to take the dele b1 certification exam. Learning a language through the study of various aspects of reality such as the environment that surrounds us, therefore nature, pollution, or the use of technologies in various fields, inevitably involves STEM subjects, enriching the student not only with the contents of the same but also of the vocabulary and communicative skills in the foreign language. The Involvement of STEM subjects concerns the communicative situations and contents related to pollution, for example, where science, ecology, knowledge of the environment that surrounds us are touched; or even travel with the evolution of technologies and means of transport.
Aim & description of the activity	The purpose of this activity is to prepare students for the Dele b1 language certification exam. The tests are related to the four language skills: written and oral comprehension, written and oral production.
Key competencies	• Multilingual competence • Personal, social and learning to learn competence • Cultural awareness and expression competence
Learning outcomes	1. To identify links between local, national and international cultural traditions 2. To identify and use modern forms of visual and multimedia communication, also with reference to expressive strategies and technical tools for online communication;
STEM subjects	• Science • Technology
Other subjects (if applicable)	Foreign languages
Methodology	• Brainstorming • Role playing • Workshop

2. Phases

Phase nr. 1	**We talk Spanish!**
Subjects / contents	The topics and contents to be treated are personal and family, school, sports and hobbies, professions, travel, food and restaurants, health, clothes and shopping, environmental protection. Within these topics certain communicative situations are proposed to be developed in a spoken way but also themes to be developed in written form, or oral and written texts to be understood. The Involvement of STEM subjects concerns the communicative situations and contents related to pollution, for example, where science, ecology, knowledge of the environment that surrounds us are touched; or even travel with the evolution of technologies and means of transport.
Activities and teaching strategies	Design and development of a website.
Tools	Indire platform; touch screen digital whiteboard; laptop; images; audio recordings; video; photocopies
Assessment methods	Direct observation
Duration	30 hrs

3. Authentic task

Problem/ challenge of the authentic task	To improve the linguistic ability of the foreign language (especially the oral one where they are weak) through the involvement of the local community (museumes).
Stakeholders needed for the implementation of the authentic task	1. Indire 2. Instituto Cervantes 3. Local museums 4.Town harbour 5.Group of artists, cultural associations, workers at the harbour (local fishermen)
Role of the stakeholders	• Indire: it issues the final certificate of participation. • Instituto Cervantes: its issues Diplomas in Spanish as a Foreign Language (Spanish initials, DELE) on behalf of the Spanish Ministry of Education, Culture and Sport • Museums: supporting the training of students as tourist guides.
Product	• Guided visits and knowledge of the nearby • Translation in Spanish of the exhibition and items in the museum. • Creation of QR codes to focus on the explanation of the objects.
Validation method	Workshop with the Municipality and organizations active in the field of tourism.

Croatia

#1 NOISE

1. Description of the activity

Duration (hrs)	11 + 5 hours for the implementation of the authentic task
Context	Students are encouraged to take an active approach with the implementation of practical work to become aware of the problem of noise pollution, one of those ubiquitous pollution that most people are still unaware of. The problem was further elaborated on the level of health care, due to the frequent endangerment of hearing due to long-term use of headphones and listening to content that is too loud, as well as endangering the safety of young people due to the use of headphones while moving in traffic.
Aim & description of the activity	Make students aware of the existing problem of noise at all levels: noise pollution in cities, various facilities, traffic, etc.; in private life due to too loud and too long use of headphones and in safe movement due to the use of headphones while moving in traffic. The topic of the project is closely related to the content of Physics, Biology, and Geography, as well as the cross-curricular topics of Health and Sustainable Development. The project was designed as an active investigation by students about the amount of noise in the school's surroundings (Maksimir Park, Volovčica Market), the streets around the school and its interior, students' homes, and as an investigation into the effect of using headphones on hearing and safety.
Key competencies	• Mathematical competence and competence on science, technology and engineering • Digital competence • Personal, social and learning to learn competence • Citizenship competence
Learning outcomes	1. Describe the problem of noise pollution in open and closed spaces. 2. Measure, display and interpret the results of noise level measurement. 3. Analyze the consequences of long-term exposure to noise. 4. Connect the habits of wearing headphones and listening to loud music with hearing problems and traffic hazards. 5. Design and describe ways in which individuals can influence the reduction of perceived problems. 6. Design and create informative - propaganda material using ICT. 7. Present your knowledge and information propaganda material to your fellow citizens.
STEM subjects	• Science • Technology
Other subjects (if applicable)	• Civil education • Health • Sustainable Development • ICT
Methodology	• Brainstorming • Workshop • Lecture • Peer to peer • Other (Please specify): research activities in the original reality, implementation of measurements in the original reality, displaying data, interview.

2. Phases

Phase nr. 1	**Public institution Park Maksimir: Noise workshop**
Subjects / contents	• Vibration, wave, sound; noise pollution • Noise pollution • Adaptations of living beings; senses – hearing • Sustainable development: Noise pollution
Activities and teaching strategies	1. Observation of hearing and use of sound in the animal world (echolocation, hearing in snakes): systematic observation of the original reality, setting hypotheses about sound in the animal world, conversation 2. Using a sound meter, recording results: research, practical work: measuring, taking notes, comparing data 3. Consequences of noise pollution for living beings: systematic observation of animal behavior in quiet and noisy environments , conversation about the effects of noise on the life of animals in the city , brainstorming brainstorming about possible solutions and helping animals.
Tools	Devices: betdetektor, sound meter Worksheets
Assessment methods	A survey on student satisfaction with this way of working, a discussion about the contents adopted and the usefulness of what was learned.
Duration	2 hrs

