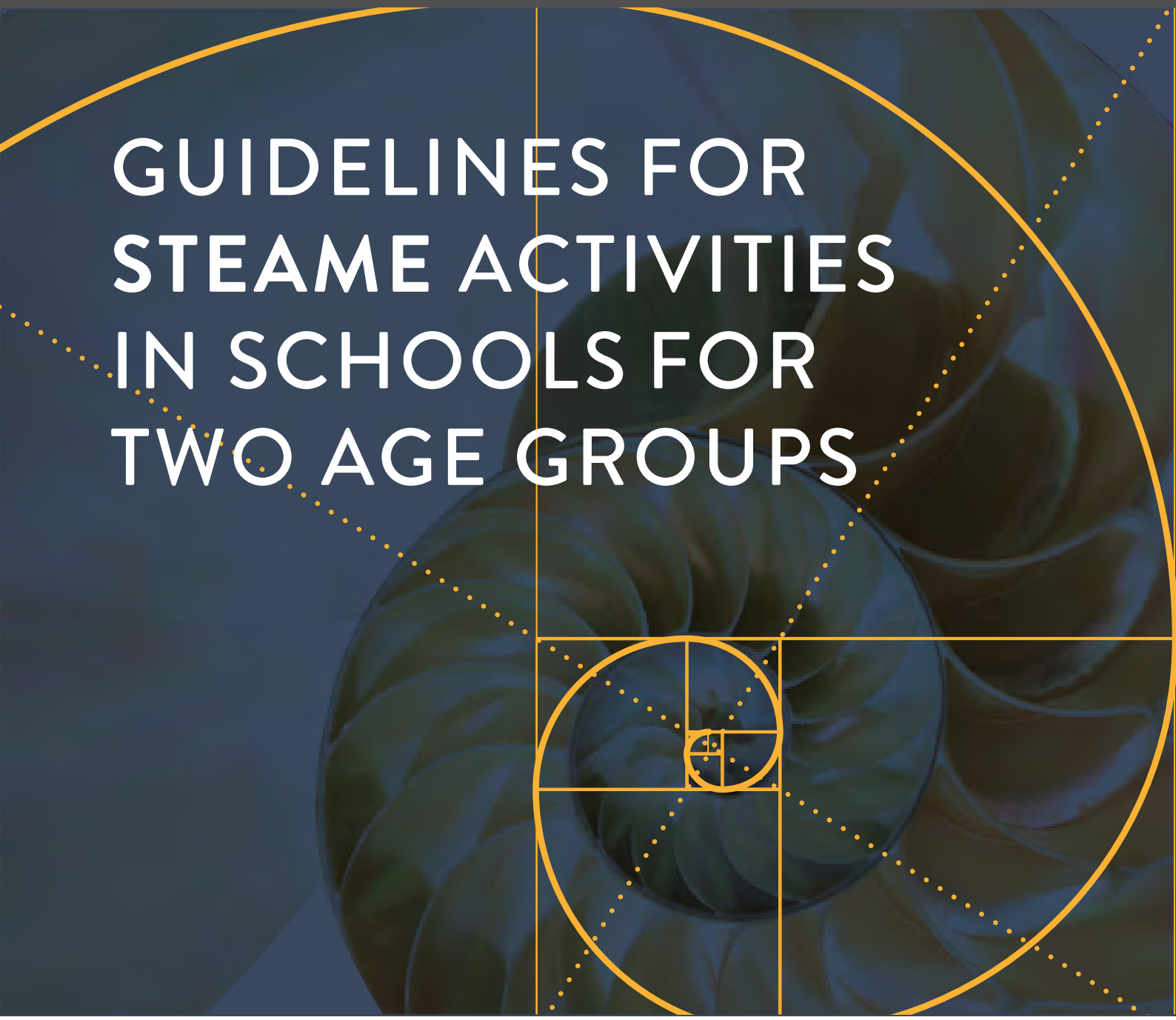
STEAME

GUIDELINES FOR STEAME ACTIVITIES IN SCHOOLS FOR TWO AGE GROUPS



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Guidelines for Developing and Implementing STEAME Schools

I02: GUIDELINES FOR STEAME ACTIVITIES IN SCHOOLS FOR TWO AGE GROUPS

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INTRODUCTION

The *Guidelines for STEAME Activities in Schools for two Age Groups*, encompass appropriate methodologies (project-based learning, inquiry-based learning and problem-solving learning) that support interdisciplinary learning and creativity and include the following:

A. The design of the proposed STEAME Learning and Creativity Plans according to the STEAME developed framework, that constitutes the future of today's Lesson Plans.
B. A guide to Learning and Creativity Plan development.
C. A set of Learning and Creativity Plans developed as samples to be used and referenced by school teachers, designed for STEAME subjects in two main categories: age level 12-15 (Grades 7-9) and age level 15-18 (Grades 10-12).
D. A sample activity plan for cooperation between schools and research institutes, developed to help teachers to cooperate with external researchers and experts in building activities for their students.
E. The STEAME Observatory, a dynamic and adaptive repository (with OERs), that provides open access to all the resources created by the partners and invitation to teachers from all over Europe and beyond to upload their STEAME material.

This book will bring more attention to the core business of learning and creativity, to help teachers implement project-based learning, inquiry-based learning and problem-solving learning in STEAME activities. This will transform teachers into learning facilitators and will allow for the implementation of STEAME Schools. At the same time this book will support the development and facilitation of the learning and creativity ability of pupils under STEAME. This can be achieved through teacher, school and research institutes collaboration in building activities for their students.

The main target group of the *Guidelines for STEAME Activities in Schools for two Age Groups,* are the teachers and educational leaders in European schools and, subsequently, students will be benefited from the results of using these guidelines for innovative educational transformation. The main category of students to be benefited are of age level 12-15 (Grades 7-9) and age level 15-18 (Grades 10-12).

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PART A (ENGLISH)

1. The STEAME Framework of Learning and Creativity Plans

1.1 Exploration of existing STEM, STEAM and Project Based Lesson Plans

The first activity of these Guidelines produced by the STEAME partners, was to explore more than 50+ international (EU and USA) STEM, STEAM and Project-based Lesson Plans (LPs) in order to explore the elements and features that would most appropriately be suitable for a STEAME Learning & Creativity plan (L&C). Out of those LPs explored, and following partners collaboration and communication, were chosen the 10 existing STEM, STEAM and Project Based Lesson Plans, and based on these partners created an outlined table with the most important of their elements (the linked references and the table are presented as an Annex 1), with the following main parts:

- General - Specifications - Synopsis
- Objectives - Methodologies
- Preparation - Means - Infrastructure
- Implementation

After that, the output leader, coordinated partners communications and engaged them in the development process of the STEAME L&C plan template by making an initial suggestion that allowed the project team to collaboratively discuss and work on each of the sections of the L&C plans. The template, when partners finished working on it, was, once more, discussed by the partnership and finalized, as presented at the next section.

1.2 Development of the STEAME Learning and Creativity (L&C) Plan

The STEAME Learning and Creativity (L&C) plan, developed by the STEAME project, aims to provide teachers with the information and resources needed to implement a STEAME lesson. The L&C Plan consists of the following five sections:

A. Overview
B. STEAME Framework
C. Objectives and Methodologies
D. Preparation and Means
E. Implementation

A brief description of the above five sections follows:

A. Overview of the L&C Plan

The section contains the general information of the L&C plan, such as:

- the related subjects (S-T-E-A-M-E) and the title of the STEAME project
- the driving question or topic
- the ages and the grades
- the duration, the timeline, the number of activities and the curriculum alignment of the L&C plan
- a brief description of the project and/or learning activities related with objectives
- contributors, references, and acknowledgements

B. STEAME Framework

The section makes a direct relation to the STEAME framework. Contains the following 3 sub-sessions:

- *Teachers' Cooperation*: Teacher 1 cooperation with Teacher 2 and formulation of students' guidance
- *STEAME in Life (SiL) Organization*: Meeting with business representatives, Entrepreneurship - STEAME in Life (SiL) Days
- *Action Plan Formulation*: Reference to the Stages and the Steps of the STEAME Framework (Action Plan Formulation)

C. Objectives and Methodologies

This section describes the learning goals and objectives, the learning outcomes and results, the prior knowledge and prerequisites of learners, the motivation, methodology, strategies, etc. It contains the following 4 sub- sessions:

- *Learning Goals and Objectives*: Identification of goals or objectives using appropriate verbs, related or corresponding to competences (knowledge – skills - values), that the student will acquire.
- *Learning Outcomes and expected Results*: Definition of Learning Outcomes using action verbs, expected results as any kind of deliverables or "artifacts".
- *Prior Knowledge and Prerequisites*: Prior experiences, knowledge and skills, the learners bring with them to this learning experience.
- *Motivation, Methodology, Strategies, Scaffolds*: Teaching strategies, approaches, methods, and/or techniques for achieving learning objectives and outputs (project-based, inquiry-based, problem-based, gamification etc.), instruction differentiation for students' needs (learning styles, multi-modal representations, roles to students etc.), active students' engagement, individual-team-classroom work, scaffolding techniques, etc.

D. Preparation and Means

This is the section that describes the preparation needed, the learning space setting, the resources, tools, etc. Contains the following 3 sub- sessions:

- *Preparation, Space Setting, Troubleshooting Tips*: Procedures, spaces, and material preparation, setting in classroom, outdoor activity, computer lab etc.
- *Resources, Tools, Material, Attachments, Equipment*: Instructional sources and digital material with the related references needed for the implementation of the learning plan.
- *Safety and Health*

E. Implementation

This section describes a complete approach to implement the L&C plan by listing the activities and procedures of the learning process, assessment and evaluation methods, presentation of the learning outcomes, etc. Contains the following 4 sub- sessions:

- *Instructional Activities, Procedures, Reflections*: Brief and comprehensive description of the creative activities, tasks, or learning experiences (individual-team-classroom working), Engagement and active participation through hands-on practices, Students' feedback and reflection on their thinking, process, or learning, monitoring students' learning and progress measuring.

- *Evaluation - Assessment*: Assessment and formative evaluation processes and rubrics to measure the student's ability to perform what was described in the objectives.
- *Presentation - Reporting - Sharing*: Documents, outputs, artifacts, products produced by the students with references, web links etc., for sharing to media.
- *Extensions - Other Information*

In particular, the **Methodologies**, the **Evaluation,** and the **Presentation** of a STEAME L&C Plan are briefly described in the following sessions (analytically descriptions are presented as an Annex 2).

1.3 Methodologies adopted by STEAME framework (PBL, IBL, PSL)

The following three methodologies are adopted by the STEAME framework:

A. Project-Based Learning Methodology (PBL)
B. Inquiry-Based Learning Methodology (IBL)
C. Problem Solving Learning Methodology (PSL)

The three methodologies are shortly described in the following paragraph (analytically STEAME descriptions are presented as an Annex 3, 4 and 5):

Project-Based Learning Methodology (PBL)

Project-Based Learning is widely recognised as a methodology by which students acquire content knowledge and skills through their involvement for an extended period of time to investigate and respond to an authentic, engaging, and complex question, problem, or challenge. The learning methodology is structured around carefully designed products and tasks and the students demonstrate the knowledge and skills they have gained by creating a public product to be presented to a real audience. The integration of Entrepreneurship or Enterprise in STEAM to complement it and create the STEAME framework, fully responds to the requirements of PBL and enhances the possibilities of application.

The strong feature based on the authenticity of the learning processes and of the outcomes is strongly linked to the development of 21st century skills which integrates PBL methodology to STEM, STEAM and STEAME frameworks. Financial, health, environmental, information and technological literacies are developed and acquired alongside more cross-curricular literacies encompassing all subjects: communication and collaboration, critical thinking and problem solving, creativity, responsibility, social and cross-cultural skills.

Inquiry-Based Learning Methodology (IBL)

The first step into inquiry-based learning is curiosity. Students drive their learning through questions; they have the role of inquirers who discover the answers on their own. The teacher is a facilitator, a mentor; The teacher is there to monitor students' progress, provide structural support when needed and ensures that the focus remains on students' questions and observations.

STEAM education and entrepreneurship are getting more and more closely linked than ever before. This happens in STEAME. Especially the connection between science and entrepreneurship is strong. One of the cornerstones of entrepreneurship is business idea generation. One common method of idea generation for new products or services is to design a solution to a given problem. Finding solutions to problems is a foundation of every field of science. STEAM education and entrepreneurship skills go hand-in-hand. The competences required to succeed in STEAM such as creativity, problem-solving, foresight, adaptability, are equally suited for success as an entrepreneur. Teachers must bear in mind what makes STEAME so enjoyable for many students: the desire to solve a problem. Teachers should give students the tools and skills they need to solve a problem and watch them work it out on their own.

Problem Solving Learning Methodology (PSL)

The 'problem solving' is the process to analyze a specific problematic situation and find a solution. The importance of this methodology is the ability to promote motivation, empower critical thinking and push the students to utilize everyday life skills. The teacher acts as facilitator. He/she explains how the problem solving works, leads the first interactions, shows the tools that are at the basis of each step (e.g. five W plus H, Root cause analysis and so on), illustrates consolidated examples, and helps to avoid the pitfalls. The cognitive process often drives to finding "out of the box" solution. The problem solving encompasses five moments:

- Comprehension
- Prediction
- Planning
- Follow up
- Evaluation

1.4 Evaluation of the implementation of the project

The main evaluation elements relate to how many STEAME subject are covered by the L&C plan, which students' **competence** and through which **process** they are developed/enhanced by the project based process, including **formative assessment** methods. These elements are based on rubrics extracted from the following related bibliography:

- Content repositories (e.g. *ReadWriteThink Rubrics*, *Assessment and Rubrics*)
- STE(A)M approaches (e.g. *iRubric: Build, Assess, Share, Collaborate*)
- Classroom observations (e.g. *A Practical Guide to Improving Classroom Observations*)
- Project-based approaches (e.g. *BIE-PBLWorks Rubrics* , *The Complete Guide to Student Digital Portfolios*)

The "**Evaluation Rubric of the students work**" template contains the following 4 main sessions:

1. STEAME Subjects (overall performance of respective concepts/discipline/content of K-12 level)
2. Competences (knowledge, skills, values-attitudes)
3. Project Management, Development and Realisisation Processes
4. Formative Assessment (specified at each L&C)

The STEAME Evaluation Template is presented as an Annex 6.

1.5 Communication skills of the STEAME project outcomes by students

The STEAME competence frameworks, describes and presents all relevant areas of competences that relate to the context of the suggested approach. Among them, the communication skills, students are encouraged to develop and enhance during their learning process.

The STEAME project, aims to achieve it, by engaging student to communicate their STEAME project outcomes through a set of activities such as the STEAME electronic journal.

Detailed information about the elements for developing presentation skills of STEAME project are given at the Annex 7 and 8.

The main sets of science communication and presentation skills that STEAME project focuses on, are presented below:

A. Science Communication Skills

The STEAME project, aiming to engage students in the development of their science communication skills, encourages them to submit their own paper in the Journal for STEAME Creations for and by School Students. To guide their effort, the STEAME project team, has developed a guidelines document, targeting school student authors. The guidelines are presented within a student paper template, describing, and guiding students, step by step, to develop each session. The template itself, follows, the main principals of a scientific paper to introduce students to expressing their scientific "findings"/ artifacts/ projects in a more formal way of expression thus developing their communication skills that relate to science.

Communication skills are an area of their own within the STEAME competence framework, and by giving students a place to express themselves, through a scientific communication process, aims to enable and relate the competence areas that relate more to the scientific aspect with those that relate to communication. Indicatively, students will have to consider how to communicate their findings/ projects/artifacts through following a specific set of the rules [Publication Manual of the American Psychological Association (6th Edition, 2010)], the use of figures and tables, etc. Students will also receive feedback in a form similar to the feedback that one would expect to receive from a scientific journal when submitting a paper for publication.

B. Presentation Skills

Presentation skills are the skills students need in delivering effective and engaging presentations to a variety of audiences. These skills cover a variety of areas such as the structure of students' presentations, the design of their slides, the tone of the voice and the body language students convey.

During the classes, activities, and projects of STEAME, all key aspects in terms of theory and practice are covered: Science, Technology, Engineering, Art, Math, Entrepreneurship. The tutor/teacher has the essential role in the process. The curriculum is leading guidelines but if the school doesn't apply STEM (STEAM/E) in their studies then the individual teacher/s should encourage students to work on their presentation and communication skills since the beginning. It relates also to the work of the teachers themselves and the use of presentations in their classes/activities.

The main phases of a successful presentation are:

[a] preparation,
[b] delivery, and
[c] follow-up

2. Guide to Learning and Creativity Plan Development

The procedure of the development and implementation of a STEAME project, based on a related Learning and Creativity (L&C) Plan, is guided by the following 3 main STEMEA "pillars":

2. Guide to Learning and Creativity Plan Development

The procedure of the development and implementation of a STEAME project, based on a related Learning and Creativity (L&C) Plan, is guided by the following 3 main STEMEA "pillars":

2.1 Preparation by teachers (4 Steps)

1. Formulating initial thoughts on the thematic sectors/areas to be covered
2. Engaging the world of the wider environment / work / business / parents / society / environment/ ethics
3. Target Age Group of Students - Associating with the Official Curriculum - Setting Goals and Objectives
4. Organization of the tasks of the parties involved - Designation of Coordinator - Workplaces etc.

2.2 Action Plan Formulation (18 Steps)

Preparation (by teachers)

1. Relation to the Real World – Reflection
2. Incentive – Motivation
3. Formulation of a problem (possibly in stages or phases) resulting from the above

Development (by students) – Guidance & Evaluation (in 9-11, by teachers)

4. Background Creation - Search / Gather Information
5. Simplify the issue - Configure the problem with a limited number of requirements
6. Case Making - Designing - identifying materials for building / development / creation
7. Construction - Workflow - Implementation of projects
8. Observation-Experimentation - Initial Conclusions
9. Documentation - Searching Thematic Areas (STEAME fields) related to the subject under study – Explanation based on Existing Theories and / or Empirical Results
10. Gathering of results / information based on points 7, 8, 9
11. First group presentation by students

Configuration & Results (by students) – Guidance & Evaluation (by teachers)

12. Configure mathematics or other STEAME models to describe / represent / illustrate the results
13. Studying the results in 9 and drawing conclusions, using 12
14. Applications in Everyday Life - Suggestions for Developing 9 (Entrepreneurship - SIL Days)

Review (by teachers)

15. Review the problem and review it under more demanding conditions

Project Completion (by students) – Guidance& Evaluation (by teachers)

16. Repeat steps 5 through 11 with additional or new requirements as formulated in 15
17. Investigation - Case Studies - Expansion - New Theories - Testing New Conclusions
18. Presentation of Conclusions - Communication Tactics.

2.3 Actions and Cooperation for Students and Teachers (10 Steps)

Each STEAME Project has a brief description and outline of organizational arrangements and responsibilities for action according some of following stages and activities by students and teachers:

STAGE	**Activities/Steps** Teacher 1(T1) Cooperation with T2 and student guidance	**Activities /Steps** **By Students** Age Group: ____	**Activities /Steps** Teacher 2 (T2) Cooperation with T1 and student guidance
A	Preparation of steps 1,2,3		Cooperation in step 3
B	Guidance in step 9	4,5,6,7,8,9,10	Support guidance in step 9
C	Creative Evaluation	11	Creative Evaluation
D	Guidance	12	Guidance
E	Guidance	13 (9+12)	Guidance
F	Organization (SIL) STEAME in Life	14 Meeting with Business representatives	Organization (SIL) STEAME in Life
G	Preparation of step 15		Cooperation in step 15
H	Guidance	16 (repetition 5-11)	Support Guidance
I	Guidance	17	Support Guidance
K	Creative Evaluation	18	Creative Evaluation

3. STEAME Learning and Creativity Plans

Following the template finalization, the STEAME project team, developed collaboratively, a prototype L&C plan, involving teachers in this process, to test and finalize, the L&C plan template. This was the basis, as a prototype and example [session 6.1], for the further development of STEAME L&C Plans for grades 7-9 [ages 12-15, see session 6.2] and grades 10-12 [ages 15-18, see session 6.3] related to STEAME (Science, Technology, Engineering, Mathematics, Entrepreneurship).

3.1 Learning and Creativity Prototype Plan

The prototype L&C plan is related to how we can construct a "**customized e-shop"** studying the economics concepts of the costs, revenue and profit in a business. It consists of five activities for two learning periods of 90 min (first lesson) include the analysis and the calculation of a firm's profit, the analysis of its costs and how this firm creates and increases its revenue. So, for all these reasons, in the second period of 90 min (second lesson), every group of students designs and creates a customized e-shop, that formulates a real problem. In this way, they understand the mechanism of the market in action.

The L&C Prototype Plan for the "Customized e-shop" is included as an Annex 9.

3.2 Learning and Creativity Plans Development for Grades 7-9

The STEAME project developed, the following 15 Learning & Creativity (L&C) plans for **grades 7-9 [ages 12-15]**, related to STEAME (Science, Technology, Engineering, Mathematics, Entrepreneurship) subjects, motivating the collaboration between teachers, to achieve a multidisciplinary approach, by providing the necessary information and resources through the use of the L&C Template, that is being described in previous sessions of this report.

The list of all these L&C Plans are included as an Annex 10.

3.3 Learning and Creativity Plans Development for Grades 10-12

The STEAME project developed, the following 11 Learning & Creativity (L&C) plans for **grades 10-12 [ages 15-18]**, related to STEAME (Science, Technology, Engineering, Mathematics, Entrepreneurship) subjects, motivating the collaboration between teachers, to achieve a multidisciplinary approach, by providing the necessary information and resources through the use of the L&C Template, that is being described in previous sessions of this report.

The list of all these L&C Plans are included as an Annex 10.

3.4 Learning and Creativity Plans Evaluation

As part of this output, during the piloting of the developed teacher training activity, with the active participation of the three partner schools, the participants presented, throughout the different training sessions, with L&C plans that were developed during the project's lifetime and are available through the **STEAME Observatory**.

Participants introduced and presented with the process of evaluating an L&C plan. It is within the context of this output to pilot the process by engaging individuals outside the project team with the **evaluation process** and asking them to act as evaluators. L&C plans, developed during the C1 training event, were also evaluated, with the active participation and involvement of all participants. This allowed them to gain hands-on experience with the complete process of developing an L&C plan (design, implement, evaluate, adjust).

This activity during the training, allowed partners to collect feed-back and experience the process as observators. Following the training, partners utilised the feed-back and their experience during the C1 training to revise their L&C plans.

The discussion of the evaluation was linked with the dynamic feature of the STEAME Observatory and the fact that any teacher may get involved and submit their own L&C plan, and if or when implemented in classroom, accompany it with its evaluation, thus supporting STEAME users to better navigate and explore the openly available plans.

The evaluation of L&C Plans during the C1 Training are presented in Annex 12.

4. Cooperation and Creativity Program between Schools & Industry

Schools are important to be open to society as key members. Collaborations with research institutes and companies can contribute to the broadening of students' horizons but also to their familiarity with research activities, related to the activity of research centers and the purposes of business units. Students participating in school groups with companies or other research organizations gain a lead in:

- Experiences in various fields,
- familiarity with research and entrepreneurship through an experiential learning process,
- information for the international educational community,
- information for the international entrepreneurship community,
- access to resources for the international economy,
- access to infrastructure that exists in institutions and companies,
- familiarity with the social dimension of research and entrepreneurship,
- awareness about the 17 Sustainable Development Goals.

This way students can form a better view of their future science choices from school age. Collaboration with educators and company executives, researchers and scientists as well as managers from the field of business and research can have multiple and multilevel benefits for their entry into the modern economic environment.
As part of the project, a **team**, starting the implementation of a project, aiming at the implementation of its idea, will encounter important questions and dilemmas in the process, in which it will have to make a decision. Many times, this decision will be difficult to make, as the team will not have the appropriate knowledge or experience required to assess the overall situation. In this way the groups of students with his teachers will be invited to collaborate with other researchers, scientists or professionals, outside of school, whom we will call them **mentors**. Mentors are people who have special knowledge and experience in their field and at the same time, are willing to provide advice and guidance.

4.1. The Rules of STEAME-ID Cooperation Program

The rules of cooperation between schools and industry are categorized as following:

- Organization of teams and rules of cooperation
- Objectives (meetings' context, exchanging ideas, methods, products)
- Meetings (scope, process of monitoring and evaluating, level of commitment, function management: agreement, time management)
- Deliverable(s) and evaluation
- Communication – Dissemination

The rules of the STEAME-ID framework are presented as an Annex 11.

4.2. The Model of the STEAME-ID Cooperation Program

Based on the above we can create a new model of cooperation between schools and Industry (research institutes - companies), from which an indicative action plan emerges. The proposed model of the cooperation is divided in to the following **four main Stages**:

Stage A. Vision - Mission - Goal - Objectives - Rules
Stage B. Design of the Cooperation - Outcomes – Communication
Stage C. Development of the Outcome
Stage D. Communication & Dissemination of the Outcome

Each stage includes many activities, such as: **Meetings** (about design, development, and dissemination of the Project), **Resources, Media, Infrastructure** (needed for the implementation of each stage).

The School and the Research Institute - Company, belongs to an ecosystem where many **external factors** have inputs to their internal "World", such as:

- a World with a variety of **Frameworks** (e.g. Frameworks of Competences, DigComp),
- a World with a variety of **Standards** (e.g. Common Core, ISO),
- a Digital World with a variety of **Environments** (e.g. Google Apps), and
- a Different and various Social **Cultures and Ecosystems**.

The model of the STEAME-ID framework is presented as an Annex 11.

4.3. The Validation of the STEAME-ID Cooperation Program

For the implementation of the STEAME-ID Program there is a guide that can be used as evaluation report that presents a check for steps of activities needed to be developed by the school and industry in cooperation. This validation template consists of the following four main stages:

- Stage A: Goal - Objectives – Methods - Rules
- Stage B: Design of the Cooperation - Outcome - Communication
- Stage C: Development of the Outcome
- Stage D: Communication & Dissemination of the Outcome

Also, the validation template includes five open fields for commenting the implemented the STEAME-ID Program (according to a SWOT based analysis):

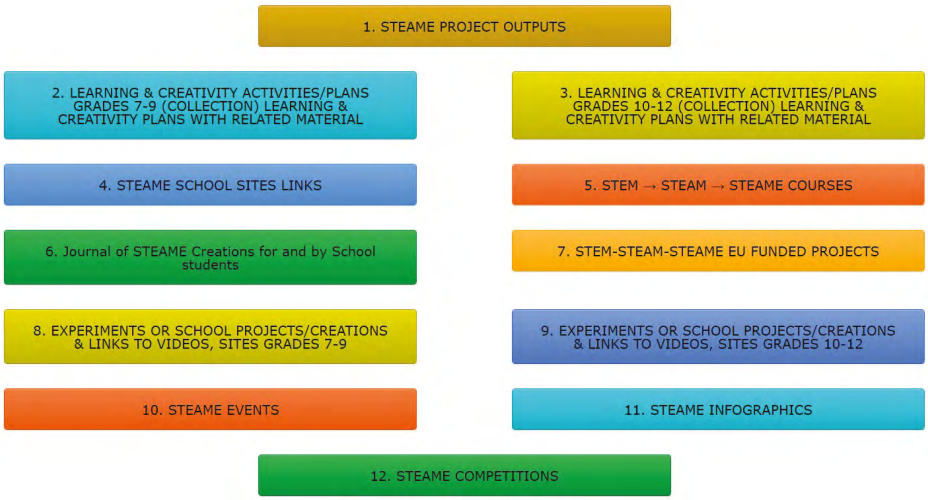
- STRENGHTS
- WEAKNESSES
- OPPORTUNITIES
- THREATS
- Additional Description/Comments/Suggestions/Changes/Expectations

Schools are invited to apply all or some of the activities during a pilot validation process on this cooperation. The evaluation template of the STEAME-ID framework is presented as an Annex 11.

5. Observatory

The Observatory is a tool mainly for school teachers in order to support a dynamic and adaptive STEAME Curriculum in their schools. The content is updated and growing continuously so all teachers in Europe and beyond have the opportunity to be updated but also to publish their own work and material. We invite posting such as, Learning and Creativity Plan (a new approach for Lesson plans), the site of their school if this contains STEAME activities, a STEAME related training course, a STEAME related EU funded project, examples of STEAME experiments or projects in school or related videos, STEAME events made or to be made and more options to appear soon.

The structure of the Observatory is:



At the Observatory anyone can:

- submit a learning and creativity plan to appear
- submit an experiment or project description to appear
- submit a STEAME school site to appear
- submit a STEAME course
- submit a STEAME EU funded project
- submit a STEAME event announcement
- submit an infographic
- submit a STEAME competitions announcement

submit point:
https://steame.eu/steame-observatory/

PART A (POLISH)

1. Ramy Planów Uczenia się i Kreatywności STEAME

1.1 Badanie istniejących planów lekcji STEM, STEAM i w Nauczaniu Projektowym

Pierwszym działaniem dla opracowania niniejszych Wytycznych przygotowanych przez partnerów STEAME było zbadanie ponad 50+ międzynarodowych (UE i USA) planów lekcji STEM, STEAM i opartych na Nauczaniu Projektowym w celu wyróżnienia elementów i funkcjonalności, które byłyby najbardziej odpowiednie dla Planów Uczenia się i Kreatywności STEAME (PUK). Spośród tych zbadanych Planów Lekcji, w oparciu o konsultacje między partnerami, wybrano 10 istniejących planów lekcji STEM, STEAM i opartych na Nauczaniu Projektowym, i na ich podstawie utworzono tabelę zawierającą ich najważniejszymi elementy (powiązane odniesienia i tabela są przedstawione jako załącznik 1), z następującymi głównymi częściami:

- Ogólne - Dane techniczne - Streszczenie
- Cele – metodologie
- Przygotowanie - Środki - Infrastruktura
- Wdrożenie

Następnie, lider rezultatu, zarządzał komunikacją między partnerami i zaangażował ich w proces opracowania szablonu PUKów STEAME poprzez przedstawienie wstępnych sugestii, które pobudziły zespół projektowy do wspólnych dyskusji I pracy nad każdą z sekcji PUKów. Szablon, gdy partnerzy zakończyli pracę nad nim, został ponownie omówiony przez cały zespół i sfinalizowany tak, jak to przedstawiono w następnej części.

