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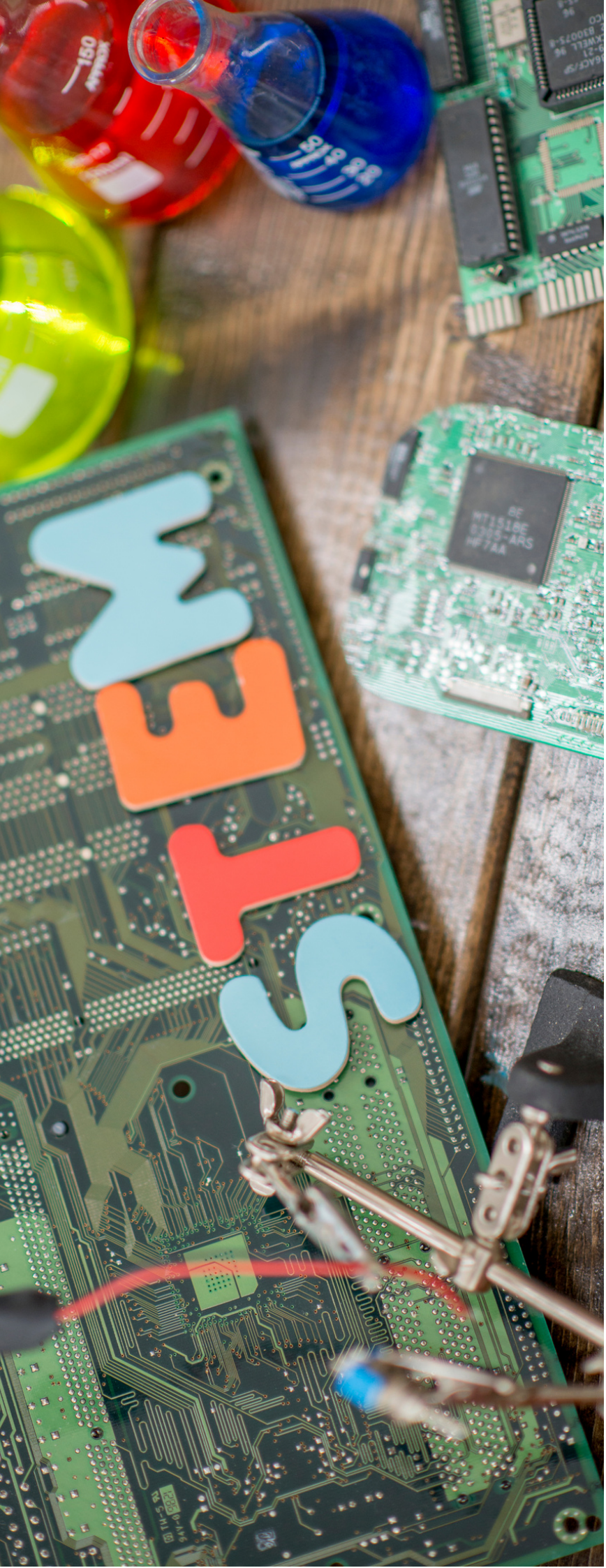
EXPERIMENTA
DISCOVER IS AN ATTITUDE - STEM PROJECT

RESEARCH REPORT & GUIDELINES



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Project: "EXPERIMENTA: a community-based approach to STEM Education".
2021-2-IT02-KA210-SCH-000050323

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Introduction

Introduction

This research report is a collection of best practices in science education across the European Union identified and analyzed by the EXPERIMENTA project partners:

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 preliminary research on innovative STEM practices and collection of best practices in STEM education across the partner countries (Italy, Croatia, Spain) is addressed to the following target groups:

- Educational communities
- Centres for professional training of teachers
- Organizations for the promotion and dissemination of scientific culture.