Phase nr. 2	**Noise measurement in the settlement**
Subjects / contents	• Vibration, wave, sound; noise pollution • Noise pollution • Ear, ear diseases • Noise pollution • Safety at work • Health • Sustainable development
Activities and teaching strategies	Noise measurement (systematic observation of the original reality, setting hypotheses about the volume of noise in different spaces around us, carrying out measurements - checking the set hypotheses, drawing conclusions, taking notes): a) at school during classes b) at school during PE lesson – team game c) at school during vacation d) in the home at night e) in the home during the day when the household members are active f) on the street g) in the park by the railway during the passing of the train and when it is not passing h) in the ZOO when people return from work i) output noise from headphones ... Students perform measurements in groups, applying the knowledge of measurement methods acquired in the previous activity. They prepare an analysis of the obtained data (displaying the data in different ways: notes, table, chart) and compare the results obtained with each other.
Tools	• Sound meters • Measurement protocol • Tables for entering data • Excel
Assessment methods	Students fill in the tables for self-evaluation; tables for peer evaluation contribution of groups and individuals to obtain final data
Duration	5 hrs

Phase nr. 3	**Doctor's visit**
Subjects / contents	Vibration, wave, sound; noise pollution Noise pollution Ear, ear diseases Noise pollution Safety at work Health Sustainable development
Activities and teaching strategies	Doctor's lecture on hearing and the health of the hearing organ; demonstration, conversation; students ask the doctor pre-prepared questions.
Tools	• Presentation • Worksheets • Biology textbook
Assessment methods	Students write down 3 new things they learned, 2 things they want to know more about, and 1 thing they knew before.
Duration	2 hrs

Phase nr. 4	**Visit of traffic safety experts**
Subjects / contents	Vibration, wave, sound; noise pollution Noise pollution Ear, ear diseases Noise pollution Safety at work Health Sustainable development
Activities and teaching strategies	Safety expert's lecture on safety in traffic: conversation Practical work - How much do I hear when I wear headphones?; experiment: setting hypotheses, carrying out experimentthey test whether they hear different traffic sounds when they have headphones with music on , checking the set hypotheses, drawing conclusions, taking notes
Tools	• Presentation • Worksheets • Headset • Recordings of traffic sounds
Assessment methods	Students complete a worksheet - a short test on the acquired knowledge about the dangers of wearing headphones and listening to music while moving in traffic.
Duration	2 hrs

3. Authentic task

Problem/ challenge of the authentic task	Create an informative propaganda campaign to raise awareness of the problem of noise pollution and the importance of preserving hearing in everyday movement.
Stakeholders needed for the implementation of the authentic task	1. Public institution Park Maksimir 2. Local committee Bruno Bušić 3. Police Department Zagrebačka 4. Council of parents of Primary School D. Cesarić 5. S. S. Kranjčević City Library
Role of the stakeholders	The public institution Park Maksimir will hold an initial workshop on noise, introducing students to the concept of noise and ways of monitoring it, as well as its effects on the living world of the Park. Bruno Bušić's local committee will be our partner in researching the impact of railway traffic noise on life in the settlement. The Zagreb Police Department is a partner from whom we will ask for information on safety and traffic problems related to noise and accidents related to the use of headphones in traffic. The Council of Parents of Dobriša Cesarić Primary School will help us in looking for experts for visits. City Library S.S. Kranjčevića will enable the final event to take place.
Product	• Informative promotional video about the problem of noise pollution • Posters about noise pollution • Posters on the safe use of headphones
Validation method	• Presentation of processes and works in the S. S. Kranjčević City Library • Presentation of the work at the Council of Parents • Students fill in the tables for self-evaluation; tables for peer evaluation contribution of groups and individuals to obtain final data.

#2 ENERGY EFFICIENCY

1. Description of the activity

Duration (hrs)	11 + 5 hours for the implementation of the authentic task
Context	Teenage students mostly learn about problems related to energy consumption and saving, the need to use the cleanest sources and forms of energy in everyday life, and the concept of energy efficiency, but they rarely implement the acquired knowledge in everyday life. By actively acquiring knowledge through experiments and research activities, students establish knowledge in the field of Physics and Technical Culture and are encouraged to apply the acquired knowledge in everyday life.
Aim & description of the activity	Make students aware of the existing problem of energy consumption and saving, the need to use the cleanest sources and forms of energy in everyday life, and the concept of energy efficiency and about the necessity of implementing acquired knowledge in everyday life without delay. The topic of the project is closely related to the content of Physics, Technical Culture and Geography, as well as the cross-curricular topics of Sustainable Development and Civic education and education.The project was designed as an active investigation by students about the energy consumption in households, personal vehicles of students' parents, as well as the possibilities of more efficient use of available energy sources and the transition to renewable and less polluting energy sources.
Key competencies	• Mathematical competence and competence on science, technology and engineering • Digital competence • Entrepreneurship • Citizenship competence
Learning outcomes	1. Describe the circuit and name the parts 2. Apply the knowledge of the circuit in the creation of vehicle models 3. Describe and compare bills for electricity consumption and heating in the home before and after the implementation of savings measures 4. Describe and compare bills for electricity consumption and heating in the school before and after the energy renovation 5. Describe which elements of the energy renovation influenced the reduction of money and/or energy consumption 6. Design ways to promote economical and responsible handling of energy
STEM subjects	• Technology • Engineering • Mathematics
Other subjects (if applicable)	• Civil education • Health • Sustainable Development • ICT
Methodology	• Brainstorming • Workshop • Lecture • Peer to peer • Other (Please specify): practical work, research, experiment.