1.2 Opracowanie Planu Uczenia się i Kreatywności STEAME (PUK)

Plan Uczenia się i Kreatywności STEAME (L&C), opracowany w ramach projektu STEAME, ma na celu dostarczenie nauczycielom informacji i zasobów potrzebnych do wdrożenia lekcji STEAME. PUK składa się z następujących pięciu części:

A. Wprowadzenie
B. Ramy STEAME
C. Cele i Metodologia
D. Przygotowanie i Środki
E. Wdrożenie

Krótki opis powyższych pięciu części jest przedstawiony poniżej:

A. Wprowadzenie do PUKa

Ta część zawiera ogólne informacje o PUKu takie, jak:

- występujące przedmioty (S-T-E-A-M-E) oraz tytuł projektu STEAME
- zasadniczy problem lub temat
- wiek i klasy
- czas trwania, harmonogram, liczba działań i dostosowanie programu nauczania PUK
- krótki opis projektu i/lub działań edukacyjnych związanych z jego celami
- współtwórcy, referencje i podziękowania

B. Ramy STEAME

Ta część nawiązuje bezpośrednio do ram STEAME. Zawiera ona następujące 3 podrozdziały:

- *Współpraca nauczycieli*: Współpraca Nauczyciela 1 z Nauczycielem 2 i formułowanie wskazówek dla uczniów
- *Organizacja STEAME w Życiu (SwŻ)*: Spotkania z przedstawicielami biznesu, Dni Przedsiębiorczości - STEAME w Życiu (SwŻ)
- *Sformułowanie planu działania*: odniesienie do etapów i kroków ram STEAME (Sformułowanie planu działania)

C. Cele i Metodologia

Ta część opisuje cele i zadania uczenia się, efekty uczenia się i oczekiwane rezultaty, wymaganą wcześniejszą wiedzę i wstępne wymagania wobec uczniów, motywację, metodologię, strategie itp. Zawiera następujące 4 podrozdziały:

- *Cele i zadania uczenia się:* Identyfikacja celów lub zadań za pomocą odpowiednich czasowników, związanych lub odpowiadających kompetencjom (wiedza – umiejętności – wartości), co uczący się będzie w stanie zrobić po wykonaniu projektu.
- *Efekty uczenia się i oczekiwane rezultaty:* Definicja efektów uczenia się za pomocą czasowników działania, oczekiwane wyniki jako wszelkiego rodzaju rezultaty lub „artefakty".
- *Wcześniejsza wiedza i wymagania wstępne*: Wcześniejsze doświadczenia, wiedza i umiejętności, które uczniowie wnoszą ze sobą do tego doświadczenia edukacyjnego.
- *Motywacja, metodologia, strategie, rusztowania*: Strategie nauczania, podejścia, metody i/lub techniki osiągania celów i wyników uczenia się (oparte na projekcie, oparte na dociekaniu, oparte na problemach, gamifikacja itp.), różnicowanie instrukcji dla potrzeb uczniów (style uczenia się, reprezentacje multimodalne, role dla uczniów itp.), aktywne zaangażowanie uczniów, praca indywidualno-zespołowa w klasie, techniki rusztowań itp.

D. Przygotowanie i Środki

W tej części opisane są niezbędne przygotowania, aranżacja przestrzeni do nauki, niezbędne środki, narzędzi itp. Zawiera ona następujące 3 podrozdziały:

- *Przygotowanie, Aranżacja Przestrzeni, Wskazówki do Radzenia sobie z Trudnościami:* Przygotowanie procedur, przestrzeni i materiałów, organizacja w klasie, zajęcia na świeżym powietrzu, laboratorium komputerowe itp.
- *Zasoby, Narzędzia, Materiały, Dodatki, Sprzęt*: Źródła instrukcji, materiały cyfrowe, odpowiednie odnośniki niezbędne do wdrożenia planu uczenia się.
- *Bezpieczeństwo i Zdrowie.*

E. Wdrożenie

Ta część opisuje kompleksowo podejście do wdrożenia PUKu poprzez podanie spisu działań i procedur w procesie uczenia się, metody oceny I ewaluacji, prezentację efektów uczenia się itp. Zawiera ona następujące 4 podrozdziały::

- *Działania wprowadzające, Procedury i Podsumowania:*: Krótki I zwięzły opis kreatywnych działań, zadań, doświadczeń z nauczania (praca indywidualna-grupowa-klasowa), Zaangażowanie i aktywny udział poprzez działania praktyczne, Informacja zwrotna od studentów, analiza ich procesów myślowych i uczenia się. Monitorowanie uczenia się uczniów i mierzenie postępów.

- *Ewaluacja – Ocena*: Procesy waluacji i oceny formującej, tabele do pomiaru zdolności studentów do wykonania tego, co zakładano w celach projektu.
- *Prezentacja – Raportowanie – Udostępnianie:* Dokumenty, rezulataty, artefakty, wyniki pracy studentów z odnośnikami, stronami internetowymi itp. do udostępniania w mediach.
- *Rozszerzenia – Inne Informacje*

Zwłaszcza **Metodologie**, **Ewaluacja** oraz **Prezentacja** STEAME Planów PUK są krótko opisane w kolejnych rozdziałach (opisy analityczne są przedstawione w Dodatku 2).

1.3 Metodologie przysposobione przez ramy STEAME (PBL, IBL, PSL)

Następujące trzy metologie zostały zaadaptowane do ram STEAME:

A. Metodologia Nauczania Projektowego (PBL)
B. Metodologia Nauczania Pytaniowego Inquiry-Based Learning Methodology (IBL)
C. Metodologia Nauczania przez Rozwiązywanie Problemów (PSL)

Te trzy metodologie zostały krótko opisane w kolejnych akapitach (opisy analityczne STEAME zostały przedstawione jako Załączniki 3, 4 oraz 5):

Metodologia Nauczania Projektowego (PBL)

Nauczanie Projektowe jest szeroko uznane jako metodologia, w której studenci nabywają wiedzę przedmiotową i umiejętności poprzez zaangażowanie przez dłuższy okres czasu w badanie i reagowanie na autentyczne i wymagające zaangażowania złożone problemy, pytania, czy wyzwania. Ta metodologia nauczania jest osnuta wokół starannie zaprojektowanych problemów i zadań. Studenci prezentują nabytą wiedzę i umiejętności poprzez stworzenie otwartego rezultatu, który może zostać zaprezentowany autentycznej publiczności. Integracja Przedsiębiorczości lub Przedsiębiorstwa w STEAM uzupełnia go w naturalny sposób, przejście do ram STEAME w pełni odpowiada wymaganiom Nauczania Projektowego i rozszerza zakres jego potencjalnych zastosowań.

Dużą rolę w integracji metodologii PBL w ramy STEM, STEAM oraz STEAME odgrywa jej oparcie w procesie uczenia na autentycznych problemach i ścisłe powiązanie wyników nauczania z rozwojem umiejętności niezbędnych w XXI wieku. Świadomość finansowa, zdrowotna, środowiskowa, informacyjna i technologiczna jest zdobywana i rozbudowywana jednocześnie z bardziej przekrojowymi umiejętnościami niezbędnymi we wszystkich nauczanych przedmiotach: komunikacja i współpraca, krytyczne myślenie, rozwiązywanie problemów, kreatywność, odpowiedzialność, umiejętności społeczne i międzykulturalne.

Metodologia Nauczania Pytaniowego (IBL)

Pierwszym krokiem do uczenia się opartego na dociekaniu jest ciekawość. Uczniowie kierują swoją nauką poprzez pytania; pełnią rolę dociekliwych, którzy sami odkrywają odpowiedzi. Nauczyciel jest facylitatorem, mentorem; Nauczyciel jest po to, aby monitorować postępy uczniów, zapewniać wsparcie strukturalne w razie potrzeby i zapewniać skupienie się na pytaniach i obserwacjach uczniów.

Edukacja STEAM i przedsiębiorczość stają się coraz ściślej powiązane niż kiedykolwiek wcześniej. Następuje przejście do STEAME. Szczególnie silny jest związek nauk przyrodniczych z przedsiębiorczością. Jednym z fundamentów przedsiębiorczości jest generowanie pomysłów na biznes. Jedną z powszechnych metod generowania pomysłów na nowe produkty lub usługi jest

zaprojektowanie rozwiązania danego problemu. Znajdowanie rozwiązań problemów to podstawa każdej dziedziny nauki. Edukacja STEAM i umiejętności w zakresie przedsiębiorczości idą w parze. Kompetencje wymagane do odniesienia sukcesu w STEAM, takie jak kreatywność, rozwiązywanie problemów, przewidywanie, zdolność adaptacji, są równie odpowiednie dla sukcesu przedsiębiorcy. Nauczyciele muszą pamiętać, co sprawia, że STEAME jest tak przyjemne dla wielu uczniów: chęć rozwiązania problemu. Nauczyciele powinni dać uczniom narzędzia i umiejętności potrzebne do rozwiązania problemu i obserwować, jak sami go rozwiązują.

Metodologia Nauczania przez Rozwiązywanie Problemów (PSL)

- „Rozwiązywanie problemów" to proces analizy konkretnej sytuacji problemowej i znalezienia rozwiązania. Znaczenie tej metodologii to umiejętność promowania motywacji, wzmacniania krytycznego myślenia i zachęcania uczniów do wykorzystywania umiejętności życia codziennego. Nauczyciel pełni rolę moderatora. Wyjaśnia, jak działa rozwiązywanie problemów, prowadzi pierwsze interakcje, pokazuje narzędzia, które są podstawą każdego kroku (np. pięć W plus H, analiza przyczyn źródłowych itd.), ilustruje skonsolidowane przykłady i pomaga uniknąć pułapki. Proces poznawczy często prowadzi do znalezienia rozwiązania „po wyjęciu z pudełka". Rozwiązywanie problemów obejmuje pięć faz:
- Zrozumienie
- Przewidywanie
- Planowanie
- Kontynuacja
- Ewaluacja

1.4 Ocena realizacji projektu

Główne elementy oceny odnoszą się do tego, ile przedmiotów STEAME jest objętych planem L&C, jakie kompetencje uczniów i w jaki sposób są rozwijane/ulepszane przez proces oparty na projekcie, w tym metody oceniania formatywnego. Elementy te są oparte na rubrykach zaczerpniętych z następującej powiązanej bibliografii:

- Repozytoria treści (n.p. *ReadWriteThink Rubrics*, *Assessment and Rubrics*)
- Podejścia STE(A)M (n.p. *iRubric: Build, Assess, Share, Collaborate*)
- Obserwacje w klasie (n.p. *A Practical Guide to Improving Classroom Observations*)
- Podejścia oparte na projektach (n.p. *BIE-PBLWorks Rubrics* , *The Complete Guide to Student Digital Portfolios*)

Szablon **„Rubryka oceny pracy uczniów"** zawiera następujące 4 główne sekcje:

1. Przedmioty STEAME (ogólne wykonanie odpowiednich koncepcji/dyscypliny/treści na poziomie K-12)
2. Kompetencje (wiedza, umiejętności, wartości-postawy)
3. Zarządzanie projektem, procesy rozwoju i realizacji
4. Ocena formująca (wyszczególniona dla każdego PUK)

Szablon oceny STEAME przedstawiono w załączniku 6.

1.5 Umiejętności komunikacji wyników projektu STEAM przez uczniów

Ramy kompetencji STEAME opisują i przedstawiają wszystkie istotne obszary kompetencji, które odnoszą się do kontekstu proponowanego podejścia. Wśród nich zachęca się uczniów do rozwijania i doskonalenia umiejętności komunikacyjnych podczas procesu uczenia się.

Projekt STEAME ma to osiągnąć, angażując uczniów do komunikowania wyników projektu STEAME za pomocą szeregu różnych działań, takich jak elektroniczne czasopismo STEAME.

Szczegółowe informacje o elementach rozwijania umiejętności prezentacji projektu STEAM znajdują się w Załączniku 7 i 8.

Poniżej przedstawiono zasadnicze umiejętności komunikacji naukowej i prezentacji, na których koncentruje się projekt STEAME:

A. Umiejętności komunikacji naukowej

Projekt STEAME, mający na celu zaangażowanie uczniów w rozwój ich umiejętności komunikacji naukowej, zachęca ich do przesyłania własnych artykułów do Journal for STEAME Creations for and by School Students. Aby pokierować ich działaniami, zespół projektu STEAME opracował dokument zawierający wytyczne, skierowany do autorów będących uczniami szkół. Wytyczne są przedstawione w szablonie pracy dla uczniów, opisując i prowadząc uczniów, krok po kroku, w celu opracowania niezbędnych elementów artykułu. Opracowany szablon oparty jest na ogólnych zasadach redakcji artykułu naukowego, ma to wprowadzić studentów do wyrażania ich naukowych „odkryć"/ artefaktów/ projektów w bardziej formalny sposób, rozwijając w ten sposób ich umiejętności komunikacyjne związane z nauką.

Umiejętności komunikacyjne są odrębnym obszarem w ramach kompetencji STEAME. Dają uczniom miejsce do wyrażania siebie poprzez proces komunikacji naukowej. Ma to na celu umożliwienie powiązania obszarów kompetencji, które odnoszą się bardziej do aspektu naukowego z tymi, które odnoszą się do komunikacji. Orientacyjnie, uczniowie będą musieli zastanowić się, w jaki sposób przekazać swoje odkrycia/ projekty/ artefakty poprzez przestrzeganie określonego zestawu zasad [Podręcznik publikacji Amerykańskiego Towarzystwa Psychologicznego (wydanie 6, 2010)], wykorzystanie rysunków i tabel itp. Otrzymają również informację zwrotną w formie podobnej do informacji zwrotnej, jakiej można oczekiwać od czasopisma naukowego, zgłaszając pracę do publikacji.

B. Umiejętności prezentacji

Umiejętności prezentacji to umiejętności potrzebne uczniom do dostarczania skutecznych i angażujących prezentacji dla różnych odbiorców. Umiejętności te obejmują różne obszary, takie jak struktura prezentacji uczniów, projektowanie slajdów, operowanie tonem głosu i mową ciała, którą uczniowie stosują.

Podczas zajęć, działań i projektów STEAME omawiane są wszystkie kluczowe aspekty z punktu widzenia teorii i praktyki: nauka, technologia, inżynieria, sztuka, matematyka, przedsiębiorczość. Tutor/nauczyciel odgrywa zasadniczą rolę w tym procesie. Program nauczania stanowi wiodące wytyczne, ale jeśli szkoła nie stosuje STEM (STEAM/E) w swoim nauczaniu, to poszczególni nauczyciele powinni zachęcać uczniów do pracy nad swoimi umiejętnościami prezentacji i komunikacji od samego początku. Dotyczy to również pracy samych nauczycieli i wykorzystania prezentacji w ich zajęciach/działaniach.

Główne etapy udanej prezentacji to:

[a] przygotowanie,
[b] dostarczenie, oraz
[c] kontynuacja

2. Wprowadzenie do Tworzenia Planów Uczenia się i Kreatywności

Procedura opracowania i wdrożenia projektu STEAME, opartego na powiązanym Planie Uczenia się i Kreatywności (PUK), opiera się na następujących 3 głównych „filarach" STEAME:

2.1 Przygotowanie przez nauczycieli (4 kroki)

1. Sformułowanie wstępnych przemyśleń na temat sektorów/obszarów tematycznych, które należy uwzględnić
2. Angażowanie świata szerszego środowiska/ pracy/ biznesu/ rodziców/ społeczeństwa/ środowiska/ etyki
3. Docelowa grupa wiekowa uczniów – nawiązanie do oficjalnego programu nauczania – wyznaczanie celów i zadań
4. Organizacja zadań zaangażowanych stron - wyznaczenie koordynatora - miejsca pracy itp.

2.2 Sformułowanie planu działania (18 kroków)

Przygotowanie (przez nauczycieli)

1. Związek ze Światem Rzeczywistym – refleksja
2. Zachęta – Motywacja
3. Sformułowanie problemu (ewentualnie etapami lub fazami) wynikające z powyższego

Rozwinięcie (uczniowie) – Prowadzenie i Ocena (w 9-11, nauczyciele)

4. Tworzenie tła — wyszukiwanie/zbieranie informacji
5. Uproszczenie problemu — konfiguracja problem z ograniczoną liczbą wymagań
6. Przejście do Problemu - Projektowanie - identyfikacja materiałów do budowy / rozwoju / tworzenia
7. Konstrukcja – Podział pracy – Implementacja projektów
8. Obserwacje - Eksperymentowanie – Wstępne wnioski
9. Dokumentacja – Wyszukiwanie obszarów tematycznych (pola STEAME) związanych z badanym przedmiotem – Wyjaśnienie na podstawie istniejących teorii i/lub wyników empirycznych
10. Zbieranie wyników / informacji na podstawie punktów 7, 8, 9
11. First group presentation by students

Konfiguracja i Wyniki (uczniowie) – Wskazówki i Ocena (nauczyciele)

12. Konfiguracja matematyki lub innych modeli STEAME, aby opisać / przedstawić / zilustrować wyniki
13. Badanie wyników z 9 i wyciąganie wniosków za pomocą 12
14. Zastosowania w życiu codziennym - Propozycje rozwoju 9 (Przedsiębiorczość - Dni SiŻ)

Recenzja (nauczyciele)

15. Recenzja problemu I recenzja przy wyższych wymaganiach

Zakończenie Projektu (uczniowie) – Prowadzenie & Ocena (nauczyciele)

16. Powtórzenie kroków od 5 do 11 z dodatkowymi lub nowymi wymaganiami sformułowanymi w 15
17. Badanie - Studia przypadków - Rozbudowa - Nowe teorie - Testowanie nowych wniosków
18. Prezentacja Wniosków – Taktyka Komunikacji.

2.3 Działania i Współpraca dla Studentów i Nauczycieli (10 kroków)

Każdy projekt STEAME zawiera krótki opis i zarys ustaleń organizacyjnych i odpowiedzialności za działanie według niektórych z następujących etapów i działań uczniów i nauczycieli:

ETAP	**Działania / Kroki** Nauczyciel 1 (T1) Współpraca z T2 i prowadzenie uczniów	**Działania / Kroki** **Uczniów** Grupa Wiekowa: ____	**Działania / Kroki** Nauczyciel 2 (T2) Współpraca z T1 i prowadzenie uczniów
A	Pzygotowanie kroków 1,2,3		Współpraca w kroku 3
B	Prowadzenie w kroku 9	4,5,6,7,8,9,10	Wspierające prowadzenie w kroku 9
C	Kreatywna Ocena	11	Kreatywna Ocena
D	Prowadzenie	12	Prowadzenie
E	Prowadzenie	13 (9+12)	Prowadzenie
F	Organizacja (WiŻ) STEAME w Życiu	14 Spotkanie z przedstawicielami biznesu	Organizacja (WiŻ) STEAME w Życiu
G	Przygotowanie kroku 15		Współpraca w kroku 15
H	Prowadzenie	16 (powtórzenie 5-11)	Wspierające prowadzenie
I	Prowadzenie	17	Wsperające prowadzenie
K	Kreatywna Ocena	18	Kreatywna Ocena

3. Plany Uczenia się i Kreatywności STEAME

Po sfinalizowaniu szablonu zespół projektowy STEAME opracował wspólnie prototypowy plan PUK, angażując w ten proces nauczycieli, aby przetestować i sfinalizować szablon planu PUK. Efektem była podstawa, jako prototyp i przykład [sekcja 6.1], dla dalszego rozwoju planów STEAME PUK dla klas 7-9 [wiek 12-15, patrz sekcja 6.2] i klas 10-12 [wiek 15-18, patrz rozdział 6.3] dotyczących STEAME (nauka, technologia, inżynieria, sztuka, matematyka, przedsiębiorczość).

3.1 Prototypowy Plan Uczenia się i Kreatywności

Prototypowy plan PUK dotyczy tego, jak możemy zbudować „dostosowany e-sklep", plan pozwala poznać ekonomiczne koncepcje kosztów, przychodów i zysku w biznesie. Składa się on z pięciu czynności obejmujących dwa okresy nauki po 90 minut (pierwsza lekcja) obejmujących analizę i obliczenie zysku firmy, analizę jej kosztów oraz sposób, w jaki firma tworzy i zwiększa swoje przychody. Z taką wiedzą, w drugim 90-minutowym okresie (druga lekcja) każda grupa studentów projektuje i tworzy spersonalizowany e-sklep, którego stworzenie jest prawdziwą istotą problem. W ten sposób uczniowie poznają mechanizmy działania rynku.

Prototypowy plan PUK dla „Dostosowanego sklepu internetowego" stanowi Załącznik 9.

3.2 Tworzenie Planów Uczenia się i Kreatywności dla Klas 7-9

W ramach projektu STEAME opracowano 15 planów Uczenia się i Kreatywności (PUK) dla **klas 7-9 [w wieku 12-15]**, związanych z przedmiotami STEAME (nauka, technologia, inżynieria, sztuka, matematyka, przedsiębiorczość), motywujących do współpracy między nauczycielami, mających osiągnąć wieloprzedmiotowe podejście poprzez dostarczenie niezbędnych informacji i zasobów z wykorzystaniem Szablonu PUK, który został opisany w poprzednich rozdziałach tego raportu.

Lista wszystkich tych planów PUK znajduje się w Załączniku 10.

3.3 Tworzenie Planów Uczenia się i Kreatywności dla Klas 10-12

W ramach projektu STEAME opracowano 11 planów Uczenia się i Kreatywności (PUK) dla **klas 10-12 [w wieku 15-18]**, związanych z przedmiotami STEAME (nauka, technologia, inżynieria, sztuka, matematyka, przedsiębiorczość), motywujących do współpracy między nauczycielami, mających osiągnąć wieloprzedmiotowe podejście poprzez dostarczenie niezbędnych informacji i zasobów z wykorzystaniem Szablonu PUK, który został opisany w poprzednich rozdziałach tego raportu.

Lista wszystkich tych planów PUK znajduje się w Załączniku 10.

3.4 Ocena Planów Uczenia się i Kreatywności

W ramach tego elementu projektu, przeprowadzono pilotaż opracowanego działania szkoleniowego dla nauczycieli. W pilotażu aktywnie uczestniczyły trzy szkoły partnerskie. Uczestnicy pilotażu podczas różnych sesji szkoleniowych przedstawili plany PUK, które zostały opracowane w trakcie trwania projektu i są dostępne za pośrednictwem **Obserwatorium STEAME**.

Uczestnicy przedstawili i przeanalizowali proces oceny planu L&C. W kontekście tego elementu projektu pilotaż przeprowadzany jest poprzez angażowanie w **proces ewaluacji** osoby spoza zespołu projektowego, które działają jako ewaluatorzy. Ocenie poddano również plany PUK opracowane podczas szkolenia C1, przy aktywnym udziale i zaangażowaniu wszystkich uczestników projektu. Pozwoliło im to na zdobycie praktycznego doświadczenia w całym procesie opracowywania planu PUK (projektowanie, wdrażanie, ocena, dostosowanie).

To działanie podczas szkolenia pozwoliło partnerom na zebranie informacji zwrotnych i przeżycie procesu w roli obserwatora. Po szkoleniu partnerzy wykorzystali informacje zwrotne i swoje doświadczenie ze szkolenia C1 do rewizji swoich planów PUK.

Dyskusja na temat ewaluacji była powiązana z dynamiczną funkcjonalnością Obserwatorium STEAME oraz faktem, że każdy nauczyciel może się zaangażować i przedstawić swój własny plan PUK. Jeśli zostanie on wdrożony w klasie, może poddać go ocenie, wspierając w ten sposób użytkowników STEAME w lepszym doborze i wykorzystaniu dostępnych planów.

Oceny planów PUK wykonane podczas treningu C1 są przedstawione w Załączniku 12.

4. Program współpracy i kreatywności między szkołami a przemysłem

Jest ważne aby szkoły były otwarte na otwarte dla społeczeństwa, dla którego są kluczowymi instytucjami. Współpraca z instytutami naukowymi i firmami może przyczynić się do poszerzenia horyzontów uczniów, w szczególności do zapoznania się z działalnością badawczą, związaną z działalnością ośrodków naukowych i celami jednostek gospodarczych. Uczniowie uczestniczący w grupach szkoleniowych w firmach lub innych organizacjach badawczych uzyskują:

- doświadczenia z różnych dziedzin,
- znajomość badań i przedsiębiorczości poprzez empiryczny proces uczenia się,
- informacje o międzynarodowej społeczności edukacyjnej,
- informacje dla międzynarodowej społeczności przedsiębiorców,
- dostęp do zasobów dla gospodarki międzynarodowej,
- dostęp do infrastruktury istniejącej w instytucjach i firmach,
- znajomość społecznego wymiaru badań i przedsiębiorczości,
- świadomość na temat 17 Celów Zrównoważonego Rozwoju.

W ten sposób uczniowie mogą uzyskać lepszy obraz swoich przyszłych wyborów naukowych już w wieku szkolnym. Współpraca z edukatorami i dyrektorami firm, badaczami i naukowcami, a także menedżerami z dziedziny biznesu i badań może przynieść wielopoziomowe korzyści dla ich wejścia w nowoczesne środowisko gospodarcze.

W ramach projektu **zespół** rozpoczynający realizację projektu, dążąc do realizacji jego zamysłu, napotka ważne pytania i dylematy w procesie, w którym będzie musiał podjąć decyzję. Wielokrotnie

ta decyzja będzie trudna do podjęcia, ponieważ zespół nie będzie dysponował odpowiednią wiedzą lub doświadczeniem wymaganym do oceny ogólnej sytuacji. W ten sposób grupy uczniów wraz z nauczycielami zostaną zaproszone do współpracy z innymi badaczami, naukowcami lub profesjonalistami spoza szkoły, których nazwiemy **mentorami**. Mentorzy to osoby, które posiadają specjalistyczną wiedzę i doświadczenie w swojej dziedzinie, a jednocześnie chętnie służą radą i wskazówkami.

4.1. Zasady Programu Współpracy STEAME-ID

Zasady współpracy szkół z przemysłem są podzielone na następujące kategorie:

- Organizacja zespołów i zasady współpracy
- Cele (kontekst spotkań, wymiana pomysłów, metod, produktów)
- Spotkania (zakres, proces monitorowania i oceny, poziom zaangażowania, zarządzanie funkcjami: umowa, zarządzanie czasem)
- Produkty i ocena
- Komunikacja – rozpowszechnianie

Zasady ram STEAME-ID przedstawiono w załączniku 11.

4.2. Model Programu Współpracy STEAME-ID

W oparciu o powyższe możemy stworzyć nowy model współpracy pomiędzy szkołami a Przemysłem (instytuty badawcze - firmy), z którego wyłania się orientacyjny plan działania. Proponowany model współpracy podzielony jest na **4 główne Etapy**:

Stage A. Wizja - Misja - Cel - Cele - Zasady
Stage B. Projekt współpracy – Efekty – Komunikacja
Stage C. Rozwój wyniku
Stage D. Komunikacja i rozpowszechnianie wyników

Każdy etap obejmuje wiele działań, takich jak: **Spotkania** (dotyczące projektowania, rozwoju i rozpowszechniania Projektu), **Zasoby**, **Media**, **Infrastruktura** (niezbędne do realizacji każdego etapu).

Szkoła i Instytut Badawczy – Firma należy do ekosystemu, w którym wiele czynników zewnętrznych ma wpyw na ich wewnętrzny „Świat", takich jak:

- Świat z różnymi **Ramami** i **Sieciami** (np. Frameworks of Competences, DigComp),
- Świat z różnymi **Standardami** (np. Common Core, ISO),
- Cyfrowy świat z różnymi **środowiskami** (np. Google Apps) oraz
- Rozmaite **Kultury** Społeczne i **Ekosystemy**.

Model ram STEAME-ID przedstawiono w załączniku 11.

4.3. Walidacja Programu Współpracy STEAME-ID

W celu realizacji Programu STEAME-ID przygotowano przewodnik, który można wykorzystać jako raport ewaluacyjny przedstawiający etapy działań, które szkoła i przemysł muszą opracować wspólnie. Ten szablon walidacji składa się z następujących czterech głównych etapów:

- Etap A: Cel - Zadania - Metody - Zasady
- Etap B: Projekt współpracy - wynik - komunikacja
- Etap C: Rozwój wyniku
- Etap D: Komunikacja i rozpowszechnianie wyników

Ponadto szablon walidacji zawiera pięć otwartych pól do komentowania wdrożonego Programu STEAME-ID (zgodnie z analizą opartą na SWOT):

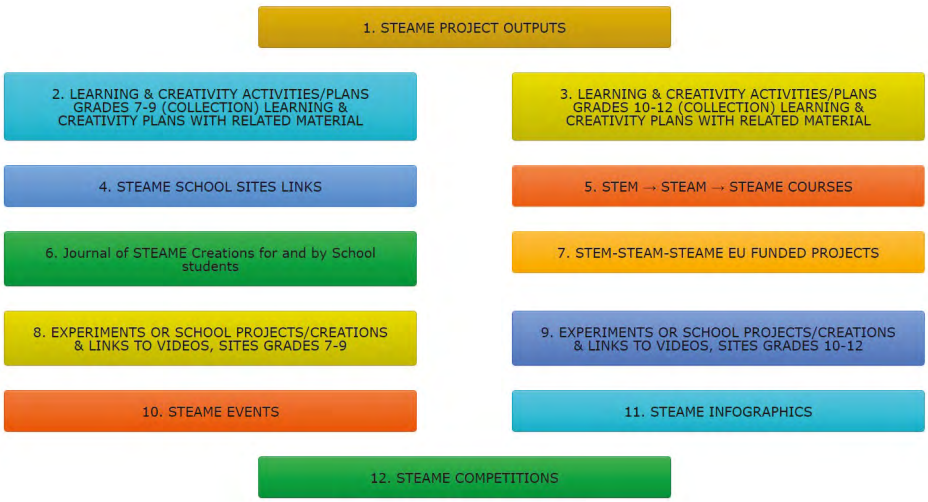
- SILNE STRONY
- SŁABE STRONY
- SZANSE
- ZAGROŻENIA
- Dodatkowy opis/komentarze/sugestie/zmiany/oczekiwania

Zachęca się szkoły do zastosowania wszystkich lub niektórych działań podczas pilotażowego procesu walidacji tej współpracy. Szablon oceny w ramach STEAME-ID przedstawiono w załączniku 11.

5. Obserwatorium

Obserwatorium jest narzędziem przeznaczonym głównie dla nauczycieli szkolnych w celu wspierania dynamicznego i adaptacyjnego programu nauczania STEAME w ich szkołach. Treści są stale aktualizowane i rozwijane, dzięki czemu wszyscy nauczyciele w Europie i poza nią mają możliwość aktualizacji, ale także publikowania własnych prac i materiałów. Zachęcamy do zamieszczania postów, takich jak Plan Uczenia się i Kreatywności (nowe podejście do planów lekcji), strona ich szkoły, jeśli zawiera zajęcia STEAME, kurs szkoleniowy związany ze STEAME, projekt związany ze STEAME finansowany przez UE, przykłady eksperymentów lub projektów STEAME w szkolne lub związane z nimi filmy, wydarzenia STEAME wykonane lub planowane oraz inne opcje, które wkrótce się pojawią.