The objectives of the EXPERIMENTA preliminary research is twofold:

1 Analysing **trends in STEM education** carrying out a detailed study. This document describes:
   - initiatives and practices adopted or proposed by public bodies/private organisations to encourage the promotion of STEM education in teachers and students.
   - success stories related to cross-sectoral cooperation involving educational communities, SMEs, third sector organizations etc.
   - good practices showing the increasing interest and attitudes of teachers and young students towards STEM hands-on activities.

2 Providing a **tool to align the actions proposed by EXPERIMENTA with existing initiatives/ policies**, as well as to provide guidelines for the implementation of the next phases of the project, with a special focus on the elaboration of the authentic material created throughout the project:
   - Design of STEM teaching activities (10 activities in total, 5 per partner school)
   - Implementation of authentic tasks (2 authentic tasks in total, 1 per partner school) with the support of the local community.

The main result of the project, the EXPERIMENTA Booklet, will contain the methodology of the project, as well as practical activities (both best practices analysed in the partner countries and authentic material created by the involved classes) with the aim to facilitate the experimentation of the EXPERIMENTA methodology within new school contexts across Europe.

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

Chapter 1
The EXPERIMENTA project

1.1 STEM Education: definition and benefits

1.2 EXPERIMENTA: a community-based approach to STEM Education

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.

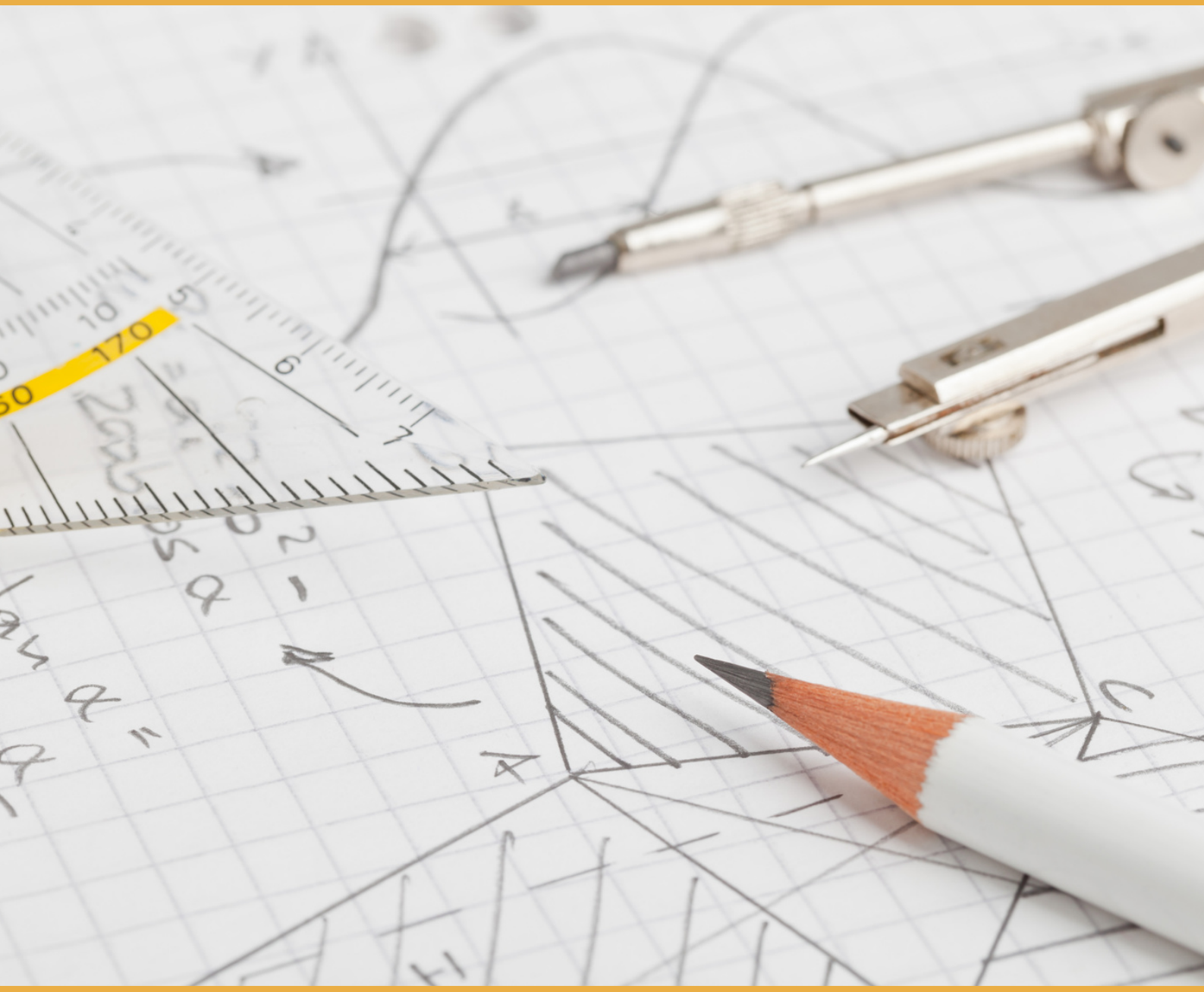
Pilot Action (Students and Teachers of participating schools).
Students and teachers who took part in the first phases of the project will be the protagonists of the educational activities as Ambassadors of EXPERIMENTA.
The Pilot Action will be articulated as follows:

1. Teacher training (peer education): the teachers involved in the previous phases will have the task of training their colleagues on the EXPERIMENTA methodology and on the use of the Booklet in teaching practice.
2. Students involved in the previous phases, will present to other peers (not involved in the previous phases) some of the educational activities in the Booklet. The students, with the support of the teachers, will also test the selected didactic activities from a laboratory point of view, following an approach focused on peer education.

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

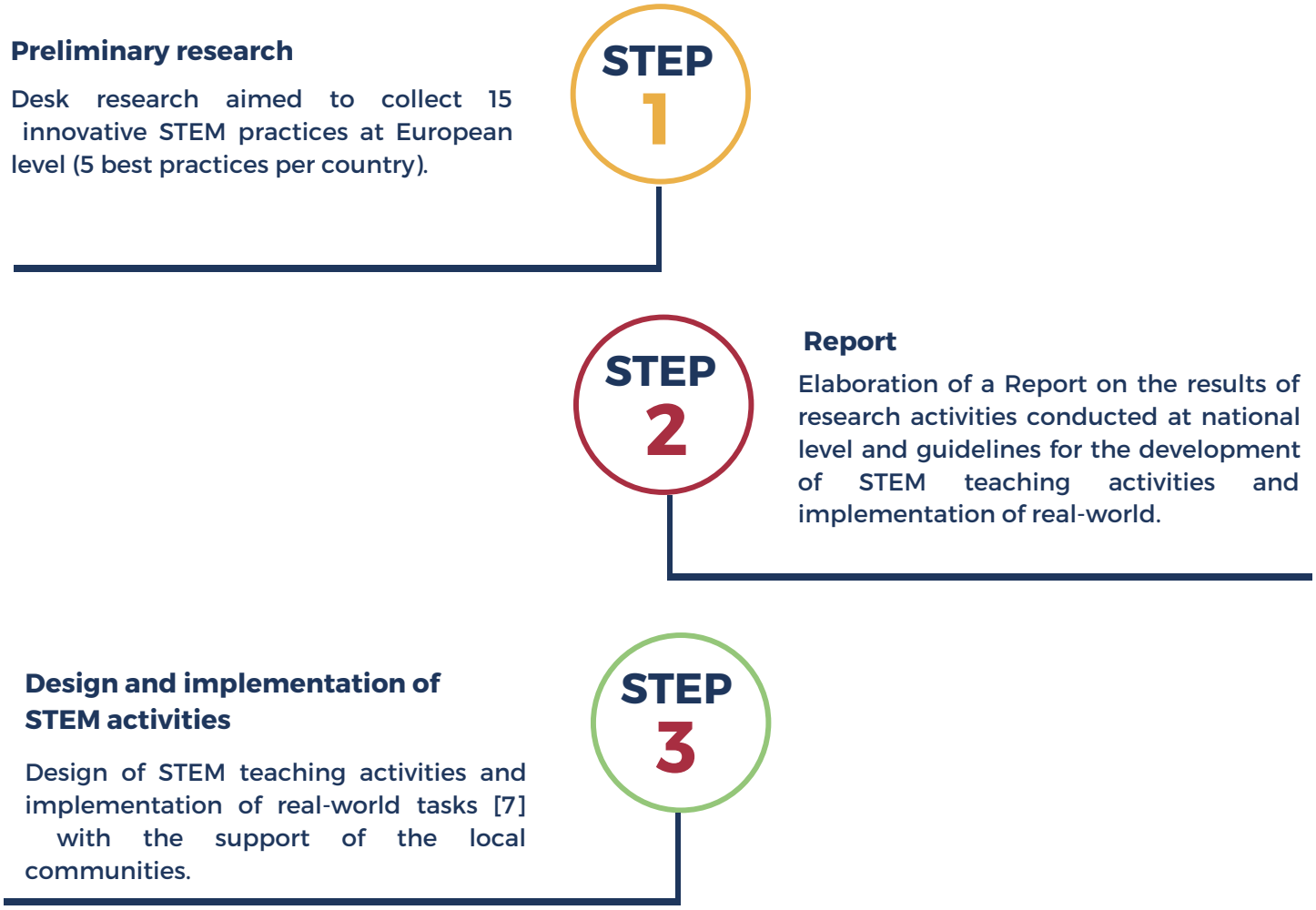
Transnational training of students in Foligno (Italy).
In April 2023, a group of students and teachers from IIS Grimaldi Pacioli and OS Cesarica will travel to Italy. They will be the EXPERIMENTA Ambassadors, in charge of presenting the project methodology and promoting its dissemination to other school contexts during the event FESTIVAL OF SCIENCE AND PHILOSOPHY, organized by LSS to promote scientific culture.
Italian and Croatian students will also present the activities designed and presented in the Booklet.

4 Final multiplier events in each country to promote the project activities and results,.



Chapter 2
The research methodology

The production of the EXPERIMENTA Booklet will be developed in three main steps:



The tasks leading to the production of the EXPERIMENTA Booklet are structured as follows:

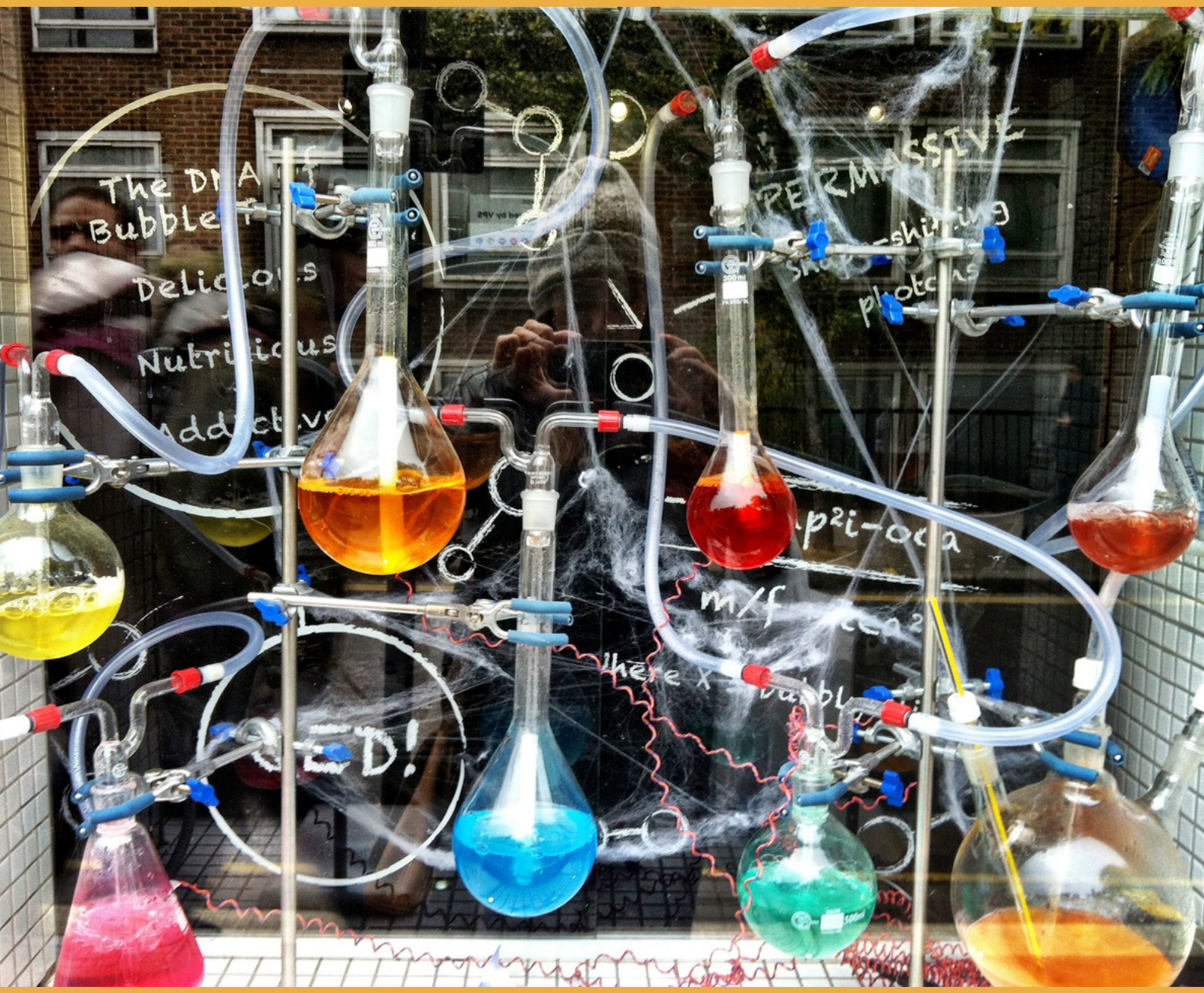
- **Definition of the research framework and tools**

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. XANO and LSS 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.

- **Research report**

The results collected at the national level have been systematized in this 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) has been implemented in June 2022) and it 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.

[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



Chapter 3
The collection of STEM best practices

The desk research consisted of the identification and the detailed analysis of 15 best practices (5 per project country) in the field of STEM education.
The main findings at country level were summarized in the specific desk research form [8] provided by LSS and XANO. The form focuses on three main sections:

- Section 1 - Best practice basic information
- Section 2 - Best practice summary
- Section 3 - Detailed description of the best practice
- Section 4 - Impact
- Section 5 – Learning outcomes
- Section 6 – Learning

3.1 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.

[8] The EXPERIMENTA desk research form can be accessed here.

#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.

It is worthwhile mentioning that all the 5 STEM educational initiatives identified and analyzed by the Italian partners are implemented by Schools. The high number of initiatives across Italy aimed to enhance the STEM approach to education shows that STEM is at the heart of the Italian education system. Indeed, the promotion of STEM education is one of the pillars of the National Digital School Plan launched by the Italian Ministry of Education, University and Research (PNSD, Law 107/2015) with the aim to innovate the national education system through digitization.

3.2 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.