2. Phases

Phase nr. 1	**Circuit**
Subjects / contents	• Electric charge, electric current, simple electric circuit, Refraction of light - decomposition of light Charges • Electric circuit, renewable energy sources, movement using electricity
Activities and teaching strategies	STEAM workshop. Talk about renewable energy sources. Making a circuit and a car using the Neuron creative Lab kit.
Tools	• Neuron creative Lab kit
Assessment methods	Presentation
Duration	2 hrs

Phase nr. 2	**Research on the consumption of electricity, heating and fuel for personal vehicles and related bills in the home**
Subjects / contents	• Analyzes spatial organizations and processes through research work, Climatic characteristics of the homeland • Electric current • Displaying numerical data • Sustainable development
Activities and teaching strategies	Students make assumptions about consumption in different seasons. Each student should individually research the consumption of electricity, heating and fuel for personal vehicles in their home for one month in each season and relate changes in consumption and costs to climatic characteristics. Students compare the collected data and the conclusions reached.
Tools	• Bills for electricity, heating and fuel for the personal vehicles of the students' parents
Assessment methods	Presentation of research results
Duration	3 hrs

Phase nr. 3	**A car with an electric motor**
Subjects / contents	• Electricity, simple electric circuit, speed, motion • Traffic around us, rectangular projection, technical documentation, production of technical creation • Electric circuit, renewable energy sources, movement using electric motors.
Activities and teaching strategies	STEAM workshop. Making a car with an electric motor.
Tools	• Presentation • Electromotor • Cardboard, copper strips
Assessment methods	Presentation
Duration	2 hrs

Phase nr. 4	**Energy renovation in the Zagreb Zoo**
Subjects / contents	• Analyzes spatial organizations and processes through research work, Climatic characteristics of the homeland • Electricity • Displaying numerical data • Sustainable development
Activities and teaching strategies	Workshop on energy renovation - educators in the Zagreb Zoo will guide students through elements of energy renovation, observed improvements and possible problems after a few years.
Tools	• Presentation
Assessment methods	Quiz show
Duration	2 hrs

3. Authentic task

Problem/ challenge of the authentic task	Procedures and benefits of energy renovation of the school
Stakeholders needed for the implementation of the authentic task	1. M-STEAM, trade for training 2. City Office for Education, Zagreb 3. Zagreb Zoo
Role of the stakeholders	Members of the M-STEAM team will allow us to use their kits for STEAM activities and organize workshops on electric circuits and making electric cars. The city office for education facilitated the energy renovation of the school, and they will help us in collecting data about it. Zagreb Zoo went through the process of energy renovation a few years ago, their educators will guide students through its elements and observed improvements and possible problems after a few years.
Product	• Brochure on energy renovation of the school • Brochure on possible energy savings in the home
Validation method	Presentation of the project in the City Library

#3 CONSTRUCTION AND SAFETY

1. Description of the activity

Duration (hrs)	15 hours
Context	Everyone wants to have a home where they will feel safe and comfortable. Animals build their dwellings, and humans build the buildings in which they live, work, and spend time. However, the safety of these buildings can be compromised by some natural disasters, such as earthquakes. It is necessary to draw attention to the construction of stable buildings and make the spaces in which we live safe. It is useful to know how to make a temporary shelter torrent. Through Activities, students apply knowledge from the fields of Biology, Physics, Mathematics and Technical Culture and connect them with everyday life.
Aim & description of the activity	Better understanding of the connection between man and nature and its impact on nature. Connecting And Comparing Ways Of Building Housing for animals and human homes. Discovering that buildings can be safer and more resilient to natural disasters such as earthquakes and finding out which type of construction is safer. Observation of possible earthquake consequences through earthquake simulations. Learning to build a temporary shelter or tent. Trying to make the space we live in as safe as possible. The topic of the project is Closely Related to the contents from Physics, Biology, Mathematics, Geography and Technical Culture.
Key competencies	• Mathematical competence and competence on science, technology and engineering • Digital competence • Personal, social and learning to learn competence • Citizenship competence
Learning outcomes	1.Relate biodiversity, habitat and living conditions. 2. Connect biological discoveries with the development of civilization and the application of technology in everydaydaylife. 3. Compare body dimensions (physical size, length, area and volume). 4. Observe the simplicity, functionality and stability of building construction using hexagonal prisms (geometric bodies with flat surfaces) as opposed to building construction using cylindrical shapes (geometric bodies with curved surfaces). 5. Build a temporary shelter and set up a tent. 6. Link the construction method with the strength of the earthquake consequences. 7. Design how to make the space we live in safer for life. 8. Present knowledge to other students.
STEM subjects	• Science • Engineering • Mathematics
Other subjects (if applicable)	• Sustainable Development
Methodology	• Brainstorming • Workshop • Lecture • Peer to peer

2. Phases

Phase nr. 1	**Educational and presentation centar Natura SMZ, Petrinja** **Workshop - Construction in the animal world**
Subjects / contents	• The relationship between biodiversity, habitat and living conditions • Adaptations of living beings • Properties of wood and other materials
Activities and teaching strategies	1. Identifying animals that build their homes close to people: talking and recognizing animals near our home and school using animal picture cards, drawing conclusions 2. Observing the specifics of individual animals - how ants organize anthill, how bees build an apiary, from which materials a swallow, eagle or owl build a nest, and the resistance of habitats to natural disasters (wind, rain, flood): systematic observation through pictures, conversation 3. Testing the properties of wood and other materials, practical work 4. Watching a short film / presentation about the beaver builder, talking about its peculiarities: observation, conversation 5. Discussion whether beavers a useful neighbor or a pest: conversation, discussion.
Tools	• Devices: computer and projector, beaver presentation / movie about beaver • Animal picture cards • Examples of materials from which animals build dwellings
Assessment methods	The memory game - connect the animal with the dwelling in which it lives
Duration	4 hrs