Struktura Obserwatorium jest następująca:



W Obserwatorium każdy może:

- złożyć Plan Nauki i Kreatywności, który się pojawi
- złożyć opis eksperymentu lub projektu, który się pojawi
- przesłać stronę szkoły STEAME, która się pojawi
- przesłać kurs STEAME
- przesłać informację o projekcie STEAME finansowanym ze środków EU
- zamieścić ogłoszenie o wydarzeniu STEAME
- zamieścić infografikę
- zamieścić ogłoszenie o konkursie STEAME

submit point:
https://steame.eu/steame-observatory/

PART A (ITALIAN)

1. Il framework STEAME dei Piani di Apprendimento e Creatività

1.1 Esplorazione dei piani di lezione STEM, STEAM e dei piani basati su progetti esistenti

La prima attività delle presenti Linee Guida svolta dai partner STEAME ha previsto l'esplorazione di oltre 50 piani di lezione internazionali (UE e USA) STEM, STEAM e piani basati su progetto, al fine di considerare gli elementi e le caratteristiche più adeguati al Piano di Apprendimento & Creatività STEAME (L&C). Tra i piani di apprendimento presi in esame, e in base alla collaborazione e comunicazione tra i partner, sono stati scelti 10 piani, già esistenti, STEM, STEAM e basati su progetto. I partner hanno poi creato una tabella con gli elementi più importanti (i relativi riferimenti e la tabella sono presentati nell'Allegato 1). Queste sono le parti principali:

- Aspetti generali – Specifiche – Sinossi
- Obiettivi – Metodologie
- Preparazione - Mezzi - Infrastruttura
- Implementazione

Successivamente il responsabile dell'output ha coordinato la comunicazione tra i partner affidando loro il processo di sviluppo del modello del Piano di Apprendimento e Creatività STEAME. Ha avanzato una proposta iniziale, invitando il team di progetto a discutere in modo collaborativo e a lavorare su ciascuna delle sezioni dei Piani di Apprendimento e Creatività. Una volta che i partner hanno concluso il lavoro sul modello, lo stesso è stato nuovamente discusso dalla partnership e definito, così come presentato nella sezione successiva.

1.2 Sviluppo del Piano di Apprendimento e Creatività STEAME

Il Piano di Apprendimento e Creatività STEAME, sviluppato con il progetto STEAME, intende fornire agli insegnanti le informazioni e le risorse necessarie ad implementare una lezione STEAME. Il Piano di Apprendimento e Creatività è costituito da queste cinque sezioni:

A. Quadro generale
B. Framework STEAME
C. Obiettivi e Metodologie
D. Preparazione e Strumenti
E. Implementazione

Breve descrizione delle cinque sezioni summenzionate:

A. Quadro generale del Piano di Apprendimento e Creatività

La sezione contiene le informazioni generali sul Piano di Apprendimento e Creatività, quali:

- discipline interessate (S-T-E-A-M-E) e titolo del Progetto STEAME
- domanda guida o argomento

- età e classi
- durata, tempistica, numero di attività e allineamento al curricolo del Piano di Apprendimento e Creatività breve descrizione del progetto e/o delle attività di apprendimento correlati agli obiettivi
- contributi, riferimenti e ringraziamenti

B. Framework STEAME

La sezione riguarda il framework STEAME. Contiene le seguenti 3 sottosezioni:

- *Cooperazione tra insegnanti*: Cooperazione dell'Insegnante 1 con l'Insegnante 2 e formulazione della guida per gli studenti
- *Organizzazione STEAME nella vita reale*: Incontro con rappresentanti del mondo del lavoro, imprenditorialità – Giornate STEAME nella vita reale
- *Formulazione del Piano di Azione*: Riferimento alle Fasi e ai Progressi del framework STEAME (Formulazione del Piano di Azione)

C. Obiettivi e Metodologie

Questa sezione descrive gli obiettivi di apprendimento, i risultati di apprendimento, le conoscenze pregresse e i prerequisiti degli studenti, la motivazione, la metodologia, le strategie ecc. Essa comprende le seguenti 4 sottosezioni:

- *Obiettivi di apprendimento*: Identificazione degli obiettivi attraverso l'uso di verbi adeguati, correlati o corrispondenti alle competenze (conoscenza – abilità – valori), ciò che gli studenti sapranno fare una volta concluso il progetto.
- *Esiti dell'apprendimento e risultati attesi*: Definizione dei Risultati dell'Apprendimento attraverso l'uso di verbi di azione, risultati attesi ossia qualsiasi prodotto tangibile o "manufatto".
- *Conoscenze pregresse e prerequisiti*: Esperienze, conoscenze ed abilità pregresse che gli studenti porteranno con sé in questa esperienza d'apprendimento.
- *Motivazione, Metodologia, Strategie, Supporto all'apprendimento*: strategie, approcci, metodi, e/o tecniche di insegnamento per raggiungere gli obiettivi e i risultati di apprendimento (project-based, inquiry-based, basati su un problema, attività ludiche ecc.), istruzioni differenziate conformemente ai bisogni degli studenti (stili di apprendimento, rappresentazioni multimodali, ruoli assegnati agli studenti ecc.), coinvolgimento attivo degli studenti, lavoro individuale, in team e in aula, tecniche di supporto all'apprendimento, ecc.

D. Preparazione e Strumenti

Questa è la sezione che descrive la preparazione necessaria, il setting di apprendimento, le risorse, gli strumenti, ecc. Contiene le seguenti 3 sottosezioni:

- *Preparazione, Setting, Suggerimenti per la Risoluzione di Problemi*: Procedure, spazi e preparazione dei materiali, setting in aula, attività all'aperto, laboratorio d'informatica ecc.
- *Risorse, Strumenti, Materiale, Allegati, Attrezzatura*: Fonti educative e materiale digitale con relativi riferimenti necessari ad implementare il piano di apprendimento.
- *Salute e Sicurezza*

E. Implementazione

Questa sezione descrive un approccio completo per implementare il Piano di Apprendimento e Creatività elencando le attività e le fasi del processo di apprendimento, la valutazione e i metodi valutativi, la presentazione dei risultati dell'apprendimento, ecc. Contiene le seguenti 4 sottosezioni:

- *Attività, fasi didattiche e riflessioni:* descrizione breve ed esaustiva delle attività creative, dei compiti o delle esperienze di apprendimento (lavoro individuale, in team e in aula), coinvolgimento e partecipazione attiva attraverso esperienze pratiche, feedback e riflessione degli studenti sul loro modo di pensare o sull'apprendimento, monitoraggio dell'apprendimento degli studenti e misurazione dei progressi.
- *Osservazione e Valutazione*: Valutazione, processi e griglie per la valutazione formativa, finalizzati a misurare la capacità degli studenti di svolgere quanto descritto negli obiettivi.
- *Presentazione - Reporting - Condivisione*: Documenti, risultati, manufatti, prodotti realizzati dagli studenti con riferimenti, link, ecc. per la condivisione sui media.
- *Approfondimenti – Altre informazioni*

Nelle sezioni che seguono è riportata una breve descrizione delle **Metodologie**, della **Valutazione** e della **Presentazione** di un piano di Apprendimento e Creatività STEAME (le descrizioni analitiche sono presentate sotto forma di Allegato 2).

1.3 Metodologie adottate dal framework STEAME (PBL, IBL, PSL)

Nel framework STEAME vengono adottate queste tre metodologie:

A. Metodologia di apprendimento basata su progetto (Project-Based Learning Methodology - PBL)
B. Metodologia di apprendimento basata sull'indagine (Inquiry-based Learning Methodology - IBL)
C. Metodologia di apprendimento basata sulla risoluzione di un problema (Problem Solving Learning Methodology - PSL)

Nel paragrafo che segue è riportata una breve descrizione di queste tre metodologie (le descrizioni analitiche STEAME sono presentate sotto forma di Allegati 3, 4 e 5):

Metodologia di apprendimento basata su progetto (PBL)

L'apprendimento basato su progetto è ampiamente riconosciuto come metodologia con cui gli studenti acquisiscono conoscenze e abilità relative ai contenuti, in quanto sono chiamati, attraverso il loro coinvolgimento per un lungo periodo di tempo ad indagare e rispondere ad una domanda, ad un problema o ad una sfida autentici, impegnativi e complessi. La metodologia di apprendimento è strutturata attorno a prodotti e compiti pensati accuratamente e gli studenti dimostrano le conoscenze e le abilità acquisite creando un prodotto da presentare ad un pubblico reale. L'integrazione dell'Imprenditorialità o dell'Impresa in STEAM, per completarlo, e la creazione del framework STEAME, rispondono pienamente ai requisiti della PBL e ne esaltano le possibilità di applicazione.

La caratteristica essenziale basata sull'autenticità dei processi di apprendimento e dei risultati è strettamente legata allo sviluppo delle abilità del 21° secolo; ciò integra la metodologia PBL con i framework STEM, STEAM e STEAME. Con l'alfabetizzazione nei settori di finanza, salute, ambiente,

informazione e tecnologia si sviluppa e si acquisisce un'alfabetizzazione trasversale che interessa tutte le discipline: comunicazione e collaborazione, pensiero critico e problem solving, creatività, responsabilità, abilità sociali e interculturali.

Metodologia di apprendimento inquiry-based (IBL)

Il primo passo verso l'apprendimento inquiry-based è la curiosità. Gli studenti gestiscono il loro apprendimento attraverso domande e assumono il ruolo di chi si pone domande per trovare da sé le risposte. L'insegnante è un facilitatore, un mentore. É presente per monitorare i progressi degli studenti, per fornire supporto strutturale laddove necessario e per assicurare che sia mantenuto il focus sulle domande e sulle osservazioni degli studenti.

La didattica STEAM e l'imprenditorialità si stanno collegando come mai prima d'ora. Ciò accade in STEAME. Il legame è forte soprattutto tra scienza ed imprenditorialità. Una delle pietre miliari dell'imprenditorialità è la generazione di idee di business. Un metodo comune di generare idee per nuovi prodotti o servizi consiste nel progettare una soluzione ad un dato problema.

Trovare delle soluzioni ai problemi è alla base di ogni ambito scientifico. La didattica STEAM e le abilità imprenditoriali procedono di pari passo. Le competenze richieste per avere successo con STEAM, quali creatività, problem-solving, capacità di previsione, flessibilità, sono tutte necessarie anche per il successo di un imprenditore. Gli insegnanti devono tenere presente cosa rende STEAME così piacevole per molti studenti: il desiderio di risolvere un problema. Gli insegnanti dovrebbero fornire agli studenti gli strumenti e le abilità di cui necessitano per risolvere un problema e osservarli mentre lo risolvono da soli.

Metodologia di apprendimento Problem Solving (PSL)

Il "problem solving"' è il processo che consiste nell'analisi di una specifica situazione problematica e nel trovare una soluzione. L'importanza di questa metodologia è l'abilità di promuovere la motivazione, di potenziare il pensiero critico e di indurre gli studenti ad utilizzare le life skills quotidiane. L'insegnante funge da facilitatore: spiega come funziona il problem solving, conduce le prime interazioni, mostra gli strumenti alla base di ogni step (es. le cinque W più H, analisi delle cause e così via), illustra esempi consolidati e contribuisce ad evitare le insidie. Spesso il processo cognitivo spinge a trovare soluzioni "fuori dagli schemi". Il problem solving comprende cinque momenti:

- Comprensione
- Previsione
- Pianificazione
- Follow-up
- Valutazione

1.4 Valutazione dell'implementazione del progetto

I principali elementi di valutazione riguardano quante discipline STEAME sono coinvolte nel Piano di Apprendimento e Creatività, quali **competenze** degli studenti e attraverso quale **processo** vengono sviluppate/potenziate durante il progetto, compresi i metodi di **valutazione formativa**. Questi elementi si basano su griglie ricavate dalla seguente bibliografia:

- Raccolte di contenuti (es. ReadWriteThink Rubrics, Assessment and Rubrics)
- Approcci STE(A)M (es. iRubric: Build, Assess, Share, Collaborate)
- Osservazioni in aula (es. A Practical Guide to Improving Classroom Observations)
- Approcci project-based (es. BIE-PBLWorks Rubrics , The Complete Guide to Student Digital Portfolios)

Il modello "**Valutazione del lavoro degli studenti**" prevede le seguenti 4 sessioni principali:

1. Discipline STEAME (performance generale dei rispettivi concetti/disciplina/contenuti di livello K-12)
2. Competenze (conoscenze, abilità, valori-atteggiamenti)
3. Processi di gestione, sviluppo e realizzazione del progetto
4. Valutazione formativa (specificata per ogni Piano di Apprendimento e Creatività)

Il modello di valutazione STEAME è presentato nell'Allegato 6.

1.5 Abilità di comunicazione dei risultati di progetti STEAME da parte degli studenti

Il framework delle competenze STEAME descrive e presenta tutte le rilevanti aree delle competenze relative al contesto dell'approccio consigliato. Tra queste, figurano le abilità comunicative che gli studenti sono incoraggiati a sviluppare e a potenziare durante il processo di apprendimento.

Il progetto STEAME mira al conseguimento di tali abilità sollecitando gli studenti a comunicare i loro risultati del progetto STEAME attraverso una serie di attività, quali la rivista elettronica STEAME.

Informazioni dettagliate sugli elementi necessari allo sviluppo delle abilità di presentazione del progetto STEAME sono fornite negli Allegati 7 e 8.

Di seguito vengono illustrate le principali abilità di comunicazione scientifica e di presentazione su cui si focalizza il progetto STEAME:

A. Abilità di comunicazione scientifica

Il progetto STEAME, il cui obiettivo consiste nel coinvolgere gli studenti a sviluppare le loro abilità nella comunicazione scientifica, incoraggia gli studenti a pubblicare il proprio elaborato nella rivista Journal for STEAME Creations per e degli Studenti della Scuola. Per indirizzare gli studenti, il team di progetto STEAME ha sviluppato delle linee guida rivolte agli studenti autori. Le linee guida sono presentate in un modello di elaborato che offre agli studenti una descrizione e una guida, per sviluppare ciascuna sezione passo dopo passo. Il modello stesso segue i principi fondamentali di un elaborato scientifico per avviare gli studenti ad esprimere le loro "scoperte"/le loro produzioni/i loro progetti scientifici con espressioni più formali, e sviluppando così abilità comunicative in ambito scientifico.

Le abilità comunicative rappresentano un'area a sé stante all'interno del framework delle competenze STEAME. Agli studenti viene assegnato uno spazio per esprimersi attraverso un processo di comunicazione scientifica e in questo modo essi sono in grado di mettere in relazione le aree di competenza dell'ambito scientifico con quelle della comunicazione. Indicativamente gli studenti dovranno considerare come comunicare i propri risultati/progetti/manufatti seguendo

una serie specifica di regole [Publication of Manual of the american Psychological Association (6th edition 2020) Pubblicazione del Manuale dell'Associazione Americana di Psicologia (sesta edizione, 2010)], l'utilizzo di numeri e tabelle, ecc. Gli studenti riceveranno anche un feedback in una forma simile a quella che ci si aspetterebbe di ricevere da una rivista scientifica quando si pubblica un elaborato.

B. Abilità di presentazione

Le abilità di presentazione sono le abilità necessarie agli studenti per realizzare presentazioni efficaci e coinvolgenti di fronte a diverse tipologie di pubblico. Tali abilità interessano una varietà di aree, quali la struttura delle presentazioni degli studenti, la progettazione delle slide, il tono della voce e il linguaggio del corpo che gli studenti veicolano.

Durante le lezioni, le attività e i progetti STEAME, vengono trattati tutti gli aspetti chiave teorici e pratici: Scienza, Tecnologia, Ingegneria, Arte, Matematica, Imprenditorialità. Il tutor/insegnante svolge un ruolo fondamentale nel processo. Il curricolo standard è il cuore delle linee guida, tuttavia se la scuola non applica STEM (STEAM/E) nei propri corsi di studio, il singolo insegnante dovrebbe sin dall'inizio incoraggiare gli studenti a lavorare sulle loro abilità di comunicazione e presentazione. Questo si riferisce anche al lavoro degli insegnanti stessi e all'uso delle presentazioni durante le loro lezioni/attività.

Le fasi principali di una presentazione di successo sono:

[a] preparazione
[b] esposizione
[c] follow-up

2. Guida allo sviluppo del Piano di Apprendimento e Creatività

La procedura dello sviluppo e dell'implementazione di un progetto STEAME, basata sul relativo Piano di Apprendimento e Creatività, si fonda su questi 3 "pilastri" principali STEAME:

2.1 Preparazione da parte degli insegnanti (4 step)

1. Formulare le idee iniziali su ambiti tematici/aree da trattare
2. Coinvolgere il contesto più ampio: lavoro/business/genitori/società/ambiente/etica
3. Selezionare il gruppo di studenti per età – Abbinarlo al curriculum ufficiale – Definire le finalità e gli obiettivi
4. Organizzare i compiti dei soggetti coinvolti – Designare il coordinatore – Spazi di lavoro ecc.

2.2 Formulazione del Piano di Azione (18 step)

Preparazione (svolta dagli insegnanti)

1. Riferimento al mondo reale – Riflessione
2. Incentivo – Motivazione
3. Formulazione di un problema (possibilmente in fasi) sulla base di quanto sopra

Sviluppo (svolto dagli studenti) – Guida & valutazione (punti 9-11, svolta dagli insegnanti)

4. Creazione del background - Ricerca/Raccolta di informazioni
5. Semplificazione del problema – Configurazione del problema con un numero limitato di richieste
6. Creazione di un caso - Progettazione – Identificazione dei materiali necessari per costruzione/sviluppo/creazione
7. Costruzione – Flusso di lavoro – Implementazione di progetti
8. Osservazione- Sperimentazione – Conclusioni iniziali
9. Documentazione – Ricerca di aree tematiche (ambiti STEAME) collegate alla disciplina oggetto di studio – Spiegazione basata su teorie esistenti e / o risultati empirici
10. Raccolta di risultati/informazioni basate sui punti 7, 8, 9
11. Prima presentazione di gruppo svolta dagli studenti

Configurazione & Risultati (affidati agli studenti) – Guida & Valutazione (affidate agli insegnanti)

12. Configurare modelli matematici o altri modelli STEAME per descrivere/rappresentare/ illustrare i risultati
13. Studiare i risultati di cui al punto 9 e trarre le conclusioni, utilizzando il punto 12
14. Applicazioni nella vita quotidiana – Suggerimenti per sviluppare punto 9 (Imprenditorialità – Giornate STEAM nella vita reale)

Revisione (svolto dagli insegnanti)

15. Esaminare il problema in condizioni più difficili

Completamento del progetto (svolto dagli studenti) – Guida & Valutazione (affidata agli insegnanti)

16. Ripetere gli step da 5 a 11 con ulteriori o nuovi requisiti come riportato al punto 15
17. Indagine – Studi di casi – Approfondimento – Nuove teorie – Verificare nuove conclusioni
18. Presentazione delle conclusioni – Tattiche comunicative

2.3 Azioni e cooperazione per studenti ed insegnanti (10 step)

In ogni progetto STEAME è presente una breve descrizione e vengono delineati gli aspetti organizzativi e le responsabilità di azione conformemente ad alcune delle seguenti fasi e attività affidate a studenti ed insegnanti:

FASE	**Attività/Step** Insegnante 1 (I1) Cooperazione con I2 e guida rivolta agli studenti	**Attività/Step** **degli studenti** Gruppo di età: _____	**Attività /Step** Insegnante 2 (I2) Cooperazione con I1 e guida rivolta agli studenti
A	Preparazione degli step 1, 2, 3		Cooperazione nello step 3
B	Guida nello step 9	4, 5, 6, 7, 8, 9, 10	Guida di supporto nello step 9
C	Valutazione creativa	11	Valutazione creativa
D	Guida	12	Guida
E	Guida	13 (9+12)	Guida
F	Organizzazione STEAME nella vita quotidiana	14 Incontro con rappresentanti del mondo del lavoro	Organizzazione STEAME nella vita quotidiana
G	Preparazione dello step 15		Cooperazione nello step 15
H	Guida	16 (ripetizione da 5 a 11)	Guida di supporto
I	Guida	17	Guida di supporto
K	Valutazione creativa	18	Valutazione creativa

3. Piani di Apprendimento e Creatività STEAME

Una volta definito il modello, il team di progetto STEAME ha sviluppato congiuntamente un Piano di Apprendimento e Creatività prototipo, coinvolgendo in questo processo gli insegnanti per verificare e ultimare il modello del Piano di Apprendimento e Creatività. Ciò ha rappresentato la base di prototipo ed esempio [sezione 6.1] per l'ulteriore sviluppo di Piani di Apprendimento e Creatività STEAME per le classi 7-9 [12-15 anni, si veda la sezione 6.2] e per le classi 10-12 [15-18 anni, si veda la sezione 6.3] correlati a STEAME (Science, Technology, Engineering, Mathematics, Entrepreneurship – *scienza, tecnologia, ingegneria, matematica, imprenditorialità*).

3.1 Piano di Apprendimento e Creatività prototipo

Il Piano di Apprendimento e Creatività prototipo riguarda la costruzione di un "**e-shop personalizzato"** studiando i concetti economici di costi, entrate e utili in un'azienda. Consta di cinque attività per due lezioni di 90 minuti (prima lezione) e comprende l'analisi e il calcolo dell'utile di un'azienda, l'analisi dei relativi costi e il modo in cui l'azienda crea e aumenta le entrate. Sulla base di tutti questi aspetti, nei 90 minuti successivi (seconda lezione), ogni gruppo di studenti progetta e crea un e-shop personalizzato che simula un problema reale. In questo modo gli studenti comprendono il meccanismo del mercato.

Il Piano di Apprendimento e Creatività prototipo pensato per l'"E-shop personalizzato" è riportato nell'Allegato 9.

3.2 Sviluppo di Piani di Apprendimento e Creatività per le classi 7-9

Il progetto STEAME ha sviluppato i seguenti 15 Piani di Apprendimento e Creatività per le **classi 7-9 [12-15 anni]**, correlati alle discipline STEAME (Science, Technology, Engineering, Mathematics, Entrepreneurship), promuovendo la collaborazione tra insegnanti al fine di garantire un approccio multidisciplinare, fornendo le informazioni e le risorse necessarie mediante l'utilizzo del Modello di Apprendimento e Creatività descritto nelle sezioni precedenti.

L'elenco di tutti questi Piani di Apprendimento e Creatività è presentato nell'Allegato 10.

3.3 Sviluppo di Piani di Apprendimento e Creatività per le classi 10-12

Il progetto STEAME ha sviluppato i seguenti 11 Piani di Apprendimento e Creatività per le **classi 10-12 [15-18 anni]**, correlati alle discipline STEAME (Science, Technology, Engineering, Mathematics, Entrepreneurship), promuovendo la collaborazione tra insegnanti al fine di garantire un approccio multidisciplinare, fornendo le informazioni e le risorse necessarie mediante l'utilizzo del Modello di Apprendimento e Creatività descritto nelle sezioni precedenti.

L'elenco di tutti questi Piani di Apprendimento e Creatività è presentato nell'Allegato 10.

3.4 Valutazione dei Piani di Apprendimento e Creatività

In quanto parte di questo output, durante la sperimentazione dell'attività formativa degli insegnanti, che ha coinvolto attivamente tre scuole partner, i partecipanti hanno presentato i Piani di Apprendimento e Creatività sviluppati nel corso del progetto e disponibili nello **STEAME Observatory (Osservatorio STEAME)**.

I partecipanti hanno introdotto e presentato il processo di valutazione di un Piano di Apprendimento e Creatività. E' prevista dal contenuto dell'output il coinvolgimento nel **processo di valutazione** di individui esterni al team di progetto ai quali è stato chiesto di fungere da valutatori. Sono stati valutati anche i Piani di Apprendimento e Creatività sviluppati durante l'evento di formazione C1, con la partecipazione e il coinvolgimento attivo di tutti i partecipanti. Ciò ha permesso loro di acquisire esperienza pratica nell'intero processo di sviluppo di un Piano di Apprendimento e Creatività (progettazione, implementazione, valutazione, revisione).

Nel corso della formazione tale attività ha consentito ai partner di raccogliere dei feedback e di vivere il processo in qualità di osservatori. Dopo la formazione, i partner hanno utilizzato i feedback e la propria esperienza durante la formazione C1 per rivedere i propri piani di Apprendimento e Creatività.

La discussione sulla valutazione è stata associata alla dinamicità dell'Osservatorio STEAME e al fatto che qualsiasi insegnante possa essere coinvolto e possa presentare il proprio piano di Apprendimento e Creatività, che, qualora implementato in aula, sarà accompagnato da relativa valutazione, supportando così chi utilizza STEAME per navigare meglio ed esplorare i piani disponibili.

La valutazione dei Piani di Apprendimento e Creatività durante la formazione C1 è riportata nell'Allegato 12.

4. Programma di Cooperazione e Creatività tra Scuole & Industria

È importante che le scuole siano aperte alla società in qualità di soggetti chiave. Le collaborazioni con gli istituti di ricerca e con le aziende possono non solo contribuire ad ampliare gli orizzonti degli studenti, ma permettono a questi ultimi anche di acquisire familiarità con le attività dei centri di ricerca e con le finalità delle aziende. Gli studenti che in gruppo collaborano con aziende o altre organizzazioni sono avvantaggiati in quanto:

- Fanno esperienze in diversi ambiti
- Acquisiscono familiarità con la ricerca e l'imprenditorialità grazie ad un processo di apprendimento esperienziale
- Acquisiscono informazioni per la comunità educativa internazionale
- Acquisiscono informazioni per la comunità dell'imprenditoria internazionale
- Hanno accesso a risorse per l'economia internazionale
- Hanno accesso all'infrastruttura esistente in aziende ed istituzioni
- Acquisiscono familiarità con la dimensione sociale della ricerca e dell'imprenditorialità
- Acquisiscono consapevolezza sui 17 Obiettivi di Sviluppo Sostenibile

In questo modo gli studenti, sin dall'età scolare, possono farsi un'idea migliore delle possibili scelte future in ambito scientifico. La collaborazione con educatori, dirigenti di azienda, ricercatori, scienziati, manager nel commercio e nella ricerca può portare molteplici vantaggi a più livelli per l'ingresso nel moderno contesto economico.

In quanto parte del progetto, un **team** che si accinge a realizzare un progetto, che intende implementarne l'idea, dovrà misurarsi con importanti domande e dilemmi durante il processo di implementazione, durante il quale sarà chiamato a prendere una decisione. Molto spesso sarà una decisione difficile da prendere, poiché il team non avrà le conoscenze o l'esperienza necessarie a valutare la situazione generale. Così i gruppi di studenti assieme ai loro insegnanti saranno invitati a collaborare con altri ricercatori, scienziati o professionisti esterni alla scuola, che chiameremo **mentori**. I mentori sono persone che possiedono particolari conoscenze ed esperienza nel proprio settore e che al tempo stesso sono disponibili a dare consigli e a fornire consulenza.

4.1. Le Regole del Programma di Cooperazione STEAME-ID

Le regole della cooperazione tra scuole e industria sono classificate nel modo seguente:

- Organizzazione di team e regole di cooperazione
- Obiettivi (contesto delle riunioni, scambio di idee, metodi, prodotti)
- Riunioni (finalità, processo di monitoraggio e valutazione, livello di impegno, gestione funzioni: contratto, gestione tempi)
- Prodotto(i) e valutazione
- Comunicazione – Disseminazione

Le regole del framework STEAME-ID sono presentate nell'Allegato 11.

4.2. Il Modello del Programma di Cooperazione STEAME-ID

Conformemente a quanto sopra riportato, possiamo creare un nuovo modello di cooperazione tra scuole e industria (istituti di ricerca – aziende), da cui emerge un piano di azione indicativo. Il modello di cooperazione proposto si suddivide nelle seguenti **4 fasi principali**:

Fase A. Vision - Mission – Finalità - Obiettivi - Regole
Fase B. Progettazione della Cooperazione – Risultati – Comunicazione
Fase C. Sviluppo del Risultato

Fase D. Comunicazione e disseminazione del Risultato

Ogni fase comprende molte attività, quali: **Riunioni** (riguardanti progettazione, sviluppo e disseminazione del Progetto), **Risorse, Media, Infrastruttura** (necessari ad implementare ogni fase).

La Scuola e l'Istituto di Ricerca/Azienda appartengono ad un ecosistema in cui molti **fattori esterni** contribuiscono al loro "Mondo" interno, quali:

- un mondo con una varietà di **framework** (es. framework delle competenze, DigComp)
- un mondo con una varietà di **standard** (es. Common Core, ISO)
- un mondo digitale con una varietà di **ambienti** (es. Google Apps)
- culture **sociali ed ecosistemi** vari e differenti

Il modello del framework STEAME-ID è presentato nell' Allegato 11.

4.3. Convalida del Programma di Cooperazione STEAME-ID

Per l'implementazione del Programma STEAME-ID è disponibile una guida che può essere impiegata quale report di valutazione con cui controllare gli step delle attività che scuola ed industria devono necessariamente compiere cooperando tra di loro. Questo modello di convalida è costituto dalle seguenti quattro fasi principali:

- Fase A: Finalità - Obiettivi – Metodi - Regole
- Fase B: Progettazione della Cooperazione – Risultato – Comunicazione
- Fase C: Sviluppo del Risultato
- Fase D: Comunicazione e disseminazione del risultato

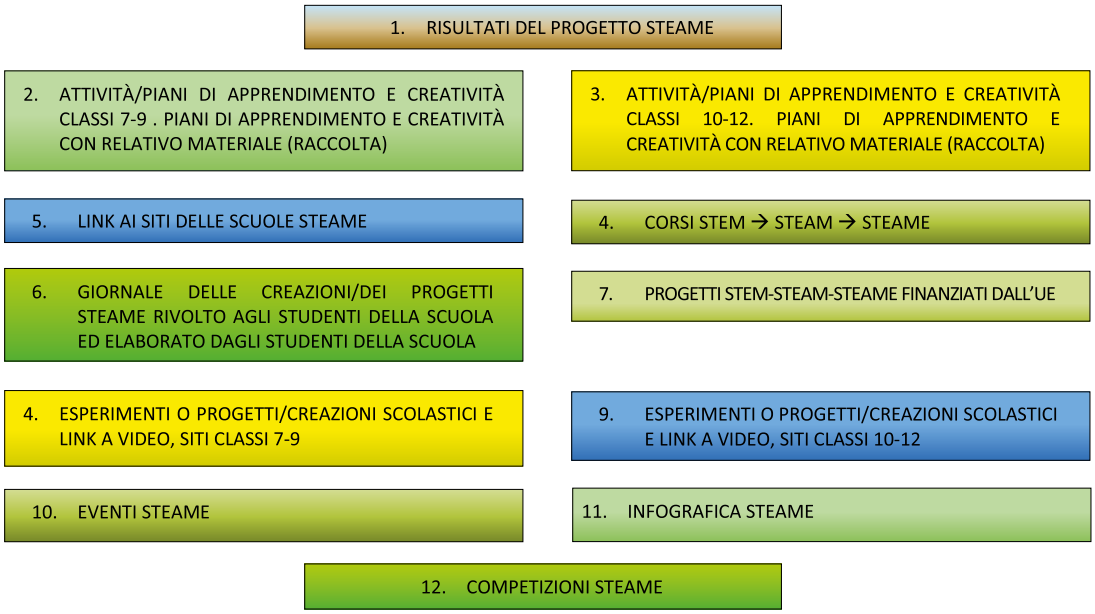
Il modello di convalida include inoltre cinque campi aperti per commentare il Programma STEAME-ID implementato (conformemente all'analisi SWOT):

- PUNTI DI FORZA
- DEBOLEZZE
- OPPORTUNITA'
- MINACCE
- Ulteriori descrizione/commenti/suggerimenti/modifiche/aspettative

Si raccomanda alle scuole di proporre tutte o alcune delle attività durante il processo di convalida pilota relativo a questa cooperazione. Il modello di valutazione del framework STEAME-ID è presentato nell'Allegato 11.