The STEM initiatives identified by OS CESARICA are based on the implementation of workshops based on practical activities connected to students real-life. It is crucial to support students' to learn about things that have an impact on them in their daily lives, as it can bring huge benefits to their interest and motivation.

3.3 Spain

The desk research carried out by XANO led to the identification and analysis of the following STEM initiatives:

#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.

The Spanish partner also identified some extra good practices focused on STEM:

#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

3.4 Cross-country analysis: from the preliminary research to the EXPERIMENTA Booklet

The results collected at the national level have been systematized in this 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.

As highlighted in the previous section, 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.
Our methodology is therefore 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 this preliminary research, 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.

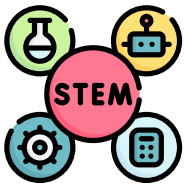
Enhancing active learning
Motivation is key to unlock students' internal drive for learning. In order to enhance students' motivation and attitudes, they should be engaged in the learning process.

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.

The analysis of the three national contexts (Italy, Croatia, Spain) implemented in June 2022 allowed the setting up of a consistent p**edagogical and didactic framework** for the resulting guidelines for the design of STEM teaching activities and implementation of real-world 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 I) .

List of possible authentic tasks based on the collaboration with the local community (Annex II).

The authentic material (design of 10 STEM activities and implementation of min.2 real-world tasks) by OS CESARICA and ITE Grimaldi Pacioli with the support of LSS and XANO will be fully described in the main project result: the EXPERIMENTA Booklet. The Booklet, containing the project methodology and students and teachers' direct experience, will be available in EN, IT, ES and HR.

We do believe that the EXPERIMENTA approach can contribute to the promotion of scientific education across Europe, playing a key role in **increasing the popularity of STEM studies** and careers, as well as **developing new skills for the employment market**.
Indeed, the paper Encouraging STEM studies highlights that "there is evidence of skills shortages in STEM) fields in spite of high unemployment rates in many Member States (…). Analysis by CEDEFOP shows that employment of STEM professionals and associate professionals in the European Union has increased since 2000 in spite of the economic crisis and demand is expected to grow until 2025. (…) Employment in STEM is male-dominated. Women account for just 24 % of science and engineering professionals and 15 % of science and engineering associate professionals8 . Current demand of STEM skills concerns both upper-secondary and tertiary graduates and this trend is expected to persist. Currently 48 % of STEM-related occupations require medium level qualifications which are mostly acquired through initial upper-secondary level VET. This figure is forecasted to fall just to 46 % in 2025".

Annexes

1. STEM teaching activities Template
2. EXPERIMENTA's list of authentic tasks based on the collaboration with the local community

1. STEM teaching activities Template

STEM Activity nr:	Title:

1. Description of the STEM Activity

Duration (hrs) *min.10, max.40 hrs, real world task included	
Beneficiaries (age, profile etc.)	
Context	Please provide a short description of the topic of the Activity in relation to the students' educational path and explain why you decided to focus on such a topic.
Preparation & resources	
Aim & description of the activity	
Key competencies (According to the Council Recommendation on Key Competences for Lifelong Learning)	☐ 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
Learning outcomes *min.5 max.10	1. 2. 3. 4. 5. 6. 7. 8. 9. 10.
STEM subjects	☐ Science ☐ Technology ☐ Engineering ☐ Mathematics
Other subjects (if applicable)	
Methodology	☐ Brainstorming ☐ Role playing ☐ Workshop ☐ Lecture ☐ Peer to peer Other (Please specify):
Notes & tips	

2. Phases

Phase nr:	Title
Subjects and contents	Specify the subject(s) and related content to be covered
Activities and teaching strategies	Specify the type of activity proposed and the teaching strategy used
Tools	Indicate the tools, materials, and documents to be used
Assessment methods	Please provide information concerning the assessment procedure (process and product assessment).
Durations (hrs)	

3. Real-world task

Problem/challenge of the real-world task	Identify a problem/need to be addressed through the real-world task. The real-world task should be: - meaningful and challenging for students - consistent with the topic(s)
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 real-life task 1. 2. 3.
Role of each stakeholder	Provide detailed information about the role/contribution of each stakeholder
Product	Provide detailed information about the product (multimedia/paper format) that the students are asked to deliver as final results of the real world-tasks (e.g. brochure, social media Facebook page
Validation methods	How will you involve and collect feedback from the stakeholders at the end of the real-world task? (e.g. organization of a meeting with the local stakeholder; organization of a local event (exhibition to present the final product; validation questionnaire etc).