Phase nr. 2	**Educational and presentation centar Natura SMZ, Petrinja** **Workshop - Tube or honeycomb, which is bigger, which is stronger?**
Subjects / contents	• Arthropods - bees, pollination • Polygons, area and volume of geometric bodies • Body dimensions (physical size, surface length and volume)
Activities and teaching strategies	1. Discovering the peculiarities of bees - their importance in the ecosystem, reproduction by pollination, beehives, honey production: presentation / film, conversation 2. Comparison of different types of honey: practical work - tasting and comparing different types of honey 3. Research of the functional structure of the beehive a) calculating the area of a circle and a regular hexagon inscribed in it b) calculation of the volume the roller and the hexagonal prism belonging to it c) comparison of obtained quantities - calculation, data recording, comparison and analysis of obtained results, work in pairs or groups 4. Making a creation from round straw sand hexagonal pencils: practical work, inference

Tools	• Projector and computer, presentation / film • Different types of honey for tasting • Data entry tables • Straws (round) and pencils (hexagonal) • Worksheets
Assessment methods	Comparing results with other groups
Duration	3 hrs

Phase nr. 3	**Constructions**
Subjects / contents	• Body interaction, motion and force
Activities and teaching strategies	1. Making bridges from paper of different thicknesses, observing the effect of load on the bridge: practical work, measurement, data recording 2. Making a high structure of paper, competition which group will build a taller and more stable building of 8 A4 paper, 5 staples and 7 cm of duct tape: group work, competition, announcement of winners, construction analysis, teamwork analysis
Tools	• Data recording tables • Paper, staples, duct tape
Assessment methods	• Presentation of group work
Duration	2 hrs

Phase nr. 4	**Borongaj Scout Detachment Workshop**
Subjects / contents	• Technology • Physical problem solving skills
Activities and teaching strategies	1. Making a temporary shelter from weather from ten twings and handy material - demonstration, practical work 2. Tent erection and demolition - demonstration, group practical work
Tools	• Ten twings and handy materials • A six-part tent construction and eight pegs for one tent
Assessment methods	Questionnaire
Duration	4 hrs

Phase nr. 5	**M-STEAM Workshop: Earthquake simulation**
Subjects / contents	• Wave formation, wave energy transfer • Variability of relief under the influence of internal processes • Rectangular projection • Earthquake • Quality and durability of the building
Activities and teaching strategies	1. STEAM workshop. 2. Talk about the origin and impact of earthquakes. Development of earthquake simulation and durability testing of building models.
Tools	• Presentation • Lego WeDo 2.0 • Tablet
Assessment methods	Quiz show
Duration	2 hrs

3. Authentic task

Problem/ challenge of the authentic task	Learn how to protect ourselves from the consequences of an earthquake by securing objects that could fall on us and injure us during earthquakes. Be aware of the importance of safety on construction sites.
Stakeholders needed for the implementation of the authentic task	1. Natura Educational and Presentation Center, Petrinja 2. Borongaj Scout Detachment 3. M-STEAM, a craft for teaching 4. D. Cesarić Elementary School Student Council
Role of the stakeholders	1. The educational presentation center Natura from Petrinja will hold a workshop on construction of the animal world and a workshop on functional construction of beehives, and will map the stability and strength in construction of animal housing to the need for safer construction of human living spaces. 2. The Borongaj scout troop will allow students to try to make a temporary shelter or tent that should be safe for humans. 3. M-STEAM will show students the possible consequences of an earthquake depending on the type of building. 4. The student council of Dobriša Cesarić Primary School will listen to the results of our activities and share new knowledge to their classes.
Product	• Informative promotional video on the need for safer construction of building sand the possibilities of earthquake protection • Posters on how to protect against the side effects of earthquakes
Validation method	• Questionnaire • Presentation of the authentic task to the Student Council

#4 BIODIVERSITY

1. Description of the activity

Duration (hrs)	15 hours
Context	Everyone wants to have a home where they will feel safe and comfortable. Animals build their dwellings, and humans build the buildings in which they live, work, and spend time. However, the safety of these buildings can be compromised by some natural disasters, such as earthquakes. It is necessary to draw attention to the construction of stable buildings and make the spaces in which we live safe. It is useful to know how to make a temporary shelter torrent. Through Activities, students apply knowledge from the fields of Biology, Physics, Mathematics and Technical Culture and connect them with everyday life.
Aim & description of the activity	Better understanding of the connection between man and nature and its impact on nature. Connecting And Comparing Ways Of Building Housing for animals and human homes. Discovering that buildings can be safer and more resilient to natural disasters such as earthquakes and finding out which type of construction is safer. Observation of possible earthquake consequences through earthquake simulations. Learning to build a temporary shelter or tent. Trying to make the space we live in as safe as possible. The topic of the project is Closely Related to the contents from Physics, Biology, Mathematics, Geography and Technical Culture.
Key competencies	• Mathematical competence and competence on science, technology and engineering • Digital competence • Personal, social and learning to learn competence • Citizenship competence
Learning outcomes	1. Use and describe the use of mobile applications for identifying birds, bushes and trees in the city of Zagreb. 2. Enumerate and describe the main stages of development of mobile applications for determining species of living beings. 3. Recognize, list and describe the most common birds and butterflies around the school. 4. Recognize and list the most common bushes and trees around the school. 5. Explain the importance of preserving biological diversity in urban environments. 6. Make a hotel for insects. 7. Make feeders and waterers for birds and butterflies. 8. Design and create educational panels with information about the plants and animals of the school yard.
STEM subjects	• Science • Technology
Other subjects (if applicable)	
Methodology	• Brainstorming • Workshop • Peer to peer • Other (Please specify): using mobile applications in field research, research activities in the original reality, displaying data