5. Osservatorio

L'Osservatorio è uno strumento pensato principalmente per gli insegnanti al fine di supportare un curricolo STEAME dinamico e flessibile nelle scuole. Il contenuto viene aggiornato e ampliato costantemente, pertanto tutti gli insegnanti in Europa e al di fuori del territorio europeo hanno l'opportunità non solo di essere aggiornati, ma anche di pubblicare i loro lavori e materiali. Si invita a postare materiale quale Piani di Apprendimento e Creatività (un nuovo approccio per programmare le lezioni), il sito della scuola se contiene attività STEAME, corsi di formazione relativo a STEAME, progetti finanziati dall'UE relativi a STEAME, esempi di sperimentazioni o progetti STEAME nelle scuole o relativi video, eventi STEAME organizzati o da organizzare e altre opzioni da proporre a breve.
La struttura dell'Osservatorio è la seguente:



All'Osservatorio tutti possono:

- Inviare un piano di apprendimento e creatività da presentare
- Inviare un progetto o la descrizione di un esperimento da presentare
- Inviare il sito di una scuola STEAME da presentare
- Inviare un corso STEAME
- Inviare un progetto STEAME finanziato dall'UE
- Inviare l'annuncio di un evento STEAME
- Inviare una infografica
- Inviare l'annuncio di competizioni STEAME

submit point:
https://steame.eu/steame-observatory/

PART A (BULGARIAN)

1. Рамката на STEAME за учене и творческо планиране

1.1 Изследване на съществуващи STEM, STEAM и проектни учебни планове.

Първото действие в тези Насоки , което беше създадено от партньорите по STEAME, беше да проучат повече от 50 международни /от ЕС и САЩ/ STEM, STEAM проектно основани учебни планове с цел да се изследват елементите и чертите, които биха били най-подходящи за STEAME за учене и творческо планиране. От тези планове, и в последвалата съвместна работа и сътрудничество , бяха избрани десет съществуващи STEM, STEAM проектно основани учебни плана и на основата на тях, партньорите създадоха таблица с основните положения и най-важните елементи от плановете /линкове с източници и таблицата могат да се видят в Анекс 1/ със следните основни части:

- Главна- Спецификации- Конспект
- Цели – Методология
- Подготовка – Средства- Инфраструктура
- Приложение

След това лидерът за крайния резултат направи координация за комуникация между партньорите и ги въвлече в процеса по развитие на бланката за планиране на STEAME за учене и творческо планиране като направи първоначално предложение , което ангажира екипа по проекта да дискутира съвместно и да работи по всеки от плановете на учене и творческо планиране. Бланката, щом беше завършена, беше обсъдена още веднъж от партньорите и завършена, както е показана в следващата глава.

1.2 Развиване на плана за STEAME за учене и творчество /У&Т/

Планът за STEAME за учене и творчество /У&Т/, разработен от проекта STEAME има з цел да предостави на учителите информацията и ресурсите , които са нужни за да се приложи STEAME урок. Планът Учене и Творчество се състои следните пет части.

А Преглед

Б Рамката STEAME

В Цели и Методология

Г Подготовка и Методология

Д Приложение

Следва кратко описание на частите:

А Общ преглед на Плана за Учене и Творчество

Тази част съдържа обща информация за Плана като:

- Предметите, които включва (S-T-E-A-M-E) и заглавието на проекта
- Основополагащата тема или въпрос
- Възрастовата група и класовете
- Продължителността, времевият график, броят на дейностите и подравняването с учебната програма на плана за Учене и Творчество
- Кратко описание на проекта и/ или учебни дейности, отнасящи се до целите
- Сътрудници, източници и признателност

Б Рамката STEAME

Тази част прави директна препратка към рамката на STEAME. И съдържа следните три подсекции.

- Учителско сътрудничество : Учител 1 си сътрудничи с Учител 2 и се формулира ръководството за учениците
- Организация на STEAME на практика в живота / SiL/: Среща с представители на бизнеса , Предприемачество – Дни на практическо приложение на STEAME.
- Създаване на план за действие: с препратка към Етапи и Стъпки на Рамката STEAME.

В Цели и Методология

Тази част описва учебните цели и задачи и резултатите от обучението, предварителните знания и необходимите условия за учащите, мотивация, методология, стратегии и т.н.

Съдържа следните четири под-отдела:

- Цели и задачи на обучението: Диференциране на целите и задачите и определянето им, употребявайки подходящите глаголи, отнасящи се до съответстващите компетенции /знания – умения – ценности/ , това, на какво ще бъде способен учащия след проекта.
- Резултати от обучението: Дефиниране на Резултатите от Обучението употребявайки глаголи за действие, очакваните резултати и всички други отчетени резултати или ‚творения‘.
- Предварителни знания и необходими условия
- Мотивация, Методология, Стратегии и Помощни средства: стратегии на преподаване, подходи, методи и/или техники за постигане на обучителните цели и резултати /проектно-базирани, основаващи се на търсене на информация, на решаване на проблем или въпрос, игрови и т.н./ разграничаване на нуждите на учениците/ стилове на учене, използване на множество средства за представяне на информацията, ролите на учениците е т.н./

Г Подготовка и Средства

В тази част се говори за подготовката, която е нужна, подготовката на пространството за учене, ресурсите, инструментите и т.н. Съдържа три под секции:

- Подготовка, Организация на пространството, Съвети за разрешаване на възникнали проблеми: процедури, пространство и материална подготовка, обстановката в класната стая, дейности на открито, компютърна лаборатория и т.н.
- Ресурси, инструменти, материали, приставки, оборудване: Източници с инструкции и дигитални материали със съответните справочни материали за изпълнението на учебния план.
- Безопасност и здраве

Д Изпълнение

Тази част описва цялостния подход към прилагането на УиТ плана като представя списък от дейностите и процедурите на учебния процес , методите за оценка, представянето на резултатите от обучението и т.н. Съдържа следните 4 части:

- Обучителни дейности, процедури, осмисляне: Кратко и изчерпателно описание на творческите дейности, задачи или обучителни действия / индивидуална и отборна работа в класните стаи/. Ангажираност и активно участие чрез практика. Обратната връзка от ученици и отчитане на начините им на мислене, процеси или учене. Наблюдение на обучението на учениците и измерване на напредъка им.
- Оценка -: Оценяването и формиращите процеси на оценка и правила за измерване на способностите на учениците да се представят според описаното в целите.
- Представяне – Докладване –Споделяне: Документи, резултати, творения, продукти, създадени от учениците, с цитиране на източници, уеб линкове и други за споделяне онлайн.
- Допълнение – Друга информация

Методологиите, Оценяването и Представянето на плана на STEAME УиТ са описани накратко в следващите раздели /аналитични описания са представени в Анекс 2/

1.3 Методологии приети от рамката на STEAME /ПБУ, ИБУ, РПБУ/

Следните три методологии са възприети от рамката на STEAME:

А. Проектно-базирано Учене ПБУ

Б. Учене основано на изследване ИОУ

В. Учене, основано на разрешаване на проблеми РПОУ

Тези са обяснени накратко в следващия параграф /аналитични STEAME описания са представени в Анекс 3,4,5/

Методология на Проектно Базирано Учене

Проектно-базираното учене е метод, който е широко признат като начин за предоставяне на академични знания и умения учениците чрез тяхното въвличане за продължително време в разследването и търсенето на отговори на автентична и сложна задача, въпрос или предизвикателство. Методологията на учене е структурирана около внимателно проектирани продукти и задачи и учениците имат

възможност да покажат знанията и уменията, които са придобили чрез създаването на обществен продукт, който да бъде представен пред истинска публика. Интегрирането на Предприемачество или Бизнес в STEAM за да го допълни и за да създаде STEAME рамка на, напълно отговаря на изискванията на Проектно базираното учене и подобрява възможностите за прилагане.

Силната черта на този подход е основаването на автентичността на учебния процес и крайните резултати и е силно свързано с развиването на уменията на 21 век, които интегрират методологията на проектно-базираното учене към плановете на STEM, STEAM и STEAME. Финансова, здравна, екологична , информационна и технологична грамотности се развиват и придобиват заедно с междукултурна грамотност, която включва всички предмети : общуване и сътрудничество, критично мислене и решаване на задачи, творчество, , отговорност, и социални и междукултурни умения.

Методология на Учене основано на изследване

Първата стъпка от Учение основаващо се на изследване е любопитството. Учениците маневрират процесите си на учене чрез въпроси, те са в ролят ана изследователи , които откриват отговорите за себе си. Учителят е фасилитатор , ментор. Учителят присъства за да да следи напредъка на учениците и за да предоставя структурна подкрепа , когато е необходимо и за да увери, че фокусът остава върху въпросите и наблюденията на учениците.

Образованието STEAM и предприемачеството стават все повече и повече тясно свързани. Това се случва в STEAME. Не на последно място, защото връзката между наука и предприемачество е силна. Един от крайъгълните камъни в предприемачеството и бизнеса е създаването на идеи. Един от общоприетите подходи към създаването на идеи за нови продукти или услуги е създаването на решение на даден проблем. Намирането на решение е основата на всеки клон на науката. Образованието по STEAM и предприемачеството вървят ръка за ръка . Компетенциите, които се изискват в STEAM като творчество, решаване на проблеми , предвидливост, адаптивност са нужните и за успеха като предприемач.

Учителите е нужно да имат предвид , че желанието да разрешиш един проблем е това, което прави STEAME толкова приятно за много ученици. Учителите трябва да дадат на учениците инструментите и уменията да решат проблема и да ги наблюдават как те се справят сами.

Методология на Учене, основано на разрешаване на проблеми

Разрешаване на проблеми или задачи е процеса по анализа на определена проблематична ситуация с цел да се намери разрешение. Значението на тази методология е способността да се насърчи мотивираността, да се даде предимство на критичното мислене и да се подтикнат учениците да използват ежедневните си умения от живота. Учителят има роля на фасилитатор , който обяснява как работи разрешаването на проблеми , ръководи първите срещи, показва инструментите , върху се крепи всяка от стъпките /напр. пет В плюс Х, Анализ на корена на проблема и други/, илюстрира сходни примери и помага да се избягват капанит. Познавателният

процес често довежда до откриването на неочаквани разрешения. И разрешаването на проблеми включва:

- Разбиране
- Прогнозиране
- Планиране
- Продължение
- Оценяване

1.4 ОЦЕНКА НА ИЗПЪЛНЕНИЕТО НА ПРОЕКТА

Основните елементи за оценка са свързани с това колко от предметите на STEAME са покрити от плана за учене и творчество . Кои **компетенции** на учениците са покрити и от кои **процеси** чрез проектно базирания процес , включително методите за форматиращо оценяване. Тези елементи се базират на правилата взети от следните библиографии:

- Хранилище на съдържание (e.g. ReadWriteThink Rubrics, Assessment and Rubrics)
- Подходи STE(A)M (e.g. iRubric: Build, Assess, Share, Collaborate)
- Наблюдения в класната стая (e.g. A Practical Guide to Improving Classroom Observations) Проектно-базиран подход (e.g. BIE-PBLWorks Rubrics , The Complete Guide to Student Digital Portfolios)

Бланка за **Правилата за оценка на работата на учениците** съдържа следните 4 основни раздела:

1 STEAME Предмети (общо представяне по основните идеи, дисциплини и съдържание за ниво К12)

2. Компетентност (знания, умения, ценности – отношение)

3. Управление на проект, Процеси на развитие и реализация

4. Формиращо оценяване /конкретно за всеки план по учене и творчество/

Бланка за Оценяване на STEAME е представена в Анекс 6.

1.5 Комуникационни Умения на учениците като резултат от проекта STEAME

Рамката на компетенциите на STEAME описва и представя всички съответни области на компетентност, които са свързани с контекста на предложения подход. И сред тях са умения за общуване, които учениците са окуражавани да развиват и подобряват по време на учебния процес.

Начинът, по който STEAME се стреми да постигне това е като ангажира учениците да общуват по техните резултати от STEAME проекти чрез различни набори от действия като електронния дневник на STEAME.

Подробна информация за елементите за развитие на презентационни умения по проекта са дадени в Анекс 7 и 8.

Основните набори от презентационни и научни комуникационни умения, на които набляга проекта са представени по-долу.

А Умения за Научна Комуникация

Проектът STEAME, стремейки се да ангажира учениците в развитието на уменията им за общуване , ги подтиква да предават техните собствени доклади към Дневника на STEAME Творения за и от ученици. За да навигира усилията им, екипът на STEAME е създал наръчник с насоки , чиято аудитория са младите автори сред учениците. Насоките, които са представени в бланка са ученически доклад , описвайки и водейки учениците, стъпка по стъпка , как да разработят всеки отдел. Самата бланка следва основните принципи на създаване на научен доклад и въвежда учениците в начините да представят техните научни открития или творби в един по-официален начин на изразяване и по този начин да развиват техните умения за научна комуникация.

Уменията за общуване са самостоятелна област в рамките на проекта STEAME и рамката на уменията, които развива, и чрез предоставянето на пространство да се изразяват чрез процес на научна комуникация , цели да свърже по-добре областите принадлежащи на научните компетенции с тези на комуникационните компетенции. Учениците ще е нужно да се замислят как да представят своите открития /проекти/ творения като следват определен набор правила [Publication Manual of the American Psychological Association (6th Edition, 2010)],употребата на стойности и таблици и др. Учениците също получават обратна връзка под формата подобна на тази, която се очаква от научен журнал когато се предава документ за публикуване.

Б Презентационни Умения

Презентационните умения са тези умения, от които се нуждаят учениците за да могат да правят ефективни и увлекателни презентации пред различни видове публика. Тези умения покриват различни области като структурата на презентацията на учениците, дизайна на слайдовете на презентацията, тона на гласа им, езика на тялото, чрез които общуват учениците.

По време на часовете, дейностите и проектите на STEAME, всичките от основните аспекти като теория и практика са покрити: Науки, Технология, Инженерство, Изкуство, Математика, Предприемачество. Учителят има основна роля в процеса. Учебният план поставя насоките , но ако училището не прилага STEAME в учебните дейности, то тогава отделният учител трябва да окуражава учениците да работят върху техните презентации и комуникационни умения от самото начало. Това се отнася също и до работата на самите учители и употребата на презентации в техните часове и дейности.

Основните фази на успешната презентация са:

А подготовка

Б представяне

В проследяване

2. Упътване за изготвяне на план за учене и креативност

Процедурата за разработване и прилагане на проекта STEAME, базиран на подобен План за учене и креативност, се ръководи от следните три главни STEAME стълба.

2.1 Подготовка от учители (4 стъпки)

1. Формулиране на първоначални идеи по тематичните сектори/ сфери, които трябва да бъдат обхванати
2. Ангажиране на по-широка аудитория / работа/ бизнес/ родители/ общество/ околна среда/ етика
3. Набелязване на възрастова ученическа група – свързана с официалната учебна програма – поставяне на цели и задачи
4. Организиране на задачите на участващите страни – определяне на координатор – работни места и т. н.

2.2 Формулиране на план за действие (18 стъпки)

Подготовка (от учители)

1. Връзка с Реалния Свят - Отражение
2. Стимул - Мотивация
3. Формулиране на проблем (по възможност на етапи или фази) като резултат от гореспоменатото

Разработка (от ученици) – Ръководство и Оценка (в 9-11, от учители)

4. Създаване на предистория- Търсене/ събиране на информация
5. Опростяване на темата- Конфигуриране на проблема с ограничен брой изисквания
6. Създаване на казус – дизайн - определяне на материали за изграждане/ разработване/ създаване
7. Изграждане – работен процес – изпълнение на проекти
8. Наблюдение – Експериментиране – Първоначални Заключения
9. Документация- Търсене на Тематични области (STEAME сфери) свързани с изучавания предмет – Обяснение базирано на Съществуващи Теории и/ или Емпирични Резултати
10. Събиране на резултати / информация базирана върху точки 7, 8, 9
11. Първа групова презентация от ученици

Конфигуриране и Резултати (от ученици) – Насоки и оценяване (от учители)

12. Очертайте математически или други STEAME модели за описание/ представяне/ илюстриране на резултатите
13. Проучване на резултатите от т. 9 и извеждане на заключения, като се използва т. 12
14. Приложения в ежедневието – Предложения за развитие на т. 9 (Предприемачество - дни на прилагане на STEAME в живота)

Преглед (от учители)

15. Разгледайте проблема и то при по-взискателни условия

Завършване на проекта (от ученици) – Насоки и оценяване (от учители)

16. Повторете стъпки от 5 до 11 с допълнителни или нови изисквания така както е формулирано в т. 15
17. Проучване – Разглеждане на случаи – Разширяване – Нови теории – Тест на новонаправени заключения
18. Представяне на заключения – Комуникационни тактики.

2.3 Действия и сътрудничество на Ученици и Учители (10 стъпки)

Всеки STEAME проект има кратко описание и схема на организационния ред и отговорности за дейност съобразно някои от следните етапи и активности на ученици и учители;

ЕТАП	**Дейности/ Стъпки** Учители 1 (У1) Сътрудничество с У2 и напътстване на ученика	**Дейности / Стъпки на учениците** Възрастова група: ____	**Дейности/ Стъпки** Учител 2 (У2) Сътрудничество с У1 и напътстване на ученика
A	Подготовка на стъпки 1,2,3		Сътрудничество в стъпка 3
B	Ръководство в стъпка 9	4,5,6,7,8,9,10	Подпомагане в ръководството в стъпка 9
C	Креативно оценяване	11	Креативно оценяване
D	Ръководство	12	Ръководство
E	Ръководство	13 (9+12)	Ръководство
F	Организация - дни на прилагане на STEAME в живота	14 Среща с бизнес представители	Организация - дни на прилагане на STEAME в живота
G	Подготовка на стъпка 15		Сътрудничество в стъпка 15
H	Ръководство	16 (повтаряне 5-11)	Подпомагане в ръководството
I	Ръководство	17	Подпомагане в ръководството
K	Креативно оценяване	18	Креативно оценяване

3. STEAME Планове за учене и креативност

След завършването на образците, STEAME проектния екип, разработи съвместно, прототипен план за учене и креативност, включващ учители в този процес, за тестване и финализиране на план образеца. Това бе основата, като прототип и пример [секция 6.1], за по-нататъшно разработване на STEAME планове за учене и креативност за класове 7-9 [възраст 12-15, виж секция 6.2] и класове 10-12 [възраст 15-18, виж секция 6.3] свързани със STEAME (Наука, Технология, Инженерство, Математика, Предприемачество).

3.1 Прототип на план за учене и креативност

Прототипният план за учене и креативност е свързан с това как можем да създадем "**customized e-shop"** "персонализиран електронен магазин", изучавайки икономическите понятия за цени, приходи и печалби в един бизнес. Състои се от пет дейности за два учебни часа от 90 минути (първи урок), включват анализ и изчисляване на фирмена печалба, анализ на разходите и как тази фирма създава и увеличава своите приходи. Така че, поради всички тези причини, през втория час от 90 минути (втори урок), всяка група ученици проектира и създава персонализиран електронен магазин, като формулира реален проблем. По този начин, те разбират пазарния механизъм в действие.

Прототипният план за учене и креативност за персонализирания електронен магазин е включен като Анекс 9.

3.2 Разработване на планове за учене и креативност за класове 7-9

Проектът STEAME разработи следните 15 Плана за учене и креативност за класове 7-9 (възраст 12-15), свързани със STEAME предмети (Наука, Технология, Инженерство, Математика, Предприемачество), мотивирайки сътрудничеството между учители за постигане на многопредметен подход, чрез осигуряване на нужната информация и ресурси като се използва Образеца за учене и креативност, който е описан в предишни секции на този доклад.

Списъкът на всички тези Планове за учене и креативност е включен като Анекс 10.

3.3 Разработване на планове за учене и креативност за класове 10-12

Проектът STEAME разработи следните 11 Плана за учене и креативност за класове 10-12 (възраст 15-18), свързани със STEAME предмети (Наука, Технология, Инженерство, Математика, Предприемачество), мотивирайки сътрудничеството между учители за постигане на многопредметен подход, чрез осигуряване на нужната информация и ресурси като се използва Образеца за учене и креативност, който е описан в предишни секции на този доклад.

Списъкът на всички тези Планове за учене и креативност е включен като Анекс 10.

3.4 Оценяване на планове за учене и креативност

Като част от този проект, по време на управлението на развитата обучителна дейност на преподаватели, с активното участие на трите училища партньори, участниците представиха в различните обучителни сесии, плановете за учене и креативност разработени по време на проекта, които са налични чрез Обсерваторията на STEAME.

Участниците представиха процеса на оценяване на план за учене и креативност. В замисъла на този проект е да се направлява процеса на оценяване, като в него се включат индивиди извън проектния екип, които да бъдат помолени да действат като оценители. Планове за учене и креативност, разработени по време на С 1 обучението, също бяха оценени, с активното участие на всички участници. Това им позволи да натрупат практически опит с пълния процес на разработване на един План за учене и креативност (дизайн, изпълнение, оценяване, напасване).

Тази дейност по време на обучението позволи на партньорите да си набавят обратна връзка и да усетят процеса като наблюдатели. След обучението, партньорите използваха тази обратна връзка и натрупания опит по време на С1 обучението, за да ревизират своите Планове за учене и креативност.

Дискусията относно оценяването бе свързана с динамичната функция на STEAME Обсерваторията и факта, че всеки учител може да бъде участник и да предаде свой собствен План за учене и креативност, и ако, или когато го приложи в класната стая, придружен с оценка, ще подпомогне STEAME потребителите по-добре да направляват и използват открито достъпните планове.

Оценяването на Плановете за учене и креативност по време на С1 обучението е представено в Анекс 12.

4. Програма за сътрудничество и креативност между училища и предприятия

Важно е училищата да са отворени към обществото. Сътрудничество с изследователски институти и компании може да допринесе за разширяването на ученическите хоризонти, както и за тяхното запознаване с изследователи активисти, свързването им с дейността на изследователски центрове и запознаването им с целите на бизнес субекти. Ученици участващи в училищни групи, които работят с компании и други изследователски организации печелят предимство в:

- Опит в различни сфери,
- Запознаване с проучване и предприемачество чрез експериментален учебен процес,
- Информация за международното образователно общество,
- Информация за международната предприемаческа общност,
- Достъп да ресурси за международната икономика,
- Достъп до инфраструктурата, която съществува в институции и компании,
- Запознаване със социалния аспект на проучването и предприемачеството,
- Осъзнаване на седемнайсетте цели за устойчиво развитие.

По този начин учениците могат да формират едно по-добро виждане за своя бъдещ научен избор още в училищна възраст. Сътрудничеството с преподаватели и ръководни лица в компании, изследователи и учени, както и с управители от сферата на бизнеса и проучването може да има многобройни и многостепенни ползи за тяхното влизане в съвременния икономически свят.

Като част от проекта, един **екип**, започващ прилагането на своя проект, който има за цел да приложи на практика своята идея, ще се сблъска с важни въпроси и дилеми в процеса на взимане на решение. Много пъти взимането на такова решение ще бъде

трудно, тъй като екипът няма да има подходящите знания или опит, необходими за оценяването на цялостната ситуация. По този начин групите ученици със своите учители ще бъдат поканени да си сътрудничат с други изследователи, учени и професионалисти, извън училищната среда, които ще наричаме **ментори**. Менторите са хора, които имат специални знания и опит в своята сфера и в същото време имат желание да предоставят съвет и насоки.

4.1. Правила на STEAME-ID Програма за сътрудничество

Правилата за сътрудничество между училищата и бизнеса са категоризирани както следва:

- Организиране на екипи и правила за сътрудничество
- Цели (срещи, обмяна на идеи, методи, продукти)
- Срещи (обхват, процес на мониторинг и оценка, степен на отдаденост, функционален мениджмънт: споразумение, управление на времето)
- Резултат(и) от проекти и оценяване
- Оповестяване – Разпространяване

Правилата на STEAME-ID формата са представени в Анекс 11.

4.2. Моделът на STEAME-ID програма за сътрудничество

На основата на гореспоменатото можем да създадем нов модел на сътрудничество между училищата и бизнеса (изследователски институти - компании), от който се заражда нов показателен план за действие. Предложеният модел за сътрудничество се разделя на следните **4 главни етапа**:

A. Визия - Мисия- Цел - Задачи - Правила
B. Модел на сътрудничество - Резултати – Оповестяване
C. Развиване на резултатите
D. Оповестяване & Разпространение на резултатите

Всеки етап включва много дейности, като: **Срещи** (за дизайна, разработването, и разпространението на Проекта), **Ресурси, Медии, Инфраструктура** (необходими за прилагането на практика на всеки етап).

Училището и Изследователския Институт – Компания, са части от една екосистема, където много външни фактори имат принос в техния вътрешен „Свят“, като:

- Свят с много **Рамки** (например: Рамки на компетентност, Дигитална компетентност),
- Свят с много **Стандарти** (например: Common Core, ISO),
- Дигитален свят с много **Среди** (e.g. Google Apps), and
- Различни и многообразни социални **Култури и Екосистеми**.

Моделът на STEAME-ID рамката е представен като Анекс 11.

4.3. Валидизиране на STEAME-ID програма за сътрудничество

За приложението на Програмата STEAME-ID има ръководство, което може да бъде използвано като оценителен доклад, който представя списък на стъпки от действия, които трябва да бъдат разработени от училището и бизнеса, които си сътрудничат. Този модел на валидизация се състои от следните четири главни етапа:

- Етап A: Цели - Задачи – Методи - Правила
- Етап B: Дизайн на сътрудничеството – Резултати - Оповестяване
- Етап C: Развиване на резултата
- Етап D: Оповестяване & Разпространение на резултатите

Също така моделът за валидизация включва пет отворени полета за коментар на приложената на практика програма STEAME-ID (според анализ базиран на силни страни, слабости, възможности и опасности):

- СИЛНИ СТРАНИ
- СЛАБОСТИ
- ВЪЗМОЖНОСТИ
- ОПАСНОСТИ
- Допълнително описание/Коментари/Предложения/Промени/Очаквания

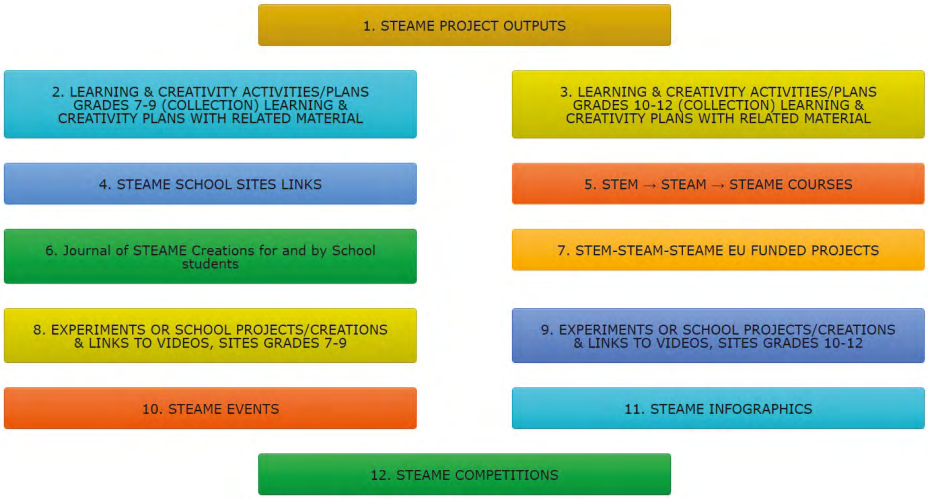
Училищата са поканени да кандидатстват за всички или някои от дейностите по време на пилотен процес за валидизация на това сътрудничество.

Моделът за оценяване на рамката STEAME-ID е представен като Анекс 11.

5. Обсерватория

Обсерваторията е инструмент главно за учители в училище, с който да поддържат динамична и адаптивна програма STEAME в своите училища. Съдържанието се актуализира и разширява непрекъснато, така че всички учители в Европа и извън нея да имат възможността да се осведомяват за новости, а също да могат да публикуват свои собствени работи и материали. Ние ви приканваме да изпращате неща като: Планове за учене и креативност (нови подходи при съставянето на урочни планове), сайта на училището, ако в него има STEAME активности като обучителни курсове свързани със STEAME, Проект финансиран от Европейския съюз, свързан със STEAME, примери за STEAME експерименти или училищни проекти, свързани видеа, проведени или предстоящи събития свързани със STEAME и други бъдещи неща.

В Обсерваторията всеки може да:



- представи План за учене и креативност
- представи описание на експеримент или проект
- представи STEAME училищен сайт
- представи STEAME курс
- представи STEAME проект, финансиран от Европейския Съюз
- представи съобщение за STEAME събитие
- представи информационна графика
- представи съобщения за STEAME състезания

submit point:
https://steame.eu/steame-observatory/

PART A (GREEK)

1. Το STEAME Πλαίσιο των Σχεδίων Μάθησης και Δημιουργικότητας

1.1 Διερεύνηση των υπαρχόντων STEM, STEAM και Project Based Σχεδίων Μαθήματων

Η πρώτη δραστηριότητα αυτών των Οδηγιών, που δημιουργήθηκε από τους εταίρους του Ευρωπαϊκού Έργου STEAME, ήταν να διευρενήσουν περισσότερα από 50 διεθνή (Ευρωπαϊκά και Αμερικάνικα) STEM, STEAM και Project-based σχέδια μαθήματος προκειμένου να μελετήσουν τα στοιχεία και τα χαρακτηριστικά που θα ταίριαζαν καλύτερα στα STEAME Σχέδια Μάθησης και Δημιουργικότητας (L&C plans). Ύστερα από συνεργασία και επικοινωνία μεταξύ των εταίρων επιλέχθηκαν 10 υπάρχοντα STEM, STEAM και Project-based σχέδια μαθήματος και βάσει αυτών οι εταίροι δημιούργησαν ένα συνοπτικό πίνακα με τα σημαντικότερα στοιχεία (οι αναφορές που συνδέονται με αυτά καθώς και ο πίνακας παρουσιάζονται στο Παράρτημα 1) που πρέπει να περιέχει ένα σχέδιο μαθήματος και αφορούν τα παρακάτω:

- Γενικά – Προδιαγραφές – Σύνοψη
- Στόχοι – Μεθοδολογίες
- Προετοιμασία
- Εφαρμογή

Στη συνέχεια, ο υπεύθυνος για το συγκεκριμένο παραδοτέο, συντόνισε την επικοινωνία μεταξύ των εταίρων και τους συμπεριέλαβε στη διαδικασία ανάπτυξης του πρότυπου STEAME Σχεδίου Μαθήματος, δημιουργώντας μια αρχική πρόταση η οποία συζητήθηκε στην ολομέλεια της σύμπραξης και επεξεργάστηκε κάθε μεμονωμένο τμήμα του πρότυπου. Όταν οι εταίροι συμφώνησαν στα επιμέρους στοιχεία του προτύπου, τότε συζητήθηκε ξανά προκειμένου να πάρει την τελική του μορφή όπως παρουσιάζεται στην παρακάτω ενότητα.