2. 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

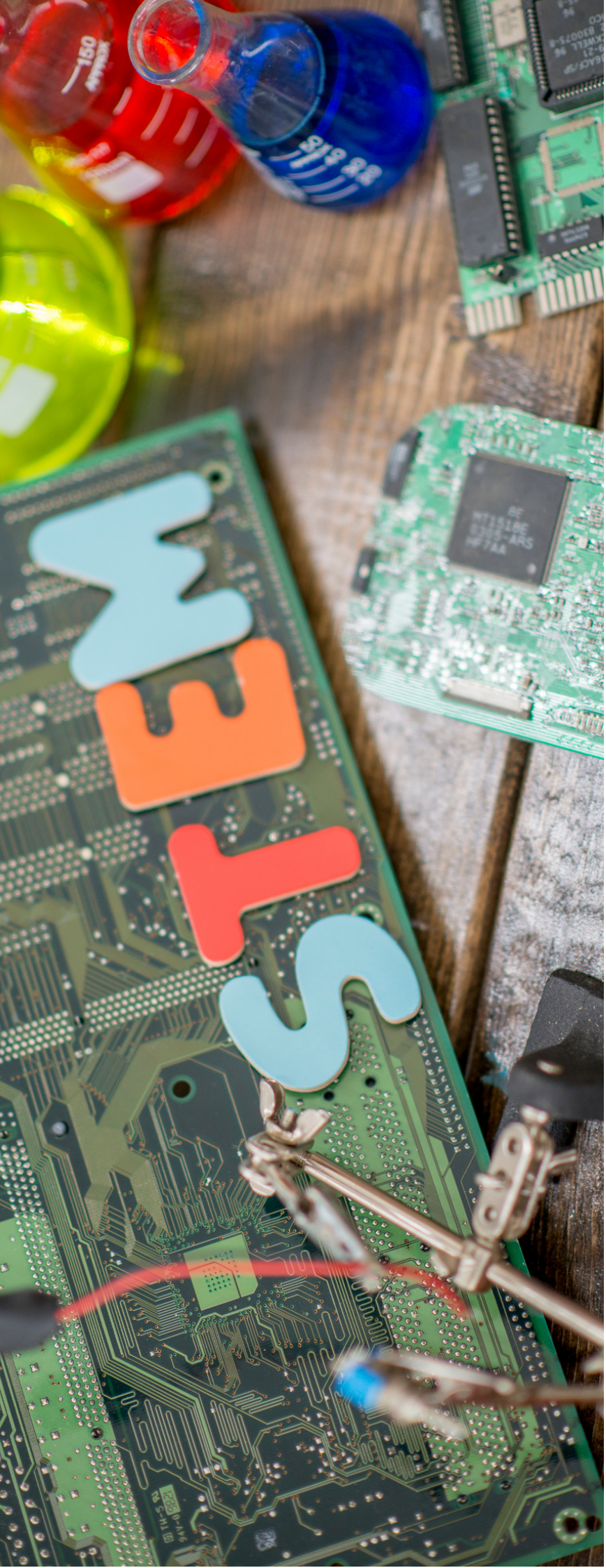
01 Translating the authentic task into an educational activity based on the following:
a. STEM subjects
b. involvement of local community (stakeholders needed for the implementation of the task).

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 - Virtue and Knowledge - Foligno, April 2023.



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