2. Phases

Phase nr. 1	**The living world of Maksimir Park**
Subjects / contents	• Birds, insects (butterflies), bushes, trees; biocenosis of Maksimir Park • City plan, cartographic research activity • Use of mobile applications
Activities and teaching strategies	1. Instructions for downloading and using applications - a short lecture 2. Downloading applications - practical work- finding, downloading and preparing the application 3. Instructions for using the butterfly key - short lecture 4. Instructions for recording the observed data, use of the map and recording of data on observed species in the map 5. Alternate determination of plants and animals and recording of data, use of the map and recording of data on observed species in the ma 6. Analysis of collected data 7. Biological diversity of Maksimir Park and balance in nature - short lecture
Tools	• Mobile application for bird identification • Kralj, J., Janec Hutinec, B., 2022., Zagrebački letači - Ptice Grada Zagreba, JU Maksimir, Zagreb • Mobile application for determining bushes and trees • Key to determine the butterfly • Maksimir park plan.
Assessment methods	• Questionnaire for students • Peer assessment
Duration	3 hrs

Phase nr. 2	**Visit of an ICT expert**
Subjects / contents	• Use of mobile applications
Activities and teaching strategies	1. Professional lecture: Creating computer applications: get to know the process of creating computer applications - market research, development 2. Finding available applications for identifying plants and animals. on the web - security, copyright - lecture and demonstration: how to take care of security and possible costs, respect copyright 3. Downloading and using applications - practical work: how to check the compatibility of the application with the device, etc.; using applications for determining plant and animal species, recording data obtained from research and determining species.

Tools	• Mobile phones • JU Maksimir applications • Computers • Internet connection
Assessment methods	Questionnaire for students and teachers on the simplicity/complexity of using mobile applications for research purposes in the original reality, on the possible desire/intention to use familiar applications to satisfy curiosity about the world around us in our free time.
Duration	2 hrs

Phase nr. 3	**The living world of Borongai**
Subjects / contents	• Birds, insects (butterflies), bushes, trees; biocenosis of Maksimir Park • City plan, cartographic research activity • Use of mobile applications
Activities and teaching strategies	1. Instructions for work in the form of a mini-lesson 2. Division of settlements into transects for research: the use of the settlement plan and the division of the space into individual areas so that each group of students can study the living world of one part of the area with the use of applications and keys to determine the species used in Maksimir Park 3. Division of tasks: division of students into groups and division of tasks within each group 5. Determining plants and animals and recording data - students' independent research work 6. Analysis of collected data: graphical display of data and comparison of data of all groups, use of settlement plan
Tools	• Mobile application for bird identification • Kralj, J., Janec Hutinec, B., 2022., Zagrebački letači - Ptice Grada Zagreba, JU Maksimir, Zagreb • Mobile application for determining bushes and trees • Key to determine the butterfly • Borongaj plan.
Assessment methods	Questionnaire for students and teachers, a survey on student satisfaction with this way of working, a discussion about the contents adopted and the usefulness of what was learned.
Duration	5 hrs

3. Authentic task

Problem/ challenge of the authentic task	Learn how to protect ourselves from the consequences of an earthquake by securing Numerous plant and animal species live in the yard of our school, but our fellow citizens are not aware of their existence and the importance of preserving biological diversity in urban environments. By actively involving school students in the construction of hotels for insects and feeders and waterers for birds and butterflies, as well as by informing fellow citizens through educational boards, we want to raise the awareness of fellow citizens.
Stakeholders needed for the implementation of the authentic task	1. Public institution Park Maksimir 2. OAZA Association, Zagreb 3. Zagreb Zoo 4. Council of parents of Dobriša Cesarić Elementary School 5. Borongaj Scout Squad
Role of the stakeholders	Employees of Maksimir Public Institution and OAZA Association will impart basic knowledge about certain plants and animals to the students. In the Zoo, students will learn how to make waterers, feeders and an insect hotel for our target species. Members of the parent council will connect students with IT experts in the local community. The scouts will help the students in making feeders, waterers, insect hotels and educational boards.
Product	The schoolyard will be equipped with a new hotel for insects, feeders and waterers for butterflies and birds, and educational boards about the living world of the schoolyard. With the help of IT experts, educational boards can be created in digital form and available via a link or barcode. The general public will be informed about the progress of the work through announcements on the school's website.
Validation method	Students will present the completed project at the Garden Festival in the school yard. All participants will be invited to the Festival and asked to fill out a questionnaire about their satisfaction with our cooperation and the benefits they see for students in this way of working. The results will be published on the school website.

#5 PLANT, ENERGY AND ME

1. Description of the activity

Duration (hrs)	11 + 10 hours for the implementation of the authentic task
Context	Students of that age, especially girls, often begin to think about food exclusively through the aspect of their own appearance, rather than quality nutrition. By encouraging students to research activities related to food and the energy it gives us, we will encourage them to think seriously about the quality of nutrition and the needs of a growing and developing organism. They will learn about veganism and vegetarianism, actively research substances in food of plant origin and learn what ecological agriculture is, and in this way connect the teaching content of STEM subjects with their everyday life.
Aim & description of the activity	The goal of the activity is to investigate human nutrition, plant-based foods, energy conversion during food production and consumption, and the possibilities of organic plant cultivation in urban environments.During a visit to a vegetarian and vegan restaurant, students will get to know various ways of human nutrition as well as some simple and popular vegetarian/vegan recipes. After the visit, the students will carry out research activities and experiments in which they will investigate the conversion of energy in food and substances in plants of plant origin, using video instructions and recordings of experiments by the Bioteka association. Members of the OAZA association will take students through urban gardens and explain the principles of growing plants in them. At the end, students will choose one of the two offered tasks from the real world:1. record a recipe for a vegetarian/vegan dish of your choice to which you will add comments about substances in food and energy conversion or2. grow an edible plant in a raised bed.
Key competencies	• Mathematical competence and competence on science, technology and engineering • Digital competence • Citizenship competence
Learning outcomes	1. Describe and compare vegan, vegetarian and regular diets 2. Determine and describe energy conversion during the production of nutrients and food consumption 3. Test to determine the presence of some substances in food of plant origin 4. Describe and enumerate procedures in ecological cultivation of edible plants 5. Apply acquired knowledge in the process of food preparation 6. Apply acquired knowledge in growing plants 7. Present practical work using digital tools - video work.
STEM subjects	• Science • Mathematics
Other subjects (if applicable)	• Computing • Sustainable Development
Methodology	• Brainstorming • Workshop • Other (Please specify): practical work (experiments, cooking, gardening).