1.2 Ανάπτυξη STEAME Σχέδιου Μάθησης και Δημιουργικότητας (L&C Plan)

Το STEAME Σχέδιο Μαθήματος και Δημιουργικότητας (L&C plan), αναπτύχθηκε από το Ευρωπαϊκό έργο STEAME, και στόχος του είναι να δώσει στους εκπαιδευτικούς όλες τις πληροφορίες και τις πηγές που χρειάζονται προκειμένου να εφαρμόσουν ένα STEAME μάθημα. Το L&C plan περιλαμβάνει τις παρακάτω πέντε ενότητες:

A. Επισκόπηση
B. Πλαίσιο STEAME
C. Στόχοι και Μεθοδολογίες
D. Προετοιμασία και Μέσα
E. Εφαρμογή

Ακολουθεί μια σύντομη περιγραφή των προαναφερθέντων πέντε ενοτήτων:

A. Επισκόπηση του L&C plan

Η ενότητα αυτή περιλαμβάνει τις γενικές πληροφορίες του L&C plan, όπως:

- τα σχετικά μαθήματα (S-T-E-A-M-E) και τον τίτλο του έργου STEAME,
- τη βασική ερώτηση ή το θέμα,
- τις ηλικίες και τις βαθμίδες,
- τη διάρκεια, το χρονοδιάγραμμα, τον αριθμό των δραστηριοτήτων και την ευθυγράμμιση του L&C plan με το πρόγραμμα σπουδών,
- μια σύντομή περιγραφή του project και/ή των μαθησιακών δραστηριοτήτων που σχετίζονται με τους στόχους ,
- όσους συνεισφέρουν στο L&C plan, τις πηγές, και τις απαντήσεις.

B. Πλαίσιο STEAME

Αυτή η ενότητα έχει άμεση σχέση με το πλαίσιο STEAME. Περιέχει τις ακόλουθες 3 υπό-ενότητες:

- *Συνεργασία μεταξύ Εκπαιδευτικών*: ο Εκπαιδευτικός 1 συνεργάζεται με τον Εκπαιδευτικό 2 και οργανώνουν την καθοδήγηση των μαθητών.
- *STEAME in Life (SiL) Διοργάνωση*: Συνάντηση με εκπροσώπους από το χώρο της επιχειρηματικότητας, Επιχειρηματικότητα - STEAME in Life (SiL) Μέρες.
- *Διαμόρφωση του Σχεδίου Δράσης*: Αναφορά στα στάδια και τα βήματα του πλαισίου STEAME (Action Plan Formulation).

C. Στόχοι και Μεθοδολογίες

Σε αυτή την ενότητα περιγράφονται οι μαθησιακοί στόχοι και ο σκοπός του σχεδίου μαθήματος, τα μαθησιακά αποτελέσματα, η πρότερη γνώση και τα προ απαιτούμενα από τους μαθητές, το κίνητρο, η μεθοδολογία, οι στρατηγικές κ.λπ. Περιλαμβάνονται οι ακόλουθες 4 υπό-ενότητες.:

- *Μαθησιακοί Στόχοι και Σκοπός*: Ταυτοποίηση των στόχων και σκοπών χρησιμοποιώντας τα κατάλληλα ρήματα που σχετίζονται ή ανταποκρίνονται σε δεξιότητες (γνώση – δεξιότητες – αξίες), που ο μαθητής θα πρέπει να έχει αποκτήσει μετά το project.
- *Μαθησιακά Αποτελέσματα και Αναμενόμενος Αντίκτυπος*: Ορισμός των Μαθησιακών Αποτελεσμάτων με τη χρήση ρημάτων δράσης, αναμενόμενος αντίκτυπος όπως κάθε είδους παραδοτέου ή ‘δημιούργημα’.
- *Πρότερη Γνώση και προ απαιτούμενα*: προηγούμενη εμπειρία, γνώση και δεξιότητες που συμβάλουν στην διεκπεραίωση αυτής της μαθησιακής εμπειρίας.
- *Κίνητρο, Μεθοδολογία, Στρατηγικές, Ικριώματα*: Στρατηγικές διδασκαλίας, προσεγγίσεις, μέθοδοι, και/ή τεχνικές για να επιτευχθούν οι μαθησιακοί στόχοι και τα αποτελέσματα (project-based, inquiry-based, problem-based, παιχνιδοποίηση κ.λπ..), διαφοροποίηση στις οδηγίες ανάλογα με τις ανάγκες των μαθητών (τρόπος εκμάθησης, πολύ-τροπικές παρουσιάσεις, ανάθεση ρόλων στους μαθητές κ.λπ.), εμπλοκή ενεργών μαθητών, ομαδική ή ατομική ενασχόληση μέσα στην τάξη, τεχνικές ικριώματος, κ.λπ.

D. Προετοιμασία και Μέσα

Σε αυτή την ενότητα περιγράφονται η προετοιμασία που πρέπει να γίνει, η διάταξη της τάξης, οι πηγές, τα εργαλεία κ.λπ. Περιλαμβάνει τις 3 ακόλουθες υπό-ενότητες:

- *Προετοιμασία, Διάταξη Τάξης, Συμβουλές Επίλυσης*: Διαδικασίες, χώροι, προετοιμασία υλικού, διάταξη μέσα στην τάξη, εξωτερικές δραστηριότητες, εργαστήριο πληροφορικής κ.λπ.
- *Πηγές, Εργαλεία, Υλικό, Επισυναπτόμενα, Εξοπλισμός*: Εκπαιδευτικές πηγές και ψηφιακό υλικό που σχετίζεται με τις πηγές που χρειάζονται για την υλοποίηση του σχεδίου μαθήματος.
- *Ασφάλεια και Υγεία*

Ε. Εφαρμογή

Η ενότητα αυτή αποτελεί μια ολοκληρωμένη προσέγγιση για την εφαρμογή του L&C plan κατηγοριοποιώντας τις δραστηριότητες της μαθησιακής διαδικασίας, τις μεθόδους αξιολόγησης, της παρουσίασης των αποτελεσμάτων κ.λπ. Περιλαμβάνει 4 υπό-ενότητες:

- *Εκπαιδευτικές Δραστηριότητες, Διαδικασίες, Αναστοχασμός*: Σύντομη και κατανοητή περιγραφή των δημιουργικών δραστηριοτήτων, των εργασιών ή των μαθησιακών εμπειριών (ατομική-ομαδική ή εργασία ολομέλειας). Εμπλοκή και ενεργό συμμετοχή μέσω πρακτικών ασκήσεων. Ανάδραση των μαθητών και αναστοχασμός πάνω στον τρόπο σκέψης, τη διαδικασία ή τη μάθηση. Έλεγχος των γνώσεων που απέκτησαν οι μαθητές και τρόπος υπολογισμού της προόδου τους.
- *Αξιολόγηση*: Διαδικασίες και ρουμπρίκες αξιολόγησης και διαμορφωτικής αξιολόγησης ώστε να μπορεί να υπολογίζεται η ικανότητα του μαθητή να αποδώσει όσα έχουν περιγραφεί στους στόχους.
- *Παρουσίαση - Αναφορά - Διαμοιρασμός*: Έγγραφα, παραδοτέα, δημιουργήματα, προϊόντα παραγόμενα από μαθητές με αναφορές, συνδέσμους κ.λπ. για διαμοιρασμό στα μέσα ενημέρωσης.
- *Προεκτάσεις – Άλλες πληροφορίες*

Ειδικά οι **Μεθοδολογίες**, η **Αξιολόγηση,** και η **Παρουσίαση** ενός STEAME L&C Plan περιγράφονται συνοπτικά στις επόμενες ενότητες (αναλυτικές περιγραφές παρουσιάζονται στο Παράρτημα 2).

1.3 Μεθοδολογίες που υιοθετούνται από το STEAME πλαίσιο (PBL, IBL, PSL)

Στο πλαίσιο STEAME υιοθετούνται οι παρακάτω τρεις μεθοδολογίες:

A. Μέθοδος βασισμένη στο Project (Project-Based Learning - PBL)
B. Μέθοδος της Διερευνητικής Μάθησης (Inquiry-Based Learning - IBL)
C. Μέθοδος Μάθησης Επίλυσης Προβλημάτων (Problem Solving Learning Methodology - PSL)

Οι 3 μεθοδολογίες περιγράφονται συνοπτικά στις παρακάτω παραγράφους (πιο αναλυτικά οι περιγραφές STEAME παρουσιάζονται στα Παραρτήματα 3, 5 και 6):

Μεθόδοι Μάθησης βασισμένοι στο Project (Project-Based Learning Methodology (PBL))

Η Μάθηση βασισμένη στο Project αναγνωρίζεται ευρέως ως η μεθοδολογία μέσω της οποίας οι μαθητές αποκτούν γνώση και δεξιότητες μέσω της συμμετοχής τους, για ένα παρατεταμένο χρονικό διάστημα σε ένα project, ώστε να ανακαλύψουν και να απαντήσουν σε ένα γνήσιο, εντυπωσιακό και περίπλοκο ερώτημα, πρόβλημα ή πρόκληση. Η μεθοδολογία της μάθησης δομείται γύρω από ένα προσεκτικά σχεδιασμένο προϊόν και δραστηριότητες και οι μαθητές επιδεικνύουν τη γνώση και τις δεξιότητες που έχουν αποκομίσει δημιουργώντας ένα διαθέσιμο προϊόν το οποίο παρουσιάζεται σε πραγματικό κοινό. Η ενσωμάτωση της Επιχειρηματικότητας ή της Επιχείρησης στο STEAM που το συμπληρώνει και δημιουργεί το πλαίσιο STEAME, ανταποκρίνεται πλήρως στις απαιτήσεις του PBL και βελτιώνει τις πιθανότητες εφαρμογής τους.

Το κυριότερο χαρακτηριστικό της αξιοπιστίας αυτής της μαθησιακής διαδικασίας και των αποτελεσμάτων της συνδέεται άμεσα με την ανάπτυξη των δεξιοτήτων του 21ου αιώνα τα οποία ενσωματώνουν τη μεθοδολογία PBL στο πλαίσιο του STEM, STEAM και STEAME. Με τα διαθεματικά μαθήματα αναπτύσσονται και κατακτούνται γραμματισμοί που έχουν σχέση με την οικονομία, την υγεία, το περιβάλλον, την πληροφορική και την τεχνολογία, περιλαμβάνοντας και όλες τις παρακάτω δεξιότητες: επικοινωνία και συνεργασία, κριτική σκέψη και επίλυση προβλημάτων, δημιουργικότητα, ανάληψη ευθυνών, κοινωνικές και διαπολιτισμικές δεξιότητες.

Μέθοδος της Διερευνητικής Μάθησης (Inquiry-Based Learning Methodology (IBL))

Το πρώτο βήμα στη Διερευνητική Μάθηση είναι η περιέργεια. Οι μαθητές καθοδηγούν τη μάθηση τους μέσω ερωτήσεων, έχουν το ρόλο του ερωτηθέντα που ανακαλύπτει μόνος του τις απαντήσεις. Ο εκπαιδευτικός είναι ο οργανωτής, ο μέντορας. Ο εκπαιδευτικός είναι εκεί για να επιτηρεί την πρόοδο των μαθητών, να παρέχει δομική υποστήριξη όταν χρειάζεται και να διασφαλίζει ότι το επίκεντρο πρέπει να παραμένει στις ερωτήσεις των μαθητών και τις παρατηρήσεις τους.

Η εκπαίδευση STEAM και η επιχειρηματικότητα συνδέονται όλο και περισσότερο. Αυτό συμβαίνει στο STEAME. Ειδικά η σύνδεση ανάμεσα στις φυσικές επιστήμες και την επιχειρηματικότητα είναι δυνατή. Ένας από τους ακρογωνιαίους λίθους της επιχειρηματικότητας είναι η δημιουργία επιχειρηματικών ιδεών. Μια κοινή μέθοδος της παραγωγής ιδεών για καινούρια προϊόντα και υπηρεσίες είναι ο σχεδιασμός της επίλυσης ενός δοθέντος προβλήματος. Η εύρεση λύσης σε προβλήματα είναι η βάση για κάθε κλάδο του επιστητού. Οι δεξιότητες της εκπαίδευσης STEAM και της επιχειρηματικότητας συμβαδίζουν. Οι δεξιότητες που απαιτούνται για να επιτύχει κάποιος στη STEAM εκπαίδευση όπως η δημιουργικότητα, η επίλυση προβλημάτων, η προνοητικότητα, η προσαρμοστικότητα είναι άμεσα συνυφασμένα με την επιτυχία στον τομέα της επιχειρηματικότητας. Οι εκπαιδευτικοί πρέπει να θυμούνται ποιο είναι το στοιχείο της STEAM εκπαίδευσης που κάνει το μάθημα διασκεδαστικό για τους μαθητές: είναι η επιθυμία να επιλύσουν ένα πρόβλημα. Οι εκπαιδευτικοί πρέπει να δίνουν στους μαθητές τα εργαλεία και τις δεξιότητες που χρειάζονται για να επιλύσουν ένα πρόβλημα και να τους βλέπουν να δουλεύουν μόνοι τους.

Μέθοδος Μάθησης με Επίλυση Προβλημάτων (Problem Solving Learning Methodology (PSL)

Η ‘Επίλυση Προβλημάτων’ είναι η διαδικασία ανάλυσης μιας συγκεκριμένες προβληματικής κατάστασης και η εύρεση λύσης. Η σημασία της μεθοδολογίας είναι η ικανότητα προώθησης του κινήτρου, ενδυνάμωσης της κριτικής σκέψης και ώθησης των μαθητών να χρησιμοποιήσουν καθημερινές δεξιότητες. Ο εκπαιδευτικός λειτουργεί ως οργανωτής. Εξηγεί τον τρόπο με τον οποίο λειτουργεί η επίλυση προβλήματος, καθοδηγεί τις αρχικές αλληλεπιδράσεις, δείχνει τα εργαλεία που αποτελούν τη βάση του κάθε βήματος (π.χ. five W plus H, Root cause analysis and so on), παρουσιάζει ενοποιημένα παραδείγματα και βοηθάει στην αποφυγή των δυσκολιών. Η γνωστική διαδικασία που ακολουθείται συχνά συμβάλλει στη δημιουργική σκέψη. Η επίλυση προβλήματος συμπεριλαμβάνει πέντε σημεία:

- Κατανόηση
- Πρόβλεψη
- Σχεδιασμός
- Ανατροφοδότηση
- Αξιολόγηση

1.4 Αξιολόγηση της εφαρμογής του project

Τα βασικά στοιχεία της αξιολόγησης σχετίζονται με το πόσες περιοχές του STEAME καλύπτονται από το L&C plan, ποιες δεξιότητες αναπτύσσονται στους μαθητές και μέσω ποιας διαδικασίας αυτές αναπτύσσονται/βελτιώνονται από το έργο, συμπεριλαμβανομένων των μεθόδων της διαμορφωτικής αξιολόγησης. Αυτά τα στοιχεία βασίζονται στις ρουμπρίκες οι οποίες βασίστηκαν στην παρακάτω βιβλιογραφία:

- Βιβλιοθήκες περιεχομένου (π.χ. *ReadWriteThink Rubrics*, *Assessment and Rubrics*)
- STE(A)M προσεγγίσεις (e.g. *iRubric: Build, Assess, Share, Collaborate*)
- Επιτόπιες παρατηρήσεις στην τάξη (e.g. *A Practical Guide to Improving Classroom Observations*)
- Project-based προσεγγίσεις (e.g. *BIE-PBLWorks Rubrics* , *The Complete Guide to Student Digital Portfolios*)

Το πλαίσιο της "**Ρουμπρίκας αξιολόγησης του έργου των μαθητών**" περιλαμβάνει τις ακόλουθες 4 κύριες ενότητες:

1. STEAME Μαθήματα (overall performance of respective concepts/discipline/content of K-12 level)
2. Δεξιότητες (γνώση, ικανότητες, αξίες-συμπεριφορές)
3. Διαχείριση έργων, Διαδικασίες Ανάπτυξης και Υλοποίησης
4. Διαμορφωτική Αξιολόγηση (προδιαγράφεται σε κάθε L&C)

Στο Παράρτημα 6 παρουσιάζεται το πρότυπο αξιολόγησης του STEAME.

1.5 Επικοινωνιακές δεξιότητες των STEAME project παραδοτέων από τους μαθητές

Το πλαίσιο δεξιοτήτων STEAME, περιγράφει και παρουσιάζει όλες τις σχετικές περιοχές των δεξιοτήτων που σχετίζονται με το περιεχόμενο της προτεινόμενης προσέγγισης. Ανάμεσα τους, οι επικοινωνιακές δεξιότητες τις οποίες οι μαθητές ενθαρρύνονται να αναπτύξουν και να βελτιώσουν κατά τη διάρκεια της διαδικασίας μάθησης.

Στόχος του έργου STEAME, είναι να το πετύχει αυτό εμπλέκοντας τους μαθητές σε διαδικασίες επικοινωνίας των αποτελεσμάτων των STEAME project τους μέσω δραστηριοτήτων όπως η δημοσίευση τους στην ηλεκτρονική εφημερίδα του STEAME.

Πιο αναλυτικές πληροφορίες για τα στοιχεία της ανάπτυξης επικοινωνιακών δεξιοτήτων του STEAME project δίνονται στα Παραρτήματα 7 και 8.

Οι κύριες ομάδες των δεξιοτήτων επικοινωνίας και παρουσίασης στα οποία εστιάζει το STEAME project, παρουσιάζονται παρακάτω:

Α. Δεξιότητες Επιστημονικής Επικοινωνίας

Το STEAME project, έχει στόχο να εμπλέξει τους μαθητές στην ανάπτυξη δεξιοτήτων επικοινωνίας σε θέματα που αφορούν τομείς του επιστητού και τους ενθαρρύνει να υποβάλλουν το δικό τους άρθρο στην εφημερίδα του STEAME η οποία δημιουργείται από μαθητές και προορίζεται για μαθητές. Η ομάδα του STEAME project δημιούργησε ένα αρχείο με οδηγίες το οποίο απευθύνεται στους συγγραφείς – μαθητές προκειμένου να καθοδηγήσει τις προσπάθειες τους. Οι οδηγίες παρουσιάζονται μέσα σε ένα πρότυπο μαθητικής εργασίας, περιγράφοντας και καθοδηγώντας τους μαθητές βήμα-βήμα προκειμένου να αναπτύξουν κάθε ενότητα. Το πρότυπο το ίδιο, ακολουθεί τις

βασικές αρχές ενός επιστημονικού άρθρου ώστε να εισάγει τους μαθητές στο πως θα περιγράφουν τα επιστημονικά ευρήματα/ δημιουργήματα/ projects με έναν πιο επίσημο τρόπο έκφρασης, αναπτύσσοντας έτσι τις επικοινωνιακές τους δεξιότητες σε θέματα που αφορούν την επιστήμη.

Οι επικοινωνιακές δεξιότητες είναι μια περιοχή μέσα στο πλαίσιο δεξιοτήτων STEAME και δίνοντας στους μαθητές ένα χώρο για να εκφράζονται, μέσω μιας διαδικασίας επιστημονικής επικοινωνίας, έχει στόχο να συσχετίσει δεξιότητες που αφορούν την επιστημονική διάσταση με τις δεξιότητες που αφορούν την επικοινωνία. Ενδεικτικά, οι μαθητές πρέπει να αναλογιστούν πως να επικοινωνήσουν τα ευρήματα τους ακολουθώντας μια συγκεκριμένη ομάδα κανόνων [Publication Manual of the American Psychological Association (6th Edition, 2010)], πως να χρησιμοποιήσουν διαγράμματα και πίνακες, κ.λπ. Οι μαθητές θα πρέπει επίσης να λαμβάνουν ανατροφοδότηση παρόμοια με αυτή που κάποιος θα ανέμενε να λάβει από μια επιστημονική εφημερίδα/ περιοδικό όταν υποβάλλει ένα άρθρο για δημοσίευση.

Β. Δεξιότητες Παρουσίασης

Οι δεξιότητες παρουσίασης είναι οι δεξιότητες που χρειάζονται οι μαθητές για να κάνουν αποτελεσματικές και εντυπωσιακές παρουσιάσεις σε διαφορετικές ομάδες κοινού. Αυτές οι δεξιότητες καλύπτουν διαφορετικές περιοχές όπως η δομή των παρουσιάσεων των μαθητών, ο σχεδιασμός των διαφανειών, ο τόνος της φωνής και η γλώσσα του σώματος μέσω των οποίων εκφράζονται οι μαθητές.

Κατά τη διάρκεια των μαθημάτων, των δραστηριοτήτων και των projects του STEAME καλύπτονται όλα τα βασικά στοιχεία τόσο θεωρητικά όσο και πρακτικά: Επιστήμες, Τεχνολογία, Μηχανική, Τέχνες, Μαθηματικά και Επιχειρηματικότητα. Ο εκπαιδευτής/εκπαιδευτικός έχει ουσιαστικό ρόλο σε αυτή τη διαδικασία. Το πρόγραμμα σπουδών δίνει τις βασικές οδηγίες αλλά σε περίπτωση που δεν εφαρμόζονται μαθήματα STE(A)M(E) τότε μεμονωμένα κάθε εκπαιδευτικός πρέπει να ενθαρρύνει τους μαθητές να δουλεύουν τις παρουσιάσεις τους και τις δεξιότητες επικοινωνίας τους από την αρχή. Σχετίζεται επίσης με την δουλειά των ίδιων των εκπαιδευτικών και τη χρήση των παρουσιάσεων στα μαθήματα/δραστηριότητες τους.

Τα βασικότερα στάδια μιας επιτυχημένης παρουσίασης είναι:

[α] προετοιμασία,
[β] παρουσίαση και
[γ] ανατροφοδότηση

2. Οδηγός για την Ανάπτυξη Σχεδίων Μάθησης και Δημιουργικότητας

Η διαδικασία της ανάπτυξης και της εφαρμογής του STEAME project, γίνεται βάσει ενός σχετικού Σχεδίου Μάθησης και Δημιουργικότητας (Learning & Creativity Plan), στηρίζεται στους ακόλουθους 3 βασικούς STEAME πυλώνες:

2.1 Προετοιμασία από τους Εκπαιδευτικούς (4 Βήματα)

1. Διατύπωση των αρχικών σκέψεων πάνω στους θεματικούς τομείς/περιοχές που θα καλυφθούν
2. Εμπλοκή του κόσμου του ευρύτερου περιβάλλοντος / εργασίας / επιχειρήσεων / γονέων / κοινωνίας / περιβάλλοντος / ηθικών αξιών
3. Ηλικιακή Ομάδα Μαθητών – Συσχετισμός με το Επίσημο Πρόγραμμα Σπουδών - Στοχοθεσία
4. Οργάνωση των δραστηριοτήτων των εμπλεκόμενων ομάδων -Ορισμός του Συντονιστή – Χώροι Εργασίας κ.λπ.

2.2 Σχηματισμός του Σχεδίου Δράσης (18 Βήματα)

Προετοιμασία (από εκπαιδευτικούς)

1. Σχέση με τον Πραγματικό Κόσμο – Αναστοχασμός
2. Ενθάρρυνση – Κίνητρο
3. Ανάλυση του προβλήματος (πιθανώς σε στάδια ή φάσεις) ως αποτέλεσμα των παραπάνω

Ανάπτυξη (από τους μαθητές) – Οδηγίες & Αξιολόγησης (στα 9-11, από τους εκπαιδευτικούς)

4. Δημιουργία Υπόβαθρου – Αναζήτηση / Συγκέντρωση Πληροφοριών
5. Απλοποίηση του προβλήματος – Διαμόρφωση του προβλήματος με ένα περιορισμένο αριθμό προϋποθέσεων
6. Δημιουργία Υποθέσεων - Σχεδιασμός – αναγνώριση των υλικών που είναι απαραίτητα για την κατασκευή / ανάπτυξη / δημιουργία
7. Κατασκευή - Ροή Εργασιών – Υλοποίηση του project
8. Παρατήρηση – Πειραματισμός – Αρχικά Συμπεράσματα
9. Τεκμηρίωση – Αναζήτηση Θεματικών Περιοχών (STEAME περιοχές) που σχετίζονται με το θέμα το οποίο μελετάται – Επεξήγηση βασισμένη στις υπάρχουσες Θεωρίες και/ή τα Εμπειρικά Αποτελέσματα
10. Συγκέντρωση των αποτελεσμάτων / πληροφοριών βάσει των 7, 8, 9
11. Πρώτη ομαδική παρουσίαση από τους μαθητές

Διαμόρφωση & Αποτελέσματα (από μαθητές) – Καθοδήγηση & Αξιολόγηση (από εκπαιδευτικούς)

12. Διαμόρφωση των μαθηματικών ή άλλων STEAME μοντέλων για να περιγραφούν / παρουσιαστούν / αποτυπωθούν τα αποτελέσματα
13. Μελέτη των αποτελεσμάτων στο 9 και εξαγωγή συμπερασμάτων, χρησιμοποιώντας το 12
14. Εφαρμογή στην Καθημερινότητα – Προτάσεις για Ανάπτυξη του 9 (Επιχειρηματικότητας - SIL Days)

Ανασκόπηση (από τους εκπαιδευτικούς)

15. Ανασκόπηση του προβλήματος υπό πιο απαιτητικές καταστάσεις

Ολοκλήρωση του project (από μαθητές) – Οδηγίες & Αξιολόγηση (από εκπαιδευτικούς)

16. Επανάληψη των βημάτων 5 μέχρι 11 με προσθήκες ή καινούριες προϋποθέσεις όπως σχηματίστηκε στο 15
17. Έρευνα -Μελέτη Περιπτώσεων - Διεύρυνση – Νέες Θεωρίες – Έλεγχος των καινούριων συμπερασμάτων
18. Παρουσίαση των Συμπερασμάτων – Τακτικές Επικοινωνίας.

2.3 Ενέργειες και Συνεργασία για Μαθητές και Εκπαιδευτικούς (10 Βήματα)

Κάθε STEAME Project έχει μία σύντομη περιγραφή και μια σύνοψη της οργάνωσης και των δράσεων τόσο για τους μαθητές όσο και για τους εκπαιδευτικούς, σύμφωνα με τα ακόλουθα στάδια και τις δραστηριότητες:

ΣΤΑΔΙΟ	**Δραστηριότητες/Βήματα** Εκπαιδευτικός 1(Τ1) Συνεργασία με Τ2 και καθοδήγηση των μαθητών	**Δραστηριότητες /Βήματα Από τους Μαθητές** Ηλικιακή Ομάδα: ____	**Δραστηριότητες /Βήματα** Εκπαιδευτικός 2 (Τ2) Συνεργασία με Τ1 και καθοδήγηση μαθητών
A	Προετοιμασία των βημάτων 1,2,3		Συνεργασία στο βήμα 3
B	Καθοδήγηση στο βήμα 9	4,5,6,7,8,9,10	Υποστήριξη καθοδήγησης στο βήμα 9
C	Δημιουργική Αξιολόγηση	11	Δημιουργική Αξιολόγηση
D	Καθοδήγηση	12	Καθοδήγηση
E	Καθοδήγηση	13 (9+12)	Καθοδήγηση
F	Οργάνωση STEAME in Life – SIL STEAME στην καθημερινότητα	14 Συνάντηση με εκπροσώπους από τον τομέα των Επιχειρήσεων	Οργάνωση STEAME in Life - SIL STEAME στην καθημερινότητα
G	Προετοιμασία του βήματος 15		Συνεργασία στο βήμα 15
H	Καθοδήγηση	16 (επανάληψη 5-11)	Υποστήριξη Καθοδήγησης
I	Καθοδήγηση	17	Υποστήριξη Καθοδήγησης
K	Δημιουργική Αξιολόγηση	18	Δημιουργική Αξιολόγηση

3. STEAME Σχέδια Μάθησης και Δημιουργικότητας

Προκειμένου να ολοκληρωθεί το πρότυπο, η ομάδα έργου του STEAME, ανέπτυξε συνεργατικά ένα πρότυπο L&C plan, εμπλέκοντας τους εκπαιδευτικούς σε αυτή τη διαδικασία προκειμένου να το ελέγξουν και να το ολοκληρώσουν. Αυτό αποτελεί τη βάση, ως πρότυπο και παράδειγμα [ενότητα 6.1], προκειμένου να αναπτυχθούν περισσότερα L&C plans για τις βαθμίδες 7-9 (ηλικίες 12-15, δες την ενότητα 6.2) και τις βαθμίδες 10-12 (ηλικίες 15-18, δες την ενότητα 6.3) που έχουν σχέση με το STEAME (Επιστήμες, Τεχνολογία, Μηχανική, Μαθηματικά, Επιχειρηματικότητα).

3.1 Πρότυπο Σχέδιο Μάθησης και Δημιουργικότητας

Το πρότυπο L&C plan αφορά τη δημιουργία ενός **'εξατομικευμένου e-shop'** που μελετάει οικονομικές έννοιες όπως τα έξοδα, τα έσοδα και το κέρδος σε μια επιχείρηση. Αποτελείται από πέντε δραστηριότητες για 4 διδακτικές ώρες (45'/διδακτική ώρα). Στις πρώτες δύο διδακτικές ώρες γίνεται η ανάλυση και ο υπολογισμός του κέρδους της επιχείρησης, αναλύονται τα κόστη και με ποιον τρόπο μπορεί η επιχείριση να δημιουργήσει και να αυξήσει τα έσοδα της. Επομένως, έχοντας αποκτήσει όλες τις παραπάνω γνώσεις, στις επόμενες δύο διδακτικές ώρες, κάθε ομάδα μαθητών καλείται να σχεδιάσει και να δημιουργήσει το δικό της εξατομικευμένο e-shop, που αποτελεί ένα πραγματικό

πρόβλημα. Με αυτό τον τρόπο, οι μαθητές αντιλαμβάνονται και κατανοούν τους μηχανισμούς της αγοράς με πρακτική εφαρμογή.