2. Phases

Phase nr. 1	**Visit to the OAZA Joyful Kitchen restaurant**
Subjects / contents	• Plant • Food • Energy
Activities and teaching strategies	1. Who works in the restaurant? - conversation 2. How the menu is created - conversation and workshop 3. Menu and prices - How is the price of a meal formed? - conversation 4. Tasting food - practical work 5. Chef's advice - conversation
Tools	• Survey for restaurant employees • Menu • Financial manager of the restaurant
Assessment methods	Questionnaire for students
Duration	3 hrs

Phase nr. 2	**Plant and food of plant origin**
Subjects / contents	• Plant parts, photosynthesis, nutrients • Chemistry: experiment, proof of starch, fat
Activities and teaching strategies	1. Plant - food producer, lecture 2. Energy conversion - from the Sun to our activities, workshops 3. Experiments: proving starch, fat in foods of plant origin https://hr.izzi.digital/DOS/604/3404.html https://www.youtube.com/watch?v=yyzWzkFsh84
Tools	• Internet connections, computers • Material and forms for recording experiments
Assessment methods	Concept mapping
Duration	4 hrs

Phase nr. 3	**Urban gardens**
Subjects / contents	• Plant • Sustainable development
Activities and teaching strategies	A visit to the urban garden and participation in current garden works - extracurricular teaching
Tools	• Survey for restaurant employees • Menu • Financial manager of the restaurant
Assessment methods	Quiz show
Duration	2 hrs

Phase nr. 4	**Preparing fruit salad**
Subjects / contents	• Conversation about the importance of fruit for a healthy diet • Preparation of fruit salad - practical work • Tasting and evaluation
Activities and teaching strategies	A visit to the urban garden and participation in current garden works - extracurricular teaching
Tools	• Ppt • Fruit • Nuts • Fruit juices • Honey • Sugar • Kitchen accessories • Gloves, masks
Assessment methods	Questionnaire
Duration	2 hrs

3. Authentic task

Problem/ challenge of the authentic task	Students choose one of the two tasks offered: 1. record a recipe for a vegetarian/vegan dish of your choice to which you will add comments about substances in food and energy conversion or 2. grow an edible plant of your choice in a raised bed (from seed or seedling) Identify a problem/need to be addressed through the real-world task. The authentic task should be: • meaningful and challenging for students • consistent with the topic(s)
Stakeholders needed for the implementation of the authentic task	1. OAZA Joyful Kitchen restaurant 2. OAZA association 3. S. S. Kranjčević City Library
Role of the stakeholders	Employees of OAZA Joyful kitchen will help students who decide to record a recipe. Employees of the OAZA association will help students who decide to build a raised bed. Students will hold a presentation of their work in the city library.
Product	1. Video: Healthy recipes 2. Raised bed (garden)
Validation method	At the event in the City Library of S.S. Kranjčević, the students will present their work.

ANNEX 3.
EXPERIMENTA's list of authentic tasks based on the collaboration with the local community

An authentic task is an assignment given to students designed to assess their ability to apply standard-driven knowledge and skills to real-world challenges.

Each participating school is asked to select and perform at least 1 of the authentic tasks suggested below.

1. Equip your school/city with an interactive botanical garden with QR codes in display. The QR codes can be scanned by visitors' mobile devices, which link them to an online resource for further information (e.g. classification of species, use of active ingredients etc).

2. Produce educational material to make one of the tourism organization of your city (e.g. city museum) of your city available to different age groups of visitors.

3. Provide solutions for the redevelopment of a vulnerable local area which is challenging from an environmental/social point of view.

4. Plan a science treasure hunt addressed to the young people of your city.

5. Design an educational escape room addressed to the young people of your city.

STEPS

01 Translating the authentic task into an educational activity based on the following:
a. STEM subjects
b. involvement of local community (stakeholders needed for the implementation of the task).

02 Identification of the purpose, objectives, methods, tools, resources and timeframe for implementation of the the authentic task.

03 Identification and engagement of local stakeholders.

04 Ongoing evaluation + evaluation of the products produced throughout the implementation authentic task (e.g. elaboration of paper material: leaflets, posters etc.) and/or digital material (QRCodes, webpages, PPT etc.)

05 Public validation of the authentic task through the organisation of an event and the presentation of the results during the Festival of Science and Philosophy - Foligno, April 2023.

ANNEX 4.
EXPERIMENTA's list of authentic tasks based on the collaboration with the local community

Author:ITE GRIMALDI PACIOLI

EXPERIMENTA Project

This questionnaire is used to evaluate the reality task implemented by each school for EXPERIMENTA project
How to use: Please answer each question and provide information as specifically as possible.
Thank you!

1.- Please select the authentic task realized by your School *

- ( ) Equip your school/city with an interactive botanical garden with QR codes in display.
- (•) Produce educational material to make one of the tourism organization of your city (e.g. 2 city museum) of your city available to different age groups of visitors.
- ( ) Provide solutions for the redevelopment of a vulnerable local area which is challenging from an environmmental/social point of view
- ( ) Plan a science treasure hunt addressed to the young people of your city.
- ( ) Design an educational escape room addressed to the young people of your city.

2.-Number of students involved in the implementation of the authentic task *

24

3.- Number of teachers involved in the implementation of the authentic task *

5

4.- Please select the STEM disciplines involved in the implementation of the authentic task *

- [x] Science
- [x] Technology
- [x] Engineering
- [ ] Mathematical

5.- Please describe the stakeholders involved in the implementation of the authentic task (please indicate their name and the role they play in the implementation of the authentic task) *

The stakeholder involved in this task is the director of Touristic Department of the city of Catanzaro, Donatella Monteverdi. The role of this local community skateholder in the implementation of this authentic task is very important because the target of the product within the local community. The two museums objects of the task, aren't fully known outside the school where they are located. Making a multimedia product that shows them is a social self-consciusness. Assessorato alla cultura di Catanzaro is the receiver of the authentic task.

6.- Please describe the learning objectives of the authentic task *

Group working, giving personal ideas, planning, projecting and building; evaluate and self-evaluate; research, choose and rebuild information; solve real problems; evaluate choices and make decisions; critical thought on active procedures; make clear to others, in different ways, procedures and result of learning process.

7.- Please describe the learning objectives the methodology and the tools used for the implementation of the authentic task *

Problem solving, cooperative learning, debate, peer education, EAS, IBSE, investigation.
Computers, digital camera, digital books, maps, music and sounds, video maker apps(CANVA, Filimora) historic and digital archives, museum instruments.

8.- Please select the key competencies acquired by your students *

- [x] Literacy competence
- [x] Multilingual competence
- [x] Mathematical competence and competence on science, technology and engineering
- [x] Digital competence
- [x] Personal, social and learning to learn competence
- [x] Citizenship competence
- [ ] Entrepreneurship
- [x] Cultural awareness and expression competence

9.- Please select the green/blue competencies acquired/consolidated by your students through the implementation of the reality task *

- [ ] Use of renewable energy
- [ ] Water management.
- [x] Waste management.
- [x] Conserving energy.
- [ ] Reducing pollution.

10.- Please select the Lifecomp competencies acquired/consolidated by your students through the implementation of the reality task *

- [x] Self-regulation
- [x] Flexibility
- [x] Wellbeing
- [x] Empathy
- [x] Collaboration
- [x] Cooperation
- [x] Growth mindset
- [x] Critical thinking
- [x] Managing learning

11.- Please describe the different phases in the implementation of the reality task and the timing of each phase. *

Phase 1: Planning: 2 h. Using a debate with students, we planned the authentic task.
Phase 2: Investigation: 5 h. We gave students real material, the access to the instruments in the school museum, and the information on the internet.
Phase 3: Building up: 6 h. the students were divided in groups to create a promotional video about the school museums to upload on the local community website , on their homepage in the MUSEI CITTADINI section.
Phase 4: Revision and self-evaluation: 2 h. The final product, before the publishing, was cecked by teachers and students and implemented.

12.- How have you evaluated the educational activity (ongoing evaluation)? *

Ongoing evaluation of learning process by the following grid; self-evaluation.

Ongoing evaluation grid
Title of the project : Youth meeting the past through the future
Fases: 4
Data: october 2022

	Descrittori					
Levels						
D	di disturbo	saltuariamente	raramente	se sollecitato	raramente	trascurato
C	passivo	a volte	a volte	talvolta	a volte	disordinato
B	attivo	frequentemente	frequentemente	spontaneamente	spesso	ordinato
A	proattivo	regolarmente	regolarmente	di buon grado	sempre	organizzato

Alunno/a

Indicatori

Partecipa nel gruppo Assume incarichi Propone idee
Accoglie idee
Rispetta gli altri
Gestisce i materiali in modo

1
annotazioni:
2
annotazioni:
3
annotazioni:

13.- How have you evaluated the products designed/realized at the end of the implementation of the reality task (product evaluation)? *

Evaluation of the final product : evaluation of the content(summary of the information, correct and linked topics); technical requirements (justifying text, selection of pictures, audio and editing); oral production(proper language, specific idioms, connectors).

14.- Please describe Which product(s) have your students designed /realized at the end of the implementation of the reality task? *

- [ ] Leaflet
- [ ] PPT
- [x] Multimedia material
- [ ] Other (please specify)

If you responded Other, please include a comment *

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15.- Please describe what you did for the public validation of the authentic task (e.g. organization of an event with the stakeholders etc). Please provide information on the feedback collected. *

School event partecipating the Major of Catanzaro Nicola Fiorita, the Assessore Donatella Monteverdi, the school manager, the press, all the students, teachers and school workers involved in the project and the representatives of every class.

16.- Describe the results obtained in terms of the skills acquired by the students involved *

Digital age literacy, communication, cooperation, creativity, inventing thinkuing, problem solving, responsibibity, quality and productivity.

17.-Describe the results obtained in terms of the skills acquired by the teachers involved. *

Collaboration, security, classroom management, speed, efficiency, imagination.

18.-Describe the impact of the implementation of the reality task on your School. *

The impact of the implementation was so positive because both students and teachers for the first time took place in an international project. They were enthusiast to create the activity and feel themselves useful to own school and to the local community.

19.- Describe the impact of the implementation of the reality task on your local community. *

The activity is a promotional video about the two school museums that will be published on the official website of " Comune di catanzaro", assessorato al Turismo.

20.- Finally, is there anything else you would like to let us know? *

No, thank you

Author:OS CESARICA

EXPERIMENTA Project

This questionnaire is used to evaluate the reality task implemented by each school for EXPERIMENTA project
How to use: Please answer each question and provide information as specifically as possible.
Thank you!