Στο Παράρτημα 9 υπάρχει το πρότυπο L&C Plan για το 'εξατομικευμένο e-shop'.

3.2 Ανάπτυξη Σχεδίων Μάθησης και Δημιουργικότητας για τις Ηλικιακές Βαθμίδες 7-9

Το έργο STEAME ανέπτυξε 15 Σχέδια Μάθησης και Δημιουργικότητας για τις **ηλικιακές βαθμίδες 7-9 [ηλικίες 12-15]**, που σχετίζονται με μαθήματα STEAME (Επιστήμες, Τεχνολογία, Μηχανική, Τέχνες, Μαθηματικά, Επιχειρηματικότητα), ενθαρρύνοντας τη συνεργασία μεταξύ εκπαιδευτικών προκειμένου να πετύχουν μια διεπιστημονική προσέγγιση, δίνοντας τις κατάλληλες πληροφορίες και πηγές μέσω του L&C plan, που περιγράφεται σε προηγούμενες ενότητες σε αυτό έγγραφο.

Η λίστα με όλα τα παραπάνω L&C Plans βρίσκεται στο Παράρτημα 10.

3.3 Ανάπτυξη Σχεδίων Μάθησης και Δημιουργικότητας για τις Ηλικιακές Βαθμίδες 10-12

Το έργο STEAME ανέπτυξε 15 Σχέδια Μάθησης και Δημιουργικότητας για τις **ηλικιακές βαθμίδες 10-12 [ηλικίες 15-18]**, που σχετίζονται με μαθήματα STEAME (Επιστήμες, Τεχνολογία, Μηχανική, Τέχνες, Μαθηματικά, Επιχειρηματικότητα), ενθαρρύνοντας τη συνεργασία μεταξύ εκπαιδευτικών προκειμένου να πετύχουν μια διεπιστημονική προσέγγιση, δίνοντας τις κατάλληλες πληροφορίες και πηγές μέσω του L&C plan, που περιγράφεται σε προηγούμενες ενότητες σε αυτό έγγραφο.

Η λίστα με όλα τα παραπάνω L&C Plans βρίσκονται στο Παράρτημα 10.

3.4 Αξιολόγηση των Σχεδίων Μάθησης και Δημιουργικότητας

Ως μέρος αυτού του παραδοτέου, κατά τη διάρκεια της πιλοτικής εφαρμογής της κατάρτισης εκπαιδευτικών, με την ενεργή συμμετοχή των τριών εταίρων – σχολείων, οι συμμετέχοντες παρουσίασαν τα L&C plans που δημιουργήθηκαν και είναι διαθέσιμα στο **STEAME Observatory.**

Στους συμμετέχοντες παρουσιάστηκε η διαδικασία αξιολόγησης ενός L&C plan. Μέρος του συγκεκριμένου παραδοτέου είναι η πιλοτική εφαρμογή της διαδικασίας εμπλέκοντας άτομα εκτός ομάδας έργου με τη **διαδικασία αξιολόγησης** ζητώντας τους να λάβουν αυτοί το ρόλο του αξιολογητή. Επιπλέον, αξιολογήθηκαν τα L&C plans που αναπτύχθηκαν κατά τη διάρκεια της κατάρτισης C1 με την ενεργό συμμετοχή και εμπλοκή όλων των συμμετεχόντων. Αυτό έδωσε τη δυνατότητα στους συμμετέχοντες να κερδίσουν πρακτική εμπειρία με την ολοκληρωμένη διαδικασία της ανάπτυξης ενός L&C plan (σχεδιασμός, εφαρμογή, αξιολόγηση, προσαρμογή).

Οι εταίροι του έργου, κατά τη διάρκεια της δραστηριότητας αυτής, που ήταν μέρος της κατάρτισης, είχαν την ευκαιρία να παρακολουθήσουν τη διαδικασία ως εξωτερικοί παρατηρητές. Μετά το πέρας της κατάρτισης, οι εταίροι συνέλεξαν την ανατροφοδότηση καθώς και την εμπειρία που κέρδισαν από το C1 προκειμένου να επιμεληθούν τα L&C plans τους.

Η συζήτηση που αφορούσε την αξιολόγηση συνδέθηκε και με το χαρακτηριστικό της δυναμικής του STEAME Observatory και το γεγονός ότι κάθε εκπαιδευτικός μπορεί να συμμετέχει υποβάλλοντας το δικό του L&C plan, ή ακόμα και να εφαρμόζει τα ήδη υπάρχοντα στην τάξη του δίνοντας ανατροφοδότηση στους εταίρους, υποστηρίζοντας τους με αυτό τον τρόπο στο να μπορούν να χειρίζονται καλύτερα τα σχέδια που υπάρχουν και είναι ελεύθερης πρόσβασης.

Η αξιολόγηση των L&C Plans κατά τη διάρκεια του C1 Training παρουσιάζεται στο Παράρτημα 12.

4. Συνεργασία και Δημιουργικό Πρόγραμμα ανάμεσα σε Σχολείο & Βιομηχανία

Είναι βασικό τα σχολεία να είναι ανοιχτά στην κοινωνία. Οι συνεργασίες μεταξύ σχολείων και εταιριών συνεισφέρει στο άνοιγμα του ορίζοντα της σκέψης των μαθητών καθώς και στην εξοικείωση τους με δραστηριότητες έρευνας, αντίστοιχες με αυτές που γίνονται σε ερευνητικά κέντρα ή για τους σκοπούς επιχειρήσεων. Οι μαθητές που συμμετέχουν σε συμπράξεις μεταξύ σχολείων και βιομηχανίας επωφελούνται ως προς τα παρακάτω:

- κερδίζουν εμπειρία σε διάφορους τομείς του επιστητού,
- εξοικειώνονται με την έρευνα και την επιχειρηματικότητα μέσω εμπειρικής διαδικασίας μάθησης,
- ενημερώνονται για τη διεθνή εκπαιδευτική κοινότητα,
- ενημερώνονται για τη διεθνή επιχειρηματική κοινότητα,
- έχουν πρόσβαση σε πηγές ενημέρωσης για τη διεθνή οικονομία,
- έχουν πρόσβαση σε υποδομές ιδρυμάτων και εταιριών,
- εξοικειώνονται με την κοινωνική διάσταση της έρευνας και της επιχειρηματικότητας,
- ενημερώνονται και αντιλαμβάνονται τους 17 Στόχους για Βιώσιμη Ανάπτυξη.

Με αυτό τον τρόπο δίνεται η δυνατότητα στους μαθητές να αποκτήσουν καλύτερη οπτική όσον αφορά τις επιλογές τους στο μέλλον, ήδη από τη σχολική ηλικία. Η συνεργασία εκπαιδευτικών με στελέχη επιχειρήσεων, ερευνητές και επιστήμονες καθώς και managers από τον τομέα των επιχειρήσεων και της έρευνας μπορεί να έχει πολλαπλά και πολύ-επίπεδα πλεονεκτήματα στην είσοδό τους στο σύγχρονο περιβάλλον της οικονομίας.

Ως μέρος του έργου, **μια ομάδα,** η οποία ξεκινάει την εφαρμογή του προγράμματος, με στόχο την εφαρμογή της ιδέας του, θα αντιμετωπίσει σημαντικά διλήμματα και θα τεθούν ερωτήματα τα οποία αφορούν τη διαδικασία, και για τα οποία θα πρέπει οι ίδιοι να λάβουν αποφάσεις. Πολλές φορές η απόφαση αυτή θα είναι δύσκολη καθώς η ομάδα δε θα έχει την απαιτούμενη γνώση και εμπειρία για να αξιολογήσει τη γενική κατάσταση. Για αυτό το λόγο οι ομάδες των μαθητών μαζί με τους εκπαιδευτικούς τους θα προσκαλέσουν ερευνητές, επιστήμονες και επαγγελματίες εκτός σχολείου για να συνεργαστούν. Τους ανθρώπους αυτούς τους ονομάζουμε **μέντορες.** Μέντορες είναι οι άνθρωποι οι οποίοι διαθέτουν την απαραίτητη γνώση και εμπειρία σε ένα τομέα του επιστητού, ενώ ταυτόχρονα είναι πρόθυμοι να παρέχουν συμβουλές και καθοδήγηση.

4.1. Οι κανόνες του STEAME-ID Προγράμματος Συνεργασίας

Οι κανόνες της συνεργασίας ανάμεσα στα σχολεία και τη βιομηχανία κατηγοριοποιούνται όπως φαίνεται παρακάτω:

- Οργάνωση ομάδων και κανόνων συνεργασίας
- Στόχοι (περιεχόμενο των συναντήσεων, ανταλλαγή ιδεών, μέθοδοι, προϊόντα)

- Συναντήσεις (πεδίο, διαδικασία ελέγχου κι αξιολόγησης, επίπεδο δέσμευσης, διαχείριση λειτουργίας: συμφωνία, διαχείριση χρόνου)
- Παραδοτέα και αξιολόγηση
- Επικοινωνία – Διάχυση Αποτελεσμάτων

Οι κανόνες στο πλαίσιο του STEAME-ID παρουσιάζονται στο Παράρτημα 11.

4.2. Το μοντέλο του STEAME-ID Προγράμματος Συνεργασίας

Βάσει των παραπάνω μπορούμε να δημιουργήσουμε ένα νέο μοντέλο συνεργασία ανάμεσα στα σχολεία και τη βιομηχανία (ερευνητικά κέντρα – εταιρίες), από το οποίο προκύπτει ένα ενδεικτικό πλάνο δράσης. Το προτεινόμενο μοντέλο συνεργασίας χωρίζεται στα ακόλουθα **4 κύρια επίπεδα**:

Στάδιο Α. Όραμα- Αποστολή - Σκοπός - Στόχοι - Κανόνες
Στάδιο Β. Σχεδιασμός της Συνεργασίας - Αποτελέσματα – Επικοινωνία
Στάδιο C. Ανάπτυξη των Αποτελεσμάτων
Στάδιο D. Επικοινωνία & Διάχυση των αποτελεσμάτων

Κάθε στάδιο αποτελείται από πολλές δραστηριότητες όπως: **Συναντήσεις** (σχετικά με το σχεδιασμό, την ανάπτυξη και τη διάδοση του έργου), **Πηγές, Μέσα, Υποδομές** (που χρειάζονται για την εφαρμογή του κάθε σταδίου).

Τα Σχολεία καθώς και τα Ερευνητικά Κέντρα και οι Εταιρίες ανήκουν σε ένα οικοσύστημα που επηρεάζονται από πολλούς **εξωτερικούς παράγοντες** οι οποίοι επηρεάζουν την εσωτερική τους λειτουργία όπως:

- μια ποικιλία **Πλαισίων** (π.χ. Πλαίσια Δεξιοτήτων, DigComp),
- μια ποικιλία **Προτύπων** (e.g. Common Core, ISO),
- ένας Ψηφιακός Κόσμος με διαφορετικά **Περιβάλλοντα** (e.g. Google Apps), και
- διαφορετικές και ποικίλες **Κουλτούρες και Οικοσυστήματα**.

Το μοντέλο του πλασίου STEAME-ID παρουσιάζεται στο Παράρτημα 11.

4.3. Η Επικύρωση του STEAME-ID Προγράμματος Συνεργασίας

Για την εφαρμογή του προγράμματος STEAME-ID υπάρχει ένας οδηγός ο οποίος μπορεί να χρησιμοποιηθεί ως αναφορά αξιολόγησης μέσα από μια λίστα ελέγχουν των βημάτων που πρέπει να ακολουθούν τόσο το σχολείο όσο και η βιομηχανία μέσα στη συνεργασία τους. Το πλαίσιο επικύρωσης αποτελείται από 4 κύρια στάδια:

- Στάδιο Α: Σκοπός - Στόχοι – Μέθοδοι - Κανόνες
- Στάδιο Β: Σχεδιασμός της Συνεργασίας - Αποτέλεσμα - Επικοινωνία
- Στάδιο C: Ανάπτυξη των Αποτελεσμάτων
- Στάδιο D: Επικοινωνία & Διάδοση των αποτελεσμάτων

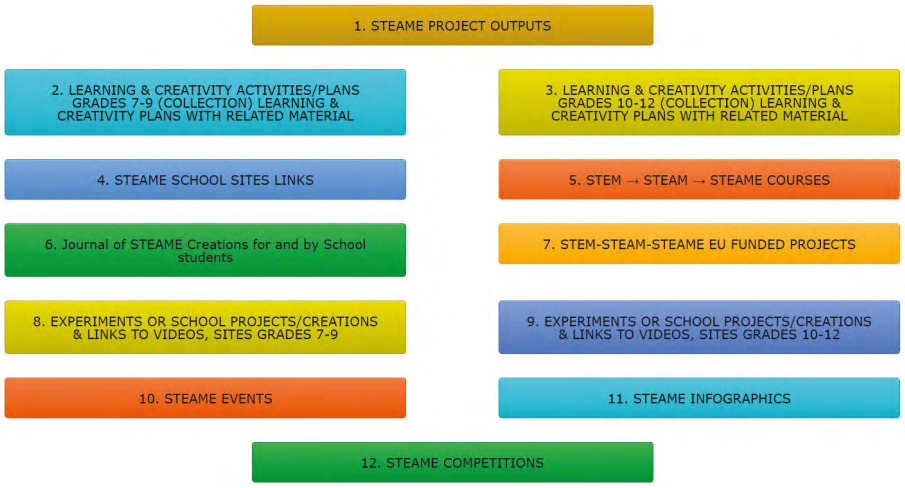
Επιπλέον, η επικύρωση του πλαισίου έχει και 5 πεδία ανοιχτών ερωτήσεων για περαιτέρω σχολιασμό της εφαρμογής του Προγράμματος STEAME-ID (σύμφωνα με μια SWOT ανάλυση):

- ΔΥΝΑΤΟΤΗΤΕΣ
- ΑΔΥΝΑΜΙΕΣ
- ΕΥΚΑΙΡΙΕΣ
- ΑΠΕΙΛΕΣ
- Επιπλέον Περιγραφή/Σχόλια/Προτάσεις/Αλλαγές/Προσδόκιες

Τα σχολεία καλούνται να εφαρμόσουν μέρος ή όλες αυτές τις δραστηριότητες κατά τη διάρκεια της πιλοτικής διαδικασίας της επικύρωσης αυτής της συνεργασίας. Το πλαίσιο αξιολόγησης του STEAME-ID παρουσιάζεται στο Παράρτημα 11.

5. Observatory

Το Observatory είναι ένα εργαλείο που προορίζεται κυρίως για τους εκπαιδευτικούς προκειμένου να υποστηρίξουν ένα δυναμικό και ευπροσάρμοστο πρόγραμμα σπουδών STEAME στα σχολεία τους. Το περιεχόμενο ενημερώνεται και εμπλουτίζεται διαρκώς έτσι ώστε όλοι οι εκπαιδευτικοί στην Ευρώπη και πέρα από αυτή να έχουν τη δυνατότητα να ενημερώνονται αλλά και να δημοσιεύουν τη δική τους δουλειά και το δικό τους υλικό. Καλούμε όλους τους εκπαιδευτικούς να δημοσιεύσουν υλικό όπως για παράδειγμα Σχέδια Μάθησης και Δημιουργικότητας (μια καινούρια προσέγγιση στα σχέδια μαθήματος), το website του σχολείου τους αν αυτό περιέχει δραστηριότητες STEAME, μαθήματα κατάρτισης STEAME, έργα σχετικά με STEAME που συγχρηματοδοτούνται από το Erasmus, παραδείγματα από πειράματα STEAME ή projects στο σχολείο και σχετικά βίντεο, STEAME εκδηλώσεις που έχουν πραγματοποιηθεί ή πρόκειται να γίνουν, ενώ πολύ σύντομα θα υπάρχουν περισσότερες επιλογές. Η δομή του Observatory είναι:



Στο Observatory ο καθένας μπορεί να:

- υποβάλλει ένα L&C plan
- υποβάλλει ένα πείραμα ή περιγραφή έργου
- υποβάλλει το website ενός STEAME σχολείου
- υποβάλλει ένα STEAME μάθημα
- υποβάλλει ένα STEAME Ευρωπαϊκά επιδοτούμενο έργο
- υποβάλλει την ανακοίνωση μιας STEAME εκδήλωσης
- υποβάλλει ένα infographic
- υποβάλλει μια ανακοίνωση για STEAME διαγωνισμούς

submit point:
https://steame.eu/steame-observatory/

PART B: ANNEXES (ENGLISH)

1. Table with L&C Element from existing STEM, STEAM and Project Based Lesson Plans

#	Element-Field	E	F	P	S	T	Y	U	X	L
*	General - Specifications - Synopsis									
1	Title	√	√	√	√	√	√	√	√	√
2	Driving Question, Topic	√	√	√			√			√
3	Grade Level, Age Range, Age Group	√		√		√	√	√	√	√
4	Group Size					√	√			
5	Subject Areas *(min 2 STEAME fields)* Curriculum Alignment and/or 21st century skills	√		√		√	√		√	
6	Duration, Time Frame, Timeline, Calendar	√		√		√	√		√	√
7	Description, Summary, Overview		√	√	√	√	√	√		√
8	Language	√								
9	Public Products			√						√
10	Analytics	√					√			
11	Contributors, Partner Details, Related Program					√	√		√	√
12	Acknowledgements					√				
*	STEAME Framework: - Prototype Model of Teachers Cooperation (18) - Model for Project Work Assessment with Entrepreneurial Criteria - Model for Student Reporting and Presentation (Communication skills)									
*	Objectives - Methodologies									
13	Learning Goals, Objectives	√	√	√		√	√		√	√
14	Learning Outcomes and expected Results		√	√			√			
15	Educational Standards					√				√
16	Prior Knowledge, Prerequisites	√		√		√				
17	Methodology, Motivation, Strategies, Scaffolds	√	√	√	√	√	√		√	√
*	Preparation - Means - Infrastructure									
18	Preparation, Space Setting	√					√			
19	Resources, Tools, Material, Attachments, Equipment	√	√	√		√	√	√	√	√
20	Troubleshooting Tips					√				
21	Safety and Health					√			√	
*	Implementation									
22	Instructional Activities, Procedure, Reflections	√	√	√	√	√	√	√	√	√
23	Extensions - Other Information	√		√		√				√
24	Assessment (Project Based work), Evaluation	√		√	√	√	√		√	√
25	Presentation - Reporting - Sharing (for Students)	√		√		√			√	√

E: EL-STEM_Learning-Plan_Igloo **F:** Full-STEAM-Ahead_Physical Education **P:** PBLWorks_Project-Planner-v2019 **S:** STEAM4U_Allegato-20-amification	**T:** TeachEngineering Bouncing-Balls, Discovering-Phi, Saving-a-Life **Y:** Ypatia_Learning-Plan_Play-Decide **U:** Euro-STEAM_Science-Tasters **X:** Scientix Lesson Plan **L:** Tolerance_Learning-Plan-Builder

2. STEAME L&C Plan Template

S	T	Eng	A	M	Ent
☐	☐	☐	☐	☐	☐

1. Overview

Title			
Driving Question or Topic	*Composition of one or small number of essential questions (or related topics)*		
Ages, Grades, …	*Age selection*	*K-12 grade level selection*	
Duration, Timeline, Activities	*Number of learning hours*	*Timeline/frame, calendar*	*Number of activities*
Curriculum Alignment			
Contributors, Partners			
Abstract - Synopsis	*Brief description of the project and/or learning activities related with objectives (50-100 words)*		
References, Acknowledgements			

2. STEAME Framework*

Teachers' Cooperation	*Teacher 1 cooperation with Teacher 2 and formulation of students' guidance*
STEAME in Life (SiL) Organization	*Meeting with business representatives* *Entrepreneurship - STEAME in Life (SiL) Days*
Action Plan Formulation	*Reference to the Stages and the Steps of the STEAME Framework (Action Plan Formulation)*

3. Objectives and Methodologies

Learning Goals and Objectives	*Identification of goals or objectives using appropriate verbs, related or corresponding to competences (knowledge – skills - values), what learner be able to do after the project*
Learning Outcomes and expected Results	*Definition of Learning Outcomes using action verbs* *Expected results as any kind of deliverables or "artifacts"*
Prior Knowledge and Prerequisites	*Prior experiences, knowledge and skills do the learners bring with them to this learning experience*
Motivation, Methodology, Strategies, Scaffolds	*Teaching strategies, approaches, methods, and/or techniques for achieving learning objectives and outputs (project-based, inquiry-based, problem-solving, gamification etc.)* *Instruction differentiation for students' needs (learning styles, multi-modal representations, roles to students etc.)* *Active students' engagement, individual-team-classroom work, scaffolding techniques, etc.*

4. Preparation and Means

Preparation, Space Setting, *Troubleshooting Tips* Resources, Tools, Material, Attachments, Equipment *Safety and Health*	*Procedures, spaces, and material preparation* *Setting in classroom, outdoor activity, computer lab etc* *Instructional sources and digital material with the related references needed for the implementation of the learning plan*

5. Implementation

Instructional Activities, Procedures, Reflections Assessment - Evaluation Presentation - Reporting - Sharing *Extensions - Other Information*	*Brief and comprehensive description of the creative activities, tasks, or learning experiences (individual-team-classroom working)* *Engagement and active participation through hands-on practices* *Students' feedback and reflection on their thinking, process, or learning.* *Monitoring students' learning and progress measuring* *Assessment and formative evaluation processes and rubrics to measure the student's ability to perform what was described in the objectives* *Documents, outputs, artifacts, products produced by the students with references, web links etc, for sharing to media*

3. Project-Based Learning Methodology (PBL)

S	T	Eng	A	M	Ent
☐	☐	☐	☐	☐	☐

1. Project-based learning - an educational theory

	Project-Based Learning (PBL) is widely recognised as a methodology by which students acquire content knowledge and skills through their involvement for an extended period of time to investigate and respond to an authentic, engaging, and complex question, problem, or challenge. The learning methodology is structured around carefully designed products and tasks and the students demonstrate the knowledge and skills they have gained by creating a public product to be presented to a real audience. The methodology was born from the realisation that traditional teaching methods do not completely account for students' multiple intelligences and learning styles, and more importantly, they make learning more arduous: they often adopt teaching practices that students find boring and do not help them in retaining the information. The idea was to set up a learning system which could combine the acquisition of standard content material with meaningful tasks and activities for students' direct involvement.

2. The project-based design

The elements of project – based design	
	The PBL methodology implies a well-planned, well-organised process to guide teachers in the different steps of the project design:
Learning goals	At the heart of a project are the students' learning goals, which focus on key, significant standard-related knowledge combined with life skills (critical thinking, problem-solving, communication, collaboration), which are to be taught in context.
The driving question or problem	The project evolves around a problem to be solved or a complex question to answer. The question/problem must be meaningful and relevant to the current students' interests and needs and linked directly to the real life. A good question which is provocative and intriguing has the power to motivate the students. Also, it should be challenging and attainable, so as to involve them in the task of finding solutions. Finally, when the question is open-ended, students are led to continuous research and learn to value collaboration and negotiation skills to reach a common goal.
Inquiry and research	The inquiry process is a continuous one throughout the project: the initial question generates in the students research and further questions, the answers to which are found and evaluated, and may lead to further information search.
Link to the real word	An authentic project takes into account the real-world and should be as close to life as possible in all aspects: from the activities and tools employed, to the impact on society and stakeholders and the enhancement of students' needs and aspirations.
Students lead	Project-based learning is not only student-centered, but more importantly, it is student-led, in the sense that learners are free to make choices in relation to the project and make decisions on how to organise their work and the nature of what they produce.
Reflection, Critique & Revision	Throughout the project students and teachers work together to reflect on what they are learning and how they are working, on the quality and effectiveness of their activities, on the difficulties encountered and solutions for solving them, in an attempt to improve both processes and product
The Product	Students'project product must be made public, by explaining, displaying and/or presenting it to audiences beyond the classroom. This way of making the students' learning evident and open to discussion supports students' motivation and accountability and meets the requirements for authenticity, which are the key notes of PBL.

3. Project-based design teaching practices

	While being widely focused on students' taking the lead in their learning process by making choices and adapting their work in the course of the inquiry, PBL obviously considers the 'teaching' as fundamental to the process. Teachers retain traditional prerogatives and practices alongside those strategies aimed at facilitating autonomous learning and guiding students. The role of the teacher must focus on these functions:
Aligning to standards	The preliminary stage of a PBL method requires careful planning and alignment to standards: whether a project is a new creation or an adaptation of an exhisting one, teachers must take into account content standards and the fundamental knowledge of well defined subject areas
Setting the learning goals	By defining the driving question, the learning goals are set and the teachers then plan the implementation of the project, from the kick off event to the final presentation
Implementing	The implementation phase requires teachers to adopt different strategies and pedagogical principles: encouraging the students' autonomous learning, open-ended enquiry and team work. Rather than instructing students on what to do and how to do things, the teacher collaborates with them in the management of activities breaking down tasks, gathering resources, establishing deadlines and creating the product to be publicised.
Scaffolding	The student-centred concern inherent in PBL methodology naturally allows for the implementation of inclusive scaffolding strategies and tools from the part of the teacher to help students of different abilities acquire relevant learning and attain the expected success skills.
Assessment	The formative and summative assessment of student learning is carried out continuously and with different tools and scopes (self-evaluation, team work, peer assessment), but fundamentally aims at obtaining feedback on the learning of content and on the effectiveness of the procedures applied. If necessary, content will be revised and procedures re-directed, to guarantee a successful outcome.
Different roles	In the course of the project development, the role of the teacher will then vary according to the different phases and to the learning needs of students: instructional at the presentation of the project and classroom set up, facilitator during the research phases carried out in a laboratorial set up or field work to promote significant learning. The degree of teacher's guidance in relation to students independent learning will necessarily be adapted to the age level of the students and to the learning goals set.

4. Project-based learning and STEM/STEAM/STEAME methodolody

Projec-based learning is not merely 'doing a project'	The Project- based learning methodology must not be confused with the less structured idea of 'doing a project'. In a traditional teaching-learning context students are usually told what they need to know, they memorise the information and the problem may be assigned to demonstrate how to use the information received. In this way small scale projects can be assigned at the end of a traditional teching unit as a round up and consolidation of what has been learnt in the unit. Therefore, these projects are teacher-directed and focus on the product, which will be submitted to the teacher for evaluation; the students will work alone on activities which may not have implications with real-world issues. In PBL the process is reversed: a problem is assigned, teachers and students identify what they need to know, they learn and apply it to solve the problem. The methodology is student-driven, the project is the structured unit during which real learning occurs, in terms of acquired knowledge and skills; it develops under the teacher or teachers guidance and implies collaboration and sharing between students. As the goal is not the creation of a pre-defined product, but an outcome which can be determined by the students' choices as the project develops, the method is focused on the process, not on the product, which allows the real learning. The outcome of the project acquires authenticity in relation to the real-world connections from which it derives and to which it is addressed and presented, not to the teacher but to an authentic audience or public.

PBL and STEM /STEAM education	The Project-Based methodology is strictly linked to STEM education because these two educational philosophies have complementary qualities, and PBL offers the framework on which STEM education can be structured. They both combine rigorous learning and problem solving skills. Their common purpose is to prepare students for life after school and more specifically to equip them with the skills they need in the world of work, whatever career they may choose. Another key aspect is the interdisciplinary approach and the integration of disciplines: PBL may evolve around several content areas and this fits STEM perfectly, ever more so in STEAM, which includes language arts to intergrate scientific and technological subjects for the benefit of enhancing literacy knowledge and skills. The aim of both educational frameworks is based on the assumption that students need to be able to connect the various aspects of their learning, be aware that real-world problems are necessarily interconnected and be able to research, delineate and evaluate arguments and information through reasoning.. The integration of Entrepreneurship or Enterprise in STEAM to complement it and create the STEAME framework, fully responds to the requirements of PBL and enhances the possiblities of application:
PBL and STEAME education	-Entrepreneurship or economiy–related contents will be specifically targeted and assessed and students can learn about finance, business and marketing, and get an insight into career options. Students voice and choice will allow them to shape their own learning with projections to their future life. -Entrepreneurship also engages students in the developemnt of a wide range of skills simultaneously, problem-solving, decision making, critical thinking, communication, innovation and team work, which match those sought by companies in the world of work. -Students will create products to demonstrate mastery of content standards and the acquisition of success skills. If projects are addressed to real corporations, they are authentic . Authenticity is further brought in by the fact that entrepreneurial-based projects start from real community needs and reach out into it, connecting to local companies and policy-makers. The strong feature based on the authenticity of the learning processes and of the outcomes is strongly linked to the development of 21st century skills which integrates PBL methodology to STEM/STEAM and STEAME frameworks. Financial, health, environmental, information and technological literacies are developed and acquired alongside more cross-curricular literacies encompassing all subjects: communication and collaboration, critical thinking and problem solving, creativity, responsibility, social and cross-cultural skills.
Acknowledgements:	https://www.pblworks.org/what-is-pbl https://www.edutopia.org/blog/pbl-and-steam-natural-fit-andrew-miller https://www.schooloutfitters.com/article/entrepreneurship-in-project-based-learning

4. Inquiry-Based Learning Methodology (IBL)

S	T	Eng	A	M	Ent
☐	☐	☐	☐	☐	☐

1. Inquiry-based learning

The methodology	
	The first step into inquiry-based learning is curiosity. Students drive their learning through questions; they have the role of inquirers who discover the answers on their own. The enquiry cycle is a never-ending process whose steps are: - *Ask* questions arisen out of experience - *Research* and *investigate* using diverse, authentic and challenging materials - *Create* - *Present* and *discuss* through dialogue - *Reflect* that implies expressing experience
The role of the teacher	The teacher is a facilitator, a mentor; he is there to monitor students' progress, provide structural support when needed and ensures that the focus remains on students' questions and observations.
The role of the student	The student is the protagonist of his learning process, he builds his knowledge through exploration, experience and discussion. He is no longer passive, but he is the owner of his learning experience. Inquiry-based learning gives him the opportunity to take a hands-on approach in his learning, and even into his future career.

2. Inquiry-based STEM/STEAM learning

Features	Inquiry-based STEAM learning focuses on hands-on experiences and creative ways to solve problems. It mirrors the processes and thinking that scientists, engineers, artists, mathematicians and innovators use in the real world and it's so much more than merely hands-on learning. Consequently inquiry-based science has not to be confused with 'hands-on' science because the former is more than this. Inquiry-based science employs the diverse practices scientists use to study the natural world. It is appropriate for all ages of learners and effectively teaches science content while developing scientific habits of mind at the same time. An inquiry-based STEAM classroom combines the learning of terminology and content with active processes. Inquiry-based science adopts an investigative approach to teaching and learning where students are provided with opportunities to investigate a problem, search for possible solutions, make observations, ask questions, test out ideas, and think creatively and use their intuition.
How teachers can get started with inquiry-based STEM/STEAM learning	Although creating inquiry-based STEAM or STEM lessons may seem challenging, teachers have to take it one step at a time. They have to start with a topic that they know will interest their students. They have to consider what STEAM subject will generate a range of questions, ideas and problems for their learners. Once they have a topic in mind, they have to write down what they want their students to explore, observe, experiment with, analyze, and refine. Then it's important to imagine the students at the end of this inquiry-based STEAM lesson or unit and make a list of the learning outcomes they want them to achieve through independent and group exploration (with a little guidance).