1.- Please select the authentic task realized by your School *

- (●) Equip your school/city with an interactive botanical garden with QR codes in display.
- ( ) Produce educational material to make one of the tourism organization of your city (e.g. 2 city museum) of your city available to different age groups of visitors.
- ( ) Provide solutions for the redevelopment of a vulnerable local area which is challenging from an environmmental/social point of view
- ( ) Plan a science treasure hunt addressed to the young people of your city.
- ( ) Design an educational escape room addressed to the young people of your city.

2.-Number of students involved in the implementation of the authentic task *

36

3.- Number of teachers involved in the implementation of the authentic task *

3

4.- Please select the STEM disciplines involved in the implementation of the authentic task *

- [x] Science
- [x] Technology
- [ ] Engineering
- [ ] Mathematical

5.- Please describe the stakeholders involved in the implementation of the authentic task (please indicate their name and the role they play in the implementation of the authentic task) *

The Maksimir Park public institution gave us its materials used to determine the types of trees and a booklet with the basic characteristics of the most common trees in the Maksimir Park. The OAZA association helped us in the form of a visit from an expert, a forester who helped the children identify trees that the students could not identify on their own.

6.- Please describe the learning objectives of the authentic task *

recognize, name and describe the types of trees in the school yard, list the most common types of trees in the homeland, extract important information from a scientific popular text, compose a popular scientific text, use the computer word program, create a QR code, describe the importance of preserving trees for the preservation of biological diversity, use recycled materials in everyday life

7.- Please describe the learning objectives the methodology and the tools used for the implementation of the authentic task *

the ability to observe similarities and differences in the plant world, using analogies they perfected the ability of concise and clear written expression, creating their own QR codes by applying the knowledge acquired in class, cooperation and data exchange in team work, distribution of tasks according to abilities, noticing their own strong points with which they can contribute to the community

8.- Please select the key competencies acquired by your students *

- [x] Literacy competence
- [ ] Multilingual competence
- [x] Mathematical competence and competence on science, technology and engineering
- [x] Digital competence
- [x] Personal, social and learning to learn competence
- [x] Citizenship competence
- [ ] Entrepreneurship
- [ ] Cultural awareness and expression competence

9.- Please select the green/blue competencies acquired/consolidated by your students through the implementation of the reality task *

- [ ] Use of renewable energy
- [ ] Water management.
- [x] Waste management.
- [ ] Conserving energy.
- [ ] Reducing pollution.

10.- Please select the Lifecomp competencies acquired/consolidated by your students through the implementation of the reality task *

- [ ] Self-regulation
- [ ] Flexibility
- [x] Wellbeing
- [x] Empathy
- [ ] Collaboration
- [x] Cooperation
- [ ] Growth mindset
- [x] Critical thinking
- [x] Managing learning

11.- Please describe the different phases in the implementation of the reality task and the timing of each phase. *

end of September: The Maksimir Park public institution gave us its materials used to determine the types of trees and a booklet with the basic characteristics of the most common trees in the Maksimir Park. Using these materials, the 8th grade students first identified some of the trees in the school yard independently. They copied the texts from Maksimir's Trees booklet, posted them on the web, and created QR codes for them in the computer science class. We plasticized the codes and placed them on the trees using recycled material.
beginning of October: With the help of foresters from the OAZA association, the 4th grade students identified the remaining trees in the schoolyard. These are the trees for which there is no description in the Maksimir's Trees booklet.
mid October - early November: The 8th grade students wrote their own texts about these trees based on the example of the mentioned booklet using materials from the web. In doing so, they cooperated, worked in teams and divided tasks according to interests and abilities. Then these codes were plasticized and placed on the trees.
early November: The students presented the learning path to student representatives at the school's Student Council. An event related to the Advent fair or event is planned when many parents will visit the school.

12.- How have you evaluated the educational activity (ongoing evaluation)? *

questionnaire for students and teachers on acquired knowledge and skills, assessment of one's own contribution to work through the use of symbols, peer assessment of responsible and active participation in work

13.- How have you evaluated the products designed/realized at the end of the implementation of the reality task (product evaluation)? *

Students of parallel classes tried to read the QR codes on the trees and commented on the procedure and materials.

14.- Please describe Which product(s) have your students designed /realized at the end of the implementation of the reality task? *

- [ ] Leaflet
- [ ] PPT
- [x] Multimedia material
- [ ] Other (please specify)

If you responded Other, please include a comment *

Material: https://www.youtube.com/watch?v=AvGtCjtk7yw

15.- Please describe what you did for the public validation of the authentic task (e.g. organization of an event with the stakeholders etc). Please provide information on the feedback collected. *

Teachers and parents were introduced to the Educational Path of Trees in our school yard through notifications in WhatsApp groups. After the tour, several colleagues and parents contacted us with praise and support for further work in the same direction.

16.- Describe the results obtained in terms of the skills acquired by the students involved *

The students developed the skills of teamwork, finding adequate materials on the Internet, distinguishing the important from the unimportant, cooperation with members of the local community, an active civic approach to the preservation of biological diversity in the immediate environment.

17.-Describe the results obtained in terms of the skills acquired by the teachers involved. *

The teachers perfected the skills of moderating the student's activities, encouraging them to be independent, and achieving the outcomes set by the curriculum in a fun and motivating way.

18.-Describe the impact of the implementation of the reality task on your School. *

With the educational path of trees in the yard, the school stands out in the community as an example of sustainability, as a motivator for a conscientious and informed approach to the living world around us. As an educational institution, it highlights its basic function of encouraging fellow citizens to informal lifelong learning.

19.- Describe the impact of the implementation of the reality task on your local community. *

Fellow citizens have the opportunity to acquire new knowledge in a modern and interesting way in the schoolyard, to raise awareness of the importance of an informed approach to their environment and the importance of civic activity for sustainable development and preservation of biological diversity.

20.- Finally, is there anything else you would like to let us know? *

There is nothing else.

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