3. Inquiry-based STEAME learning

From inquiry-based STEAM to STEAME learning Suggestions for teachers teaching STEAME	STEAM education and entrepreneurship are getting more and more closely linked than ever before. This happens in STEAME. Especially the connection between science and entrepreneurship is strong. One of the cornerstones of entrepreneurship is business idea generation. One common method of idea generation for new products or services is to design a solution to a given problem. Finding solutions to problems is a foundation of every field of science. STEAM education and entrepreneurship skills go hand-in-hand. The competencies required to succeed in STEAM such as creativity, problem-solving, foresight, adaptability, are equally suited for success as an entrepreneur. Teachers must bear in mind what makes STEAME so enjoyable for many students: the desire to solve a problem. Teachers should give students the tools and skills they need to solve a problem and watch them work it out on their own. STEAME teaches **actionable skills** to students, that is: - Adaptability and flexibility: Keeping an open mind is fundamental to success in both STEAM education and entrepreneurship. - Persistence: persistence and dedication are absolutely necessary to succeed. STEAME careers are notorious for tasking workers with problems that require a lot of elbow grease to solve. - Data Above Everything: Entrepreneurship requires vision, but also requires a firm understanding of practical realities. STEAM emphasizes data-driven decision-making and successful STEAM professionals base their decisions on hard facts. - Creativity: The most successful people in history (Bill Gates, Steve Jobs) had the foresight and creativity to imagine solutions to problems that didn't even exist yet! That's the sort of forward thinking teachers need to stress to their students. - Teamwork: The best solutions to problems are found when working in teams. STEAME education also provides **practical skills** for students to succeed: how to think, not what to think.
Acknowledgement:	https://resilienteducator.com/classroom-resources/steam-inquiry-based-learning/#:~:text=When%20a%20topic%20triggers%20curiosity,every%20step%20of%20the%20way. https://everfi.com/blog/k-12/stem-education-and-entrepreneurship-5-big-skills-that-overlap/

5. Problem Solving Learning Methodology (PSL)

S	T	Eng	A	M	Ent
☐	☐	☐	☐	☐	☐

1. Problem solving

The methodology	
	The 'problem solving' is the process to analyze a specific problematic situation and find a solution. The importance of this methodology is the ability to promote motivation, empower critical thinking and push the students to utilize everyday life skills. The cognitive process often drives to finding "out of the box" solution. The problem solving encompasses five moments: - *Comprehension:* the student faces up the problem, understands the different elements and asks himself/herself if he/she has previously seen something similar (compares the current situation with others seen) - *Prediction:* the student starts with the reasoning and finds out the needs, estimates the timing and the useful tools. - *Planning:* the student lists the known data, establishes the knowledge and the research field. - *Follow up:* the student tracks the progress of the process, checking the target, and changing the approach if it doesn't meet the expectations, and he/she asks for help if needed, or underlines achieved results. - *Evaluation:* at the end, when there is the solution, the student verifies that the timing was correct, if he/she adopted the right process, if mistakes have been made and how it's possible to improve.
The role of the teacher	The teacher acts as facilitator. He/she explains how the problem solving works, leads the first interactions, shows the tools that are at the basis of each step (e.g. five W plus H, Root cause analysis and so on), illustrates consolidated examples, and helps to avoid the pitfalls.
The role of the student	The student is at the center of his learning process. He/she approaches the problem, he understands the different components/problematics; he evaluates the variables, he estimates the timing and the resources; he defines the known data and the know-how; he verifies the solutions and the change of approach, the mistakes.

2. Problem solving in STEM/STEAM

Features	The 'problem solving' is a powerful method that requires a specific learning process. One of the specific features of problem solving is that it is continuously built upon previously acquired competences and rules. New situations can be approached through the already consolidated expertise and each time a new one can be learnt, effectively expanding the competences of the student. The problematic situation has to present some new aspects, not seen in previous scenarios. In a problematic situation the individual recalls memories or principles that allows him to find the right answer. There are different ways to outline the problem solving procedure, one of the most used is based on the five Ws and H: - *Who:* who is the target? - *What:* what should be done? (the project) - *Where*: where would action be required? - *When:* when does it have to be done? - *Why:* why should it be done? - *How:* how should it be run?

How teachers can get started with problem solving STEM/STEAM learning	The problem solving STEAM learning process uses real life examples. The teacher helps to learn skills that can be used in different contests: science, technology, engineering, arts and mathematics. The tutor encourages independence, providing assistance only when it is really necessary. He/she gives explanations and examples using real life. A STEM/STEAM class is empowered when students can see how their skills can be applied for practical applications. The answers, the research of solutions to a specific problem nourishes the productive thinking, the intellectual creativity, and gives the knowledge process the feature of coordination. The learning process becomes part of the students who become curious.

3. Problem solving in STEAME

From problem solving in STEAM to STEAME	Modern educational theories aim at an integration between different previously considered and studied separately as entities on their own: Science, Technology, Engineering, Arts and Mathematics. Teachers have tried to integrate these areas to solve real life problems. Lately a new field is taking the stage idea: Entrepreneurship. This is a new field of education that is gaining attention. It's growing fast. This technique finds fertile ground above all in entrepreneurship where managers are trained to use it in the everyday environment. Its wide range of tools is perfectly suited to be used in real life situations. Their best value springs from the fact that they develop a critical thinking, creative approach while, at the same time, they boost the data driven approach.
Risks	It is known that the environment, the setting, and relationship help the learning process. In order to obtain the maximum benefits from this approach, as many others, the teacher should pay attention to certain dynamics that allow students to learn. There are some dangers to avoid: - Lack of confidence from the student: in this case the student may tend to be dependent on the teacher. - Fear of making mistakes: every teacher should reassure the student and highlight the formative value of the error. - The presence of strong perceptive structures diminishes the possibility to see under a different perspective (a student doesn't recognize the form of trapezoid only because he/she has always seen it drawn in a different way). - Considering some events 'not important': this may limit creative thinking. - Functional fixedness: using always an object or the same task prevents the student from seeing it for another use - Need of a certain quantity of time to be completed: plan correctly the timing.
Suggestions for teachers teaching STEAME	Teachers must remember that this approach is not a simple exercise, it doesn't remain an abstract skill. Students want to solve real problems, but they have to be patient and consistent with their method. The educator should: - model a useful problem-solving method according to the subject involved - teach within a specific context - help students understand the problem - take enough time - ask questions and make suggestions - link errors to misconceptions

Acknowledgements:

https://cft.vanderbilt.edu/guides-sub-pages/problem-solving/
https://uwaterloo.ca/centre-for-teaching-excellence/teaching-resources/teaching-tips/developing-assignments/cross-discipline-skills/teaching-problem-solving-skills

6. Evaluation Rubrics for STEAME Projects

1. STEAME Subjects *(overall performance of respective concepts/discipline/content of K-12 level)*					
	0 - N/A	1 - basic/beginning	2 - developing	3 - advanced	
Science ☐	Technology ☐	Engineer ☐	Arts ☐	Mathematics ☐	Entrepreneurship ☐

2. Competences *(knowledge, skills, values-attitudes)*				
	basic/beginning	emerging/developing	accomplished/strong	exemplary
creativity, innovation	-selects one idea without supporting the creativity aspects of this idea -reproduces existing ideas	-develops & evaluates some original ideas for product(s) -demonstrates imagination within conventional boundaries	-uses generating techniques to develop several original ideas -carefully evaluates ideas and selects the best one to shape into a product	-takes different perspectives to improve selected ideas -uses imagination, going outside boundaries to shape into a product
critical thinking	-accepts arguments for possible answers to the questions without valid reasoning	-recognizes the need for valid reasoning and strong evidence, but does not evaluate it carefully	-evaluates arguments for answers to questions by assessing whether reasoning is valid and evidence is relevant	-justifies choice of answers used to evaluate ideas -product prototypes or problem solutions, with personal criteria
collaboration	-does not help the team or give feedback -does not ask probing questions, express -ideas	-cooperates & gives feedback but not actively -sometimes expresses ideas clearly	-helps the team solve problems & gives useful feedback -makes discussions effective by clearly expressing ideas	-collaborates with exemplary motivation asking probing questions, making sure everyone is heard -responds thoughtfully to new information & perspectives
communication, oral/written language	-uses limited vocabulary -makes many grammatical errors -does not use formal language & structures	-uses adequate vocabulary -makes various grammatical errors -uses appropriate language & some structures	-uses satisfactory vocabulary -makes few grammatical errors -uses precise language and satisfactory structures	-uses vivid vocabulary -makes no grammatical errors -uses accurate language & unique structures
digital skills	-searches, organizes, processes information in a limited way	-searches, organizes, processes information adequately to produce poor digital content	-searches, organizes, processes information in a satisfactory way to produce digital content	-searches, organizes, processes information in a systematic way to produce digital content
presentation skills	-focuses on one presentation tool -information presented shows some inaccuracies -presentation is read -presenter shows limited engagement in own presentation there is no contact to the audience	-uses limited number of presentation tools -presented information is correct but the ordering can be improved -most presentation is read -usage of the body language is limited -there is little involvement of the audience	-uses various tools and techniques to present information -information is correct and well organized -presentation process reveals more information than the presentation alone -critical points are flagged appropriately -there is some interaction with the audience	-uses diverse tools to attract attention and passes information, including: -appropriate body language; -emphasizes well key ideas and turning points -visual aids are adequate and presented in a transparent way -there is appropriate level of interaction with the audience
social and emotional competences	-consistently ignores the expected behavior -does not respect others -unable to cope with new situations and challenges	-sometimes ignores the expected behavior -respect others -copes with new situations & challenges with support	-usually behaves appropriately -respects others -participates in new situations and challenges with minimal support;	-consistently behaves appropriately -respects others -independently accepts new situations & challenges

3. Project Management, Development and Realisation Processes				
	basic/beginning	emerging/developing	accomplished/strong	exemplary
goal achievement, motivation	- achieves no or weak goal setting and motivation	- partially achieves the objectives without particularly obvious motivation	- is responsible for taking action toward goal achievement and has strong motivation	- fully achieves his/her goals with exemplary motivation
project plan and timeline	- implements & realizes his/her project plan in a limited way and is not consistent with the original plan & timeline	- implements & realizes his/her project plan which is marginally accepted with the original plan & timeline	- implements well his/her project plan that is acceptable with the original plan & timeline	- fully implements his/her project plan which is in line with the original plan & timeline
project-based process	- just "follows directions" without understanding the purpose and connection with the driving question and sub-questions - cannot see/find/develop the connections/relations between the steps and the content involved	- understands the purpose in a limited way and connection between the sub-questions of the driving question - can see/find/develop some of the connections/relations between the steps and the content involved	- works actively to fulfil all the parts of the purpose of the project that are related to the sub-questions of the driving question - finds/develops all the connections between the steps, the field investigation and the content involved	- promotes and supports the purpose of the project product explaining adequately all related questions - explains clearly and accurately the steps, the content and the process of the project's implementation
inquiry-based process	- does not ask questions - rarely provides useful research, investigations and reflection	- doesn't ask enough questions - sometimes provides useful research, investigations and reflection - shares ideas	- asks questions arising from external sources - provides useful research, investigation and reflection, using diverse materials - shares useful ideas	- asks questions arising from experience - research/investigates using authentic/challenging materials - shares, reflects and rethinks useful ideas
problem-based process	- starts solving the problems before thinking about them - does not identify any information - does not use appropriate methodologies and tools	- starts solving the problems before thinking about them - needs reminders about analyzing information - uses some methodologies and tools	- identifies hypotheses and some information needed - analyzes some of the characteristics of a problem - uses some methodologies and tools to solve the problems	- identifies hypotheses and all information needed - analyzes all the characteristics of a problem - uses different methodologies and tools to solve the problems
resources, references	- does not use appropriate resources and references or uses resources not related to the project	- uses some appropriate resources available, not at correct level (i.e., valid and up-to-date)	- uses appropriate resources generally available at correct level, with appropriate tools	- uses appropriate resources always available at multiple levels, with appropriate tools
construction, artifacts, production outputs	- presents a limited or partial output of the development process - creates artifacts with little or slight connection to the goals	- presents an adequate and acceptable output of the development process - creates artifacts that contribute to a certain extent to the goals	- presents a substantial and satisfactory output of the development process - creates artifacts that provide evidence to the goals	- presents a detailed and exceptional output of the development process - artifacts that provide robust evidence to the goals
Entrepreneurship *(last "E" of STEAME)*	- develops limited or partial junior business ideas and concepts for starting new business	- develops an adequate junior business ideas with the main categories with information	- presents detailed junior business model and prepares financial forecast. - generates innovative ideas	- develops detailed and exceptionnal junior business model - ability to provide a plan for prototypes with innovative ideas.

4. Formative Assessment (specified at each L&C)				
	D - limited/poor	C - adequate/good	B - substantial/great	A - detailed/excellent
Teacher - Activity x	e.g. Score 0-30%	e.g. Score 30-60%	e.g. Score 60-80%	e.g. Score 80-100%
Self - Group*	e.g. Score 0-30%	e.g. Score 30-60%	e.g. Score 60-80%	e.g. Score 80-100%
Self - Student*	e.g. Score 0-30%	e.g. Score 30-60%	e.g. Score 60-80%	e.g. Score 80-100%

Note 1: This is a teacher-based evaluation for each student or group, but in some cases, could also be a self or group-based evaluation. Also, each group could assess all the other groups through specified criteria (and a small contest can be held with a prize for the small contest winner.

*Note 2: Four stages of the "**Components of Assessment in PPL**" (Peer Project Learning) for a Final Grade: Reading Assurance Quiz – Project – Final Exam – End Chapter Quiz*

Main Sources:

- *BIE-PBLWorks Rubrics*
- *The Complete Guide to Student Digital Portfolios*
- *Assessment and Rubrics*
- *ReadWriteThink Rubrics*
- *iRubric: Build, Assess, Share, Collaborate*
- *Better Feedback for Better Teaching: A Practical Guide to Improving Classroom Observations*

7. Journal for STEAME Creations for and by School Students (Science Skills)

Template Guidelines for School Student Authors

First A. Author, *Student's School/ Institution, Country,* Second B. Author, *Supervisor Teacher's School/Institution, Country,* and Third C. Author, *Student's School, Country*

Abstract - These instructions are guidelines for preparing papers when submitting to the STEAME electronic Journal. You can use this document as an instruction template. The title of the paper should be written in uppercase and lowercase letters, not all uppercase, font size should be 14, bold, preferable font style is "Times New Roman". Titles of sessions should be in size 12, bold, no underline, no uppercase. In the author field you can provide full names or first name initials and then Surname. All authors names must have the same format. A space between authors' initials is required. After the Title and the Author field you should write an abstract to provide a concise and comprehensive summary of the topic you are presenting in your article. Abstract Heading font style should be italic, bold and size 11. The abstract must be strictly between 100–250 words, font style bold and size 11.

Key Words - Three to ten key words or short phrases should be provided in alphabetical order giving information about the science or arts fields involved in the manuscript. Key words font style should be italic, bold and size 11.

I. Introduction

Two to three levels of subheadings, clearly distinguished, may be used. The manuscript should start with a brief introduction describing the paper's significance. The introduction should provide enough background information to make the article intelligible to readers in other disciplines, and sufficient context that the significance of the project/experimental findings is clear. Technical terms should be defined. Symbols, abbreviations, and acronyms should be defined the first time they are used. If you are reading a PDF version of this document, you can download the file Author_Guidelines_for_STEAME_Journal.docx from the STEAME official website and use it as template to prepare your paper.

II. Manuscript preparation Guidelines

The language of the Journal is English. The manuscripts should conform to the conventions specified in the Publication Manual of the American Psychological Association (6th Edition, 2010). They should be written on A4 size page, leaving left-right and top-bottom margins at 2.54 cm ("Normal Style"). Please single-space all material, including references. Manuscripts most acceptable length is 5-15 written pages or between 1500 and 4000 words. Pages should be numbered consecutively, and the first page should contain the following information:

Names of School Student Authors, School/Institution, Full address for correspondence, including telephone and e-mail address. Name of supervisor teachers(s), if any, specify teacher next to the name. The Journal has adopted an open reviewing policy. The reviewers will remain anonymous.

A. Manuscript submission

For the purpose of reviewing, articles should be send to the STEAME Journal's Editor in Chief in an electronic version, both PDF and word format in the following e-mail address journal@cms.org.cy, with indication in the email message subject "STEAME Journal manuscript submission".

Figures and Tables

All figures and tables must be embedded in the paper, following the instructions included in this session.

i. Tables and Figures should be referenced within the text and numbered individually in the order of their citation in the text.
ii. A brief descriptive title should be displayed at the top of the table area, following the table number (e.g. Table I: ...) and at at the bottom of the figure area, following the figure number (e.g. Fig. 1: …). See examples below. Capitalize the first letter in a label only, not every word.
iii. Units should be included in parentheses, e.g., Pressure (MPa), Temperature (K), SI notation.
iv. Variables are always set in *italics* or as plain Greek letters (e.g., *P*, *T*, m). The rest of the text in the figure should be plain or bold text.

Table 1
Fundamental Quantities in the International System of Units

S.I. Unit	
Name	**Symbol**
kilogram	kg
kelvin	K
second	s
ampere	A
mole	mol

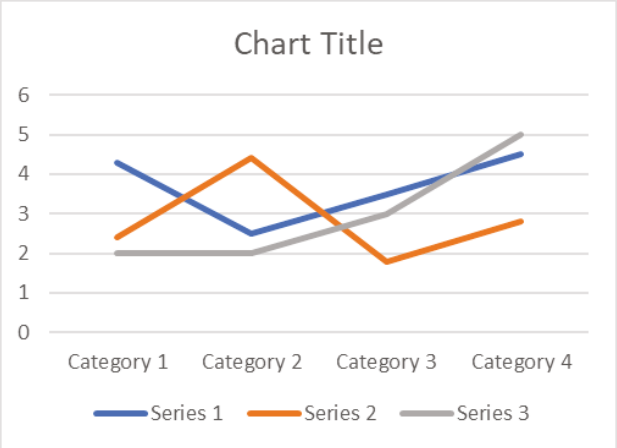


Fig.1 Category sample chart

III. Processing of Manuscripts

After the receipt of the manuscript, the Editor-in-Chief examines whether it falls within the journal's domain and complies with its style requirements. If it does not fall in the journal's domain, the Editor-in-Chief returns the manuscript to the author suggesting re-submission. If the manuscript falls in the journal's domain but does not comply with the journal's style requirement, it is returned to the author before the reviewing process continuous suggesting correction.

If the manuscript is considered appropriate, the Editor-in-Chief notifies the author and sends it to at least two reviewers. The reviewers are chosen based on their expertise on the subject. When the reviewers complete their reviews, the Editor-in-Chief informs the lead author whether the paper:

a. Has been accepted.
b. Needs some substantial revision and will be re-evaluated by the reviewers.
c. Has been rejected.

The Editor-in-Chief will also forward the reviewers' evaluations to the author. If the manuscript is accepted a final version of the paper will be requested.

B. Final submission of manuscripts

Once the manuscript has been accepted, the author should submit the final version of the manuscript. Please note the following:

a. Manuscripts should be submitted in both Microsoft Word and PDF
b. The file should follow the general instructions on style.
c. The file should use the wrap-around end-of-line feature (i.e. no returns at the end of each line). All textual elements should begin flush left, no paragraph indents. Place two returns after every element such as title, headings, paragraphs, figure and table.
d. Electronic Proofs are sent to the first-named lead author.

C. Copyright

Once the paper is been accepted authors will be asked to transfer copyright of the article to the Publisher: Cyprus Mathematical Society for STEAME project. Additional Information can be obtained from the Editor–in-Chief, Prof. Gregoris Makrides, President-Cyprus Mathematical Society, greg@thalescyprus.com. In case your research is supported by any kind of funding, include acknowledgment and details at the end of the first page in font style size 10.

IV. CONCLUSION

A conclusion session can be included in your paper. Do not replicate the abstract, describe the importance of your manuscript and mention possible future research.

REFERENCES

References should be numbered in the order in which they are cited. See ***Science*** **Citation Style** below for details of citation style. Links to external pictures or videos are possible assuming the video has ownership of the authors and all GDPR requirements are met. In-text reference style should be IEEE (2006), as shown in the examples at end of this sentence for journals and books [1] [2].

Examples from Science Citation Style:

Journals

[1] N. Tang, "On the equilibrium partial pressures of nitric acid and ammonia in the atmosphere," *Atmos, Environ,* vol. 14, pp. 819-834, 1980.

Books

[2] M. Lister, Fundamentals of Operating Systems, New York: Springer, 1984.

Additional reference examples:

Technical reports

[3] G. B. Shaw, "Practical uses of litmus paper in Möbius strips" (Tech. Rep. CUCS-29-82, Columbia Univ., 1982).

Conference proceedings (unpublished)

[4] M. Konishi, paper presented at the 14th Annual Meeting of the Society for Neuroscience, Anaheim, CA, 10 October 1984.

Theses

[5] B. Smith, thesis, Georgetown University (1973).

Electronic publication before print

[6] W. Jones, B. Smith, [Article title goes here]. *Science* 10.1126/science.1054678 (2005). [published in *Science* First Release; not yet published in print]

Other online publication

[7] E. M. Pietras, G. Cheng, A new TRADDition in intracellular antiviral signaling. *Sci. Signal.* **1**, pe36 (2008). [*Science Signaling*]

Preprints

[9] A. Smette *et al*., **http://xxx.lanl.gov/abs/astro-ph/0012193** (2001).

Article on a website

[10] Author Initial. Author Surname, 'Title', Year Published. [Online]. Available: http://Website URL. [Accessed: 10- Oct- 2013].

Example:

[10] Emarketer.com, 'Social Networking Reaches Nearly One in Four Around the World', 2014. [Online]. Available: http://www.emarketer.com/Article/Social-Networking-Reaches-Nearly-One-Four-Around-World/1009976. [Accessed: 23- Jun- 2014].

Teacher lecture notes

[11] Naughton, S 2018, Seminar 7: Transforming organisations: strategy, structure & design, lecture

8. Elements for Developing Presentation Skills

Introduction

The main objective of this document is to outline the elements, requirements and criteria for successful development of presentation skills of students who work and participate in STEAME projects.

Presentation skills are the skills students need in delivering effective and engaging presentations to a variety of audiences. These skills cover a variety of areas such as the structure of students' presentations, the design of their slides, the tone of the voice and the body language students convey.

During the classes, activities and projects of STEAME all key aspects in terms of theory and practice are covered: Science, Technology, Engineering, Art, Math, Entrepreneurship. The tutor/teacher has the essential role in the process. The curriculum is leading guidelines but if the school doesn't apply STEM (STEAM/E) in their studies then the individual teacher/s should encourage students to work on their presentation and communication skills since the beginning. It relates also to the work of the teachers themselves and the use of presentations in their classes/activities.

The main phases of a successful presentation are:

- ✓ Preparation
- ✓ Delivery
- ✓ Follow-up

Presentation preparation

Preparation involves research and building the presentation. This may mean crafting the entire text (or at least writing notes) and creating any slides and other supporting visual/audio materials.

Skills related to preparation include:

- Conducting research related to the presentation topic
- Devising charts and graphs depicting the research findings
- Learning about the audience to better tailor presentation to their needs
- Creating digital stories - use of digital materials/videos/comics/mindmaps/etc.
- Breaking up the presentation into parts of reasonable length
- Using statistics effectively to persuade the audience
- Incorporating concrete examples and stories to illustrate points and maintain audience attention
- Preparing handouts or materials to support the presentation
- Promoting presentations effectively to generate an appropriate audience

Presentation delivery

Delivery is the part the audience sees. A good delivery depends on careful preparation and confident presentation and requires its own distinctive skill set.

Skills related to delivery include[1]:

- Ice-breaking to open the topic and prepare the audience
- Present a brief roadmap/content of the presentation – a summary of what will be covered
- Emphasis on the key points/messages that are conveyed
- Use of simple and non-technical words and phrases – KISS rule – Keep It Simple Stupid
- Body language and eye contact
- Interaction with the audience with questions, stories, exercises
- Summarizing all key points at the end of the sessions and the presentation
- Capture all important information in one slide and then back it up with examples, pictures, etc.
- Whenever possible apply the Minto's Pyramid principle[2] – clustering similar ideas and messages in groups, i.e. the ideas are organized as a pyramid under a single point.
- Apply the Minto MECE principle - a grouping principle for separating a set of items into subsets that are mutually exclusive (ME) and collectively exhaustive (CE)

Frame Your Story - conceptualizing and framing what the presenter wants to say is the most vital part of preparation[3].

Presentation follow-up

Follow-up for the students involved in STEAME means to ask for feedback from their peers, teachers, parents, school authorities and other involved parties. Another important part of this phase is for students to send their presentations and other materials as follow-up and analyze the feedback.

Skills related to follow-up include:

- Creating an evaluation form to solicit feedback from attendees
- Interpreting feedback from evaluations and modifying content and/or delivery for future presentations
- Organizing a database of attendees for future presentations

[1] Doyle, A., Important Presentation Skills for Workplace Success, April 2020, www.thebalancecareers.com/list-of-presentation-skills-2059695
[2] www.barbaraminto.com
[3] Anderson, C., How to Give a Killer Presentation, HBR, June 2013

- Interviewing key attendees to gain additional feedback
- Emailing presentation slides to attendees
- Even though teachers assess the presentations as part of their overall assessment and grading, it is a good idea to ask students to think about a simple questionnaire to collect their own feedback so that they can improve their skills
- Collection of feedback by their classmates is also a good approach so that they can exchange information, practice and experience.

Types of Presentation Skills

Analytical

The best presenters are constantly improving their skills. To get better, students must be able to look honestly at their performance, assess the feedback they get, and figure out what need to be done to improve. That takes analytical thinking. More importantly, students need to have a firm grasp of the information they communicate to others. Students need to analyze their audience and be prepared to think quickly if asked questions that force them to demonstrate that they are fully aware of the material and its implications.

- Problem sensitivity
- Reporting
- Surveying
- Optimization
- Predictive modeling
- Problem-solving
- Restructuring
- Strategic planning
- Integration
- Process management
- Ongoing improvement
- Diagnostics
- Dissecting
- Evaluating
- Judgment

A presentation that's over in half the time allotted is problematic, as is one that's too long-winded.

In addition to the above skills students develop also the following as they work in teams:

- Handling difficult questions
- Leadership
- Teamwork
- Creativity
- Collaboration
- Analytical and critical thinking
- Problem-solving
- Communication – both verbal and non-verbal

- Attention to detail
- Design and visual depiction
- Prioritizing and scheduling
- Emotional intelligence
- Facilitation of discussions
- Public speaking
- Research
- Creating and managing expectations
- Motivation

Research

Research is the first step in preparing most presentations and could range from a multi-year process to spending 20 minutes online, depending on context and subject matter. In our particular case, this it the work throughout the term and/or the whole year. At the very least, students must be able to clearly frame research questions, identify appropriate information sources, and organize their results. Main role here has the science and technology teachers who provide guidance of the process and teach students how to work professionally. The elements are:

- Brainstorming
- Collaboration
- Big data analytics
- Business intelligence
- Calculating
- Case analysis
- Causal relationships
- Classifying
- Comparative analysis
- Data interpretation
- Deductive reasoning
- Inductive reasoning
- Search engine research

Verbal Communication

Public speaking is one form of verbal communication, but students will need other forms to give a good presentation. Specifically, they must know how to answer and generate questions. Part of their work could be survey making and questionnaires development to be published online, focus groups and interviews with different people including matter experts, parents, teachers, business owners, etc.

Students should be able to understand questions asked by their audience (even if they're strange or unknown for them) and provide respectful, honest, and accurate answers without getting off-topic.

- Active listening
- Focus
- Empathy
- Handling difficult questions
- Assertiveness
- Advising
- Affirmation
- Enunciation

Writing

Students may or may not need a written script, but they do need to pre-plan what they are going to say, in what order will say it, and at what level of detail. If students can write a cohesive essay, they can plan a presentation.

- Grammar
- Spelling
- Vocabulary
- Proofreading
- Building outlines
- Note-taking
- Document markups

Tools for presentation preparation and delivery

PowerPoint is the most common software and students should use all main features and functions. In addition, it would be good to include some more complex activities and include also videos, links, etc. Microsoft PowerPoint is the dominant software used to create visual aids for presentations. Students should learn to use it well, including the special features outside of basic templates that can really help them bring a presentation to life.

Other software to be used:

- Microsoft Office provides very important tools for analysis, reporting, visualization, etc – MS Excel for diagrams, graphs, tables, etc; MS Word for scenario preparation and reports.
- Keynote is used for beautiful templates.
- Google Slides is very helpful for collaborating on presentations.
- Ludus is used for creative presentations.
- Adobe Presenter is a software tool for creating e-learning content and high-quality multimedia presentations rapidly.
- Prezi uses motion, zoom, and spatial relationships to present information.
- Digital storytelling: Storyboardthat.com, Powtoon.com, Vyond, Zoho Show, Visme.
- FlowVella for exhibits and displays.
- Slidebean is used for AI-powered presentations.
- Visme is used for built-in assets to create presentations.
- Slidedog is a presentation software that seamlessly lets you switch between presentation files, interact with your audience and present.
- Haiku Deck
- CustomShow

Some of the criteria to be used by teachers when selecting proper tools and software:

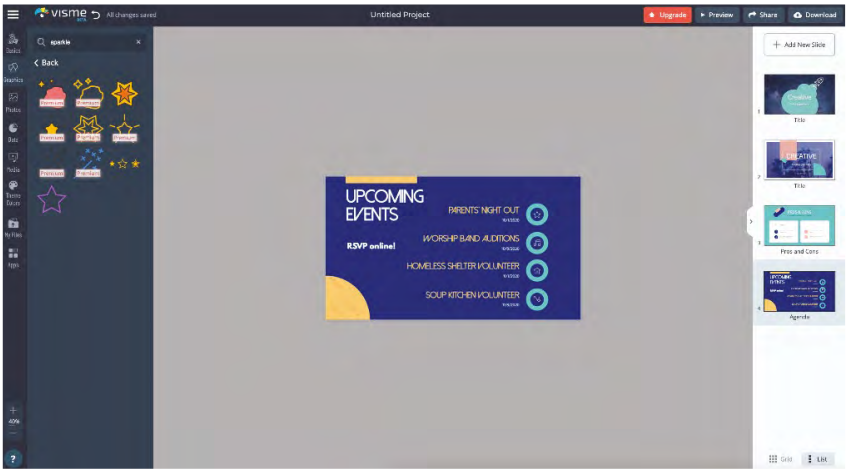
- **Pre-built-templates**: The best apps should have attractive, professional-looking templates to build presentations effectively.
- **Sharing and collaboration options**: Whether students plan to share their slides, or they just want to collaborate with a peer on a presentation, it should be easy to share files and collaborate in real-time. Especially in the context of distance and e-learning under COVID-19.
- **Media support**: Do students need to record a narration for their presentation, or insert a YouTube clip? The presentation apps should support a wide variety of media types, like audio, video, images, and animated GIFs.

- **Graphical assets**: If students need to build a presentation quickly, they don't have time to search the internet for images or make custom animations to make their presentations interesting. Students need an app with graphical assets, like stock images, graphics, charts, and animations.
- **Presentation options**: Some kind of presenter mode should be standard on a great presentation app. Teachers should show and prepare students for advanced technologies and existing software. This can be easily taken as a role by the technology (IT) teacher who covers these in their classes.

In any case it is a team work of the involved teachers and the IT one is supposed to work closely with both groups – teachers and students in order to secure a smooth process and preparation.

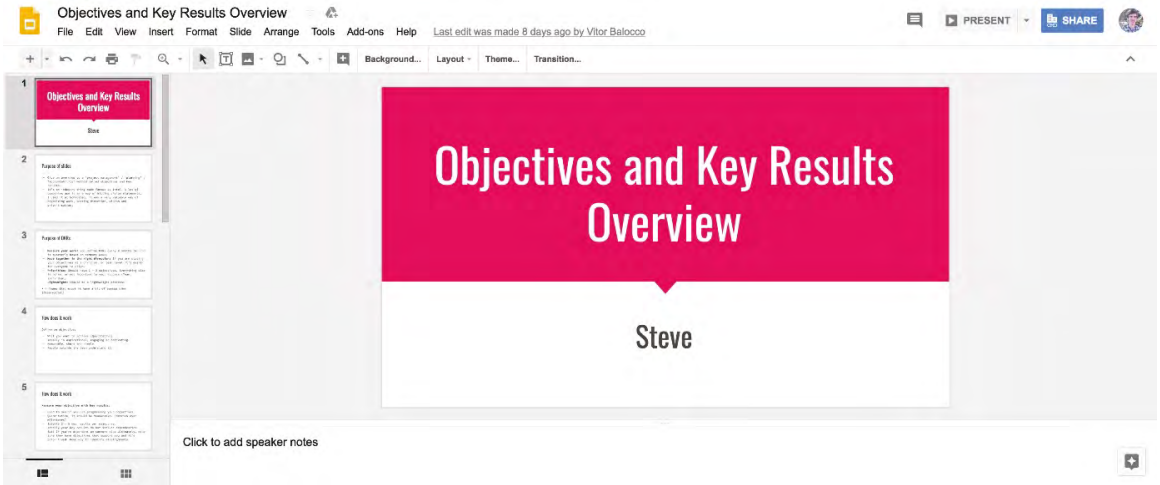
Software examples

Visme (Web)



Visme is a great presentation app when building a slideshow from scratch. It has a variety of clean and nice templates for different kinds of presentations. Students can pick from color palettes for each theme as well, or create their own color palette. There are also different slide types within each template. For example, if students choose to add a testimonial slide template to their slideshow, they can choose from several different styles depending on their theme. Visme features a large selection of icons, graphics, and images to improve the presentation. If text or chart formatting is hard for students, Visme's pre-built text boxes and graphs have a wide variety of formatting styles.

Google Slides (Web, iOS, Android)



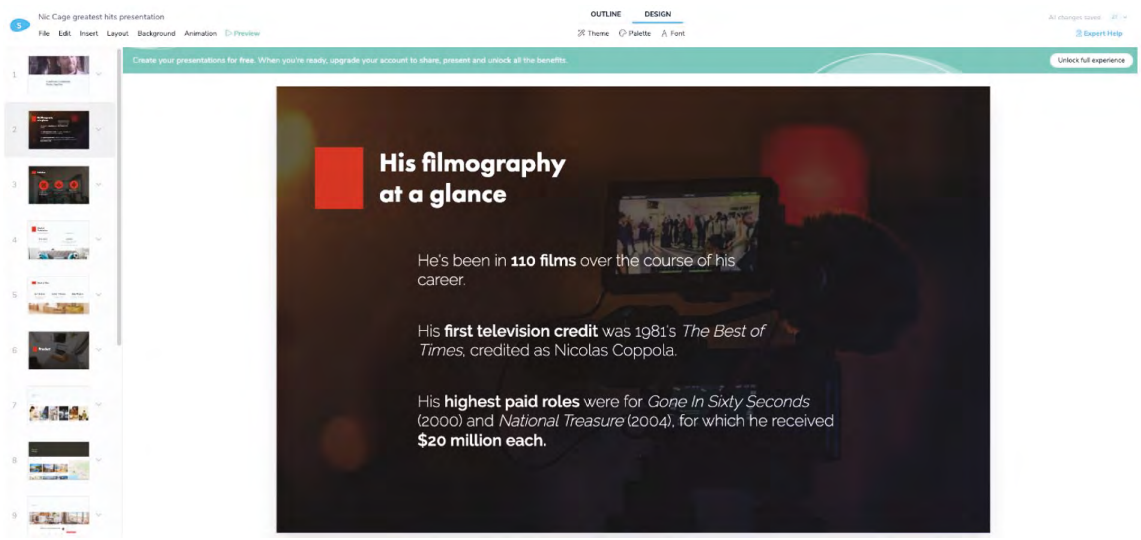
Google Slides—part of the G Suite family of apps—is a traditional presentation app designed around collaboration. It works much like PowerPoint and other presentation apps, only Google Slides runs in your browser, for free. Students can select a theme for the slideshow, then add standard slide layouts and insert text, graphics, and slide transitions from the menus. Within its presenter view, Google Slides has a great Q&A tool to make the presentation more interactive.

Ludus (Web)

It is recommended as a presentation app for creators. It is a more advanced tool for colorful and very different presentations.

Slidebean

It uses artificial intelligence throughout the product. You can choose to have it rearrange your slide order, or individual elements within a slide, to bring the most compelling parts front and center. It's an effective way to make professional presentations quicker than you could in most other presentation apps. have two options to build your presentation: either pick a template to start building, or start by writing an outline of your presentation. If you start with an outline, you'll select your theme after the fact, and Slidebean will create a presentation for you, complete with formatting. In our testing, the slideshow they created for us was pretty on-point to what we would have wanted to make. Use any of the pre-existing color palettes, or if color isn't your thing, Slidebean will generate a color palette from a URL.



Apple Keynote

Apple's presentation app is built in each Apple device and is similar to a simplified PowerPoint packed with beautiful templates and typography. Students can use it online at iCloud.com to make presentations in Keynote on a PC. Keynote is best known for its smooth animations, with enough customization options.

Assessment

Important part of the STEAME innovation is the assessment not only of the knowledge gained but also of the soft skills developed – communication, teamwork, presentation, leadership, creativity, etc. In this respect the presentations should be assessed following such criteria as:

- Delivery of the presentation – verbal and non-verbal, style
- Structure and story flow
- Use of videos and other interactive elements

- Covering the STEAME aspects of information, ideas, knowledge
- Clarity of messages on the slides
- Creativity and design
- Team presentation

These criteria can be divided into three main groups:

- Structure of presentation
- Delivery method
- Delivery style and teamwork

Source: www.presentation-process.com

Another useful tool is self-assessment generator: https://www.ratespeeches.com/g=presentation-skills-assessment-checklist-generator

Conclusion and recommendations

When teachers start their STEAME classes, lesson plans and activities they should include presentations in the overall activities, lesson and creativity plans and the assessment accordingly.

The presentations can be covered also in the IT classes with main guidelines and teaching of the existing software, tools, approaches. Science teachers should include all information together with experiments to be analyzed and presented as well. Part of their role might be teaching students how to reference and copyrights.

It might be a good approach to ask students to follow the four-level assessment:

- Self-assessment
- Assessment by the peers
- Assessment by the main teacher
- Assessment by the other teachers

It is highly recommended to use the scale of up to 100% and allocate respective importance of each criteria and level of assessment.

9. STEAME L&C Prototype Plan: "Customized e-shop"

S	T	Eng	A	M	Ent
☐	☐	☐	☐	☐	☐

1. Overview

Title	A CUSTOMIZED E-SHOP
Driving Question or Topic	What i need to know about the costs, revenue and profit in my business?
Ages, Grades, …	AGES:15-16 9^{th} - 10^{th} grade
Duration, Timeline, Activities	4 LEARNING HOURS 2*90 MINUTES 6 ACTIVITIES
Curriculum Alignment	Business Costs, Revenue and Profit
Contributors, Partners	
Abstract - Synopsis	Five activities for two learning periods of 90 min (first lesson) include the analysis and the calculation of a firm's profit, the analysis of its costs and how this firm creates and increases its revenue. So, for all these reasons, in the second period of 90 min (second lesson), every group of students designs and creates a customized e-shop, that formulates a real problem. In this way, they understand the mechanism of the market in action.
References, Acknowledgements	• Pearson Edexcel International GCSE (9-1) Economics -First published 2017, author: Rob Jones. ISBN 978-0-435-18864-1 (Student's book). Case Study (Lesson 16): Greenway Construction (activity 1). • Pearson Edexcel International GCSE (9-1) Economics -First published 2018, author: Clare McCormack. ISBN:978-0-435-19134-4 (Teacher Resource Pack).

2. STEAME Framework*

Teachers' Cooperation	1st Teacher: Economist 2nd Teacher: Technology Specialist and/or Computer Scientist (the two teachers can work together during the second lesson)
STEAME in Life (SiL) Organization	A real meeting with executives of a big firm with well-known products and on a call (via teleconference or face to face) and with a businessman whose main activity is organizing and running an e-shop.
Action Plan Formulation	**STAGE I**: Preparation by two teachers [STEPS 1-4], and **STAGE II**: Action Plan Formulation [Preparation STEPS 1-3]… Refers to the creation of this Learning Plan, by the two teachers in collaboration. **STAGE II**: Action Plan Formulation [Development STEPS 4-14, 16-17]… Refers to the realization by the students of the six activities of the Learning Plan. **STAGE II**: Action Plan Formulation [STEPS 15, 18]… Refers to the evaluation by the teachers [15], and the presentation by the students of their results [18].

3. Objectives and Methodologies

Learning Goals and Objectives	By the end of the L&C Plan, students should *define* and *calculate* (in euros): • total revenue • total fixed costs • total variable costs • total costs • average total costs • profit
Learning Outcomes and expected Results	After the project, learners will be able to investigate the market and become more competitive using new technologies. This procedure develops their critical mind and fosters their curiosity about new markets and about their future as entrepreneurs. Their communicative skills and their ability to collaborate will be enhanced, as they will be obliged to make decisions as partners. The result will be the virtual e-shop with the aid of spreadsheet for billing and pricing the product.
Prior Knowledge and Prerequisites	Basic knowledge of mathematics and spreadsheet document, global market perception (comparing prices and features)
Motivation, Methodology, Strategies, Scaffolds	The main methodologies and techniques of the course are based on inquiry-based learning. In this way, students are encouraged to explore the material, prioritize data, ask questions and share ideas. Inquiry-based learning uses different approaches to learning, including small-group discussion and guided learning. Students are involved in designing and conducting their own scientific research after having some queries and case studies. Specifically, students learn by making their own e-business, instead of memorizing facts and material. This allows them to build knowledge through exploration, experience and discussion. In addition, students get the chance to explore economic terms more deeply and learn from their own first-hand experience. Students have the opportunity to investigate a problem and find possible solutions, make comments and questions to test ideas, think creatively and use their intuition. As they explore this Learning Plan, students build critical thinking and communication skills. The cognitive skills that students develop can be used to improve comprehension in every subject, as well as in day-to-day life. Last but not least, team working and brainstorming can get the student on the path to success.

4. Preparation and Means

Preparation, Space Setting, *Troubleshooting Tips*	A free design platform of the Internet will be the basic tool and with the use of spreadsheet document, children will make the appropriate calculations for the final pricing of the product. Tablets and laptops in the classroom, will be necessary for students, in order to investigate the

	market and of course to develop their e-business. According to lesson activities students could work or individually or in groups of 4-5 students or in plenary session.
Resources, Tools, Material, Attachments, Equipment	• "The logo Game" application: apps.apple.com/us/app/logo-game-quiz/id953721694 • Infographic "Fixed vs Variable Costs": napkinfinance.com/napkin/fixed-cost-vs-variable-cost • Calculation of the profit: news.wtm.com/wp-content/uploads/2016/12/Profit-Feature.jpg • Kahoot: kahoot.it/ • Template for e-shop: www.umiet.com
Safety and Health	

5. Implementation

Instructional Activities, Procedures, Reflections	The plan can be completed in four learning hours, the two first hours with 5 activities related to the understanding and analyzing the billing of a product and the two second hours with one activity, which is the creation of their own e-business. **1. Brainstorming (20 minutes)** First of all, students are divided into groups of 4-5 persons. The teacher gives them a worksheet without explain anything or analyze the economic terms. With the help of the following infographic, children will try to answer the questions. 

2. Game for finding the well-known logos (5 minutes)

Students play with "The Logo Game" application that shows various images of business logos (or parts of logos) and ask users to identify each business.

3. Playing with quizzes about the six terms (15 minutes)

Students working either individually or in small groups, play a Kahoot quiz-game prepared by the teacher. They try to answer multiple choice questions on the 6 economic terms without being taught it, with what they have understood from the first activity.

4. Definition of the economic terms (30 minutes)

Teacher's presentation and plenary discussion, based on students' findings of the previous activities, defines the terms: costs, average costs, revenues and profit. The correlation with examples from real life is important and helpful. Through calculations and small case studies, students answer 5 multiple choice questions in the end of the presentation.

5. Case study (20 minutes)

In the end of the first lesson, students will summarize their knowledge via the worksheet, as a case study. This case study will help them to organize the data (table) and apply all the terms that they have already learned. The questions, based on the STEAME investigative approach, develop their critical minds.

	6. Creation of the e-shop (90 minutes) Every group of students creates a customized e-shop, where the consumers can choose their outfit (quality, design, color combinations etc.). As far as the application of this concept is concerned, students will separate in groups and every group will choose the style of the outfit (casual/formal) which it wants to produce and promote. We are going to investigate the market, to locate suppliers and learn about similar businesses (competitors)
Assessment - Evaluation	▪ A *self-assessment* with immediate results, is the Kahoot game (activity 3). ▪ A g*roup-assessment i*s the multiple-choice questions and the small case studies in the end of the Teachers' Presentation (activity 4). ▪ An *evaluation using a rubric with four criteria*, is the worksheet submission (activity 5). Apart from their ability to perceive and apply the economic terms, we can monitor their collaboration skills, during the above two activities.
Presentation - Reporting - Sharing	A presentation by each group takes place as an extra activity (an additional 20-minute lesson), analyzing the steps from the billing until the pricing of the product. Students should present all the variables that take into consideration in order to complete the e-shop.
Extensions - Other Information	Event - real meeting with executives of a big firm with well-known products and on a call (via teleconference or face to face) and with a businessman whose main activity is organizing and running an e-shop.

10. STEAME L&C Plans for Grades 7-9 & 10-12

Grades 7-9 (ages 12-15)

No.	Age Group	L&C Plan Name	STEAME subjects involved	Teaching Method	Available languages	Duration (Learning Hrs)
1	13-14	Open-air Museum	Technology, Arts	Communicative-Laboratorial learning	EN	15
2	9-12	Floppy Heart Valves	Science, Technology, Engineering	Inquiry based learning, Problem based learning	EN	7
3	12-15	Chair Design	Science, Technology, Engineering		EN	5-7
4	13-15	Symmetry	Science, Technology, Engineering, Arts, Mathematics	Inquiry based learning, Project based learning	EN	8
5	12-18	Network Analysis	Technology, Arts, Mathematics, Entrepreneurship	Inquiry based learning	EN	3-4
6	13-16	An Education Museum in our city!	Science, Engineering, Mathematics, Entrepreneurship	Inquiry based learning	EN, EL	13-16
7	12-15	A "smart" village on the mountain slope!	Science, Engineering, Mathematics, Entrepreneurship		EN, EL	16
8	12-14	A Guided Tour	Science, Technology, Arts, Mathematics, Entrepreneurship	Problem based learning	EN	3
9	15-16	All Equal, All different	Science, Technology, Mathematics	Inquiry based learning	EN, IT	3
10	12-15	How to Balance Function and Presentation in Liquid Packaging?	Science, Engineering, Arts, Mathematics, Entrepreneurship	Inquiry based learning	EN	6

The list of the Learning & Creativity activities/plans with related material (Grades 7-9) at the Observatory:

1.	**Research – Services Evaluation**
2.	**A Customized E-Shop**
3.	**The creation of my own advertisement**
4.	**A glass of hot chocolate**
5.	**The change of a river**
6.	**Who moved the beach?**
7.	**Open air museum**
8.	**Chair Design**
9.	**Science and Business case study**
10.	**Symmetry**
11.	**Network Analysis**
12.	**An Education Museum in our city**
13.	**A "smart" village on the mountain slope**
14.	**A guided tour**
15.	**All equal, all different**

Grades 10-12 (ages 15-18)

No.	Age Group	L&C Plan Name	STEAME subjects involved	Teaching Method	Available languages	Duration (Learning Hrs)
1	15-16	A Customised e-shop	Technology, Arts, Mathematics, Entrepreneurship	Inquiry based learning	EN	4
2	13-18	Research – Services Evaluation	Technology, Mathematics, Entrepreneurship		EN, EL	22
3	15-16	My Own Advertisement	Technology, Arts, Mathematics, Entrepreneurship	Inquiry based learning	EN	4
4	13-15	A Glass of Hot Chocolate!!!	Science, Technology, Arts, Mathematics, Entrepreneurship	Inquiry based learning, Collaborative learning	EN, EL	16
5	16-18	Road Safety	Science, Technology, Engineering, Arts, Mathematics, Entrepreneurship	Inquiry based learning, Collaborative learning	EN, EL	25
6	14-18	The Change of a River	Science, Technology, Arts, Entrepreneurship	Inquiry based learning	EN	5
7	14-18	Who Moved the Beach	Science, Technology, Engineering	Inquiry based learning	EN	4
8	13-18	Research on the STEAME aspects in the work of entrepreneurs, scientists, artists – case studies by Leonardo da Vinci and Elon Musk (Tesla)	Science, Technology, Engineering, Arts, Mathematics, Entrepreneurship	Inquiry based learning	EN	24

The list of the Learning & Creativity activities/plans with related material (Grades 10-12) at the Observatory:

1.	**Research – Services Evaluation**
2.	**A Customized E-Shop**
3.	**The creation of my own advertisement**
4.	**Road safety**
5.	**The change of a river**
6.	**Who moved the beach?**
7.	**Floppy Heart Valves**
8.	**Science and Business case study**
9.	**Network Analysis**
10.	**An Education Museum in our city**
11.	**How to balance function and presentation in Liquid Packaging**

11. STEAME-ID Program: Cooperation between Schools and Industry

The Rules of STEAME-ID Cooperation

1. Organization of team - rules of cooperation

- A new collaboration with a company and/or research institute is agreed within the context of the school environment based on mutually accepted rules of communication and collaboration and a team is formed.
  The school and the institute agree that they have common goals, achievable through a collaboration scheme/ project, and they both form the teams that will discuss and agree the way of communication between the two involved parties, the how they will be collaborating.
- The rules of communication, flow of information, mutual work, collaboration, presentation and dissemination (considering the relative rights and obligations) are agreed upon by all parties involved and are documented in a collaboration contract.
  The two parties agree on a set of rules that will dictate the rules of communication, their way of collaboration and other related activities (e.g. dissemination of the collaboration and its results, presentation of the project, etc.).

2. Organization of team – Meetings

- **Organization of collaboration: typical indicative fields within a collaboration contract are:**
  - Team name and logo
  - Team members
  - Roles, Responsibilities
- **Team scope: the mutual vision is clearly and promptly stated**
  As described above, in such a collaboration, there will be gains for both parties that will be in alignment with their main or one of their strategic goals. This will be the basis for the common vision of the collaboration and what both parties aim to be achieved.
- **The aim and objectives, as well as the responsibilities, are described (when & how, who, how many)**
  During the organisation of the collaboration and the initial meetings between the 2 teams, they clearly state and agree on the objectives and responsibilities of both teams.
- **The process of monitoring and evaluating, in a measurable way, is agreed upon.**
  Teams from both parties also agree on the way of evaluation of their collaboration and described the qualitative and quantitative indexes to be kept and used for this process. As some of the internal objectives of the 2 teams might differ or most probably be one-sided, it is important to achieve a mutual understanding between the 2 teams on what it is important to evaluate.
- **Level of Commitment: least effort spent within a timespan (weekly-monthly), timeline and milestones.**
  This is most usually an oral agreement between the two teams, stating and agreeing on their level of commitment and the resources (effort, personnel, etc.) that they are willing to dedicate to the collaboration.
- **Function management: agreement on how to record functions – processes that are to be developed and used as well as a mutual agreement on the way of monitoring the progress of the collaboration.**
  This phase will set out and describe the most common procedures-processes that are to be developed and used by the 2 teams to regulate and optimise the effectiveness of their collaboration and its results.
- **Time management: timelines (updates, resources/products/facilities access, etc.).**

The objectives of the collaboration should be tied to a time-schedule, developed at these initial phases of the cooperation. Both teams, during their meetings, are equally responsible to ensure proper time management in all aspects.

3. Objectives – Meetings' context – Exchanging ideas – Methods

- Meeting objectives analysis based on the feedback of the institution.
- Clarity of the objectives and the collaboration's outcome.
- Collaboration functions management – Agreement on how to record function – processes and how to monitor their progress.
- Development of protocols for physical collaboration within facilities that are under special circumstances
- Collaboration based on good practices such as, Brainstorming, Role Playing, Simulation, Gamification and Methodologies of Problem Solving, Inquiry Based & Project Based Learning.

4. Deliverable(s) and evaluation

- Development of the deliverables.
- Team internal evaluation.
- Promotion to the institution.
- Both parties meeting for feedback and adjustments.

19. *Communication – Dissemination*

- Communication plan, channels, frequency.
- Development of dissemination material.
- Needed resources, distribution if needed.
- Agreement on intellectual property rights: Declaration of property, its utilization, as a whole or a part.

The Model - Activity Plan of the STEAME-ID Program

#	Title of Activity	Activities by School	Activities by Industry
Stage A: Goal - Objectives - Rules			
1	Vision, Mission, Goals, Objectives	STEAME project goals-objectives	institute or company goals-objectives
2	Level of Commitment - Agreement	school leadership commitment	institute or company leadership commitment
3	Teams Building	school team	institute or company team
4	Methodologies - Tasks - Timeline	school-based methodologies	industry -based methodologies
5	Rules of Cooperation	joint rules of communication - cooperation	
6	Monitoring of Cooperation	school monitoring	monitoring
Stage B: Design of the Cooperation - Outcome - Communication			
7	Meetings for Design	internal face2face or remote	internal/general face2face or remote
8	Meetings on the field (if needed)		special areas of institutes or companies
9	Design of the Outcome (Model/Artifact/Product/Services)	design of the project outcome	customization of existing product/service or new design
10	Intellectual property rights	derived from school outcome	general agreement and industry properties
11	Communication & Dissemination Plan (internal & external)	joint design of communication & dissemination plan	
12	Required Resources' Allocation	students/educators work PDs and school resources	staff work PDs and industry resources
Stage C: Development of the Outcome			
13	Meetings for Development	internal face2face or remote	internal/general face2face or remote
14	Meetings on the field (if needed)		special areas of institutes or companies
15	Required Resources' Allocation	students/educators work PDs and school resources	staff work PDs and industry resources
16	Development of the Outcome	school outcome	industry outcome
17	Feedback - Test - Evaluation	from students/educators	from industry professionals
18	Finalize of the Outcome	school outcome	industry outcome and joint finalization
Stage D: Communication & Dissemination of the Outcome			
19	Meetings for Implementation of the Dissemination	internal face2face or remote	internal/general face2face or remote
20	Communication Resources	students/educators work PDs and school resources	staff work PDs and industry resources
21	Preparation of Dissemination Material	school materials	institutes or companies' material
22	Joined Dissemination Events	joint internal or external organization of events	

The Validation template of the STEAME-ID Program

The following tables presents a check activities needed to be developed by the school and industry in cooperation. Schools are invited to apply all or some of the activities during a pilot validation process on this cooperation.

School:	Industry:	Project:	Period:

On the following STEAME title, click by checking the boxes corresponding to the topics of fields used in the cooperation:

S	T	Eng	A	M	Ent
☐	☐	☐	☐	☐	☐

Required by school to click by checking the box corresponding to the activity realized during cooperation:

#	Steps of Activities	Activities by School		Activities by Industry	
Stage A: Goal - Objectives – Methods - Rules					
1	vision, mission, goals, objectives	☐	school project goals-objectives	☐	industry project goals-objectives
2	level of commitment - agreement	☐	school leadership commitment	☐	industry leadership commitment
3	teams building	☐	school team	☐	industry team
4	methodologies - tasks - timeline	☐	school-based methodologies	☐	industry-based methodologies
5	rules of communication-cooperation	☐	joint rules	☐	joint rules
6	monitoring of cooperation	☐	school monitoring	☐	industry monitoring
Stage B: Design of the Cooperation - Outcome - Communication					
7	meetings for design	☐	internal face2face or remote	☐	internal/general face2face or remote
8	meetings on the field (if needed)			☐	special areas of industry
9	design of the outcome (model/artifact/product/services)	☐	design of the project outcome	☐	customization of existing product/service or new design
10	intellectual property rights	☐	derived from school outcome	☐	general agreement & industry properties
11	communication-dissemination plan	☐	joint design	☐	joint design
12	required resources' allocation	☐	students/educators work PDs and school resources	☐	staff work PDs and industry resources
Stage C: Development of the Outcome					
13	meetings for development	☐	internal face2face or remote	☐	internal/general face2face or remote
14	meetings on the field (if needed)			☐	special areas of industry
15	required resources' allocation	☐	students/educators work PDs and school resources	☐	staff work PDs and industry resources
16	development of the outcome	☐	school outcome	☐	industry outcome
17	feedback - test - evaluation	☐	from students/educators	☐	from industry staff & professionals
18	finalize of the outcome	☐	school outcome	☐	industry outcome and joint finalization
Stage D: Communication & Dissemination of the Outcome					
19	meetings for implementation of the dissemination	☐	internal face2face or remote	☐	internal/general face2face or remote
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21	preparation of dissemination material	☐	school materials	☐	industry materials
22	internal/external dissemination	☐	joint organization of events	☐	joint organization of events

STRENGHTS

e.g. What could be the strongest asset? Why did you feel satisfied?

WEAKNESSES

e.g. What could be improved? Did you have enough resources/time/quality?

OPPORTUNITIES

e.g. What could be an advantage? What could be a uniqueness?

THREATS

e.g. What obstacles did you face? There was a resistance to innovations?

Any additional description/comments/suggestions/changes/expectations?

The Validation of the STEAME-ID Program: Doukas School

School: Doukas School	Industry: Gizelis Robotics	Project: Educational Robot Specs	Period: Jan-May 2021

S	T	Eng	A	M	Ent
☐	☒	☒	☒	☒	☒

#	Steps of Activities		Activities by School		Activities by Industry
Stage A: Goal - Objectives – Methods - Rules					
1	vision, mission, goals, objectives	☒	school project goals-objectives	☒	industry project goals-objectives
2	level of commitment - agreement	☒	school leadership commitment	☒	industry leadership commitment
3	teams building	☒	school team	☒	industry team
4	methodologies - tasks - timeline	☒	school-based methodologies	☒	industry-based methodologies
5	rules of communication-cooperation	☒	joint rules	☒	joint rules
6	monitoring of cooperation	☒	school monitoring	☒	industry monitoring
Stage B: Design of the Cooperation - Outcome - Communication					
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Briefly comment about the STEAME-ID Cooperation Template and/or your cooperation between School-Industry:

STRENGHTS

Some of the main observations that could be considered as strengths are the following:
- interest to collaborate
- high level of engagement by both parties
- ability through discussion to set common goals
- a common feeling of mutual benefit from the collaboration
- honesty by both parties on what each one expects from the collaboration

More specifically, from the point of initiation of communication between the school and the industry organisation, both parties, expressed their interest to collaborate. Students were asked in class if they would like to participate, and there was a noticeable expression of interest. The students were selected based on two main criteria, the first one was to have an appropriate

number of members within a team (enough to share the work and responsibilities but not to big thus impacting the efficiency of their communication and collaboration. On the other hand, the industry with excitement responded to the school request to collaborate. From the organisation of the first virtual (due to COVID-19) meeting, participating teachers and researchers observed that all students actively participated in the discussion and the industry was represented by a diverse team that included the president, the head of the IT department and the expert in robotics. The initial discussion commenced with the industry presenting the students and explaining the context of their operations and presented them with some examples of their multitasking robots. This sparked students' interest and several questions followed, mainly in relation to how the prototype robots presented operate. The next step was to set the goals of the joint team and decide how the team would work. At this point, both parties expressed their thoughts on how this collaboration could benefit both. Students were excited to provide ideas and turn a "product" design process to a learning process and the industry team was excited to brainstorm with students and see how a different age group, with higher levels of imagination and possibly a different perspective on things would impact the discussion. Finally, it was students who expressed their, logical expectations, followed by the industry team members (indicatively, students described that seeing an idea or a project being implemented at this level, by a small factory, would allow them to better plan their demanding projects, e.g. robotics contests and the industry members stated that by helping young students develop critical industry skills, they will in the future have highly qualified team members and colleagues).

WEAKNESSES

There were several aspects that could be improved based on the observations of the school team and the discussions among them that followed.
If there were no issues relating to the COVID-19 restrictions that were in place at the time, students would have visited the facilities of the industry, thus seeing up close, how a product is designed and how the development-production process is carried at an industrial level.
Furthermore, there is a need for more extensive collaboration and the development of bigger projects, always considering the available resources (especially on behalf of the industry), while ensuring their optimal utilisation.
Finally, multiple school staff members involved expressed the opinion that the industry could also adapt a discrete counselling role in other school activities (e.g. annual STEM projects, student competition, etc.).

OPPORTUNITIES

Such a collaboration offers students a change to explore the concept of entrepreneurship and supports their acquisition and development of related knowledge and skills. By having members in their own team that belong to the industry, and by observing their way of working, offers them an insight in the world of business.
As both the STEM teacher and the head of Digital Education dept. observed, that students were motivated to work with the members of the industry and had a high consideration of their expertise, which led them to pose multiple questions at every change, directed to them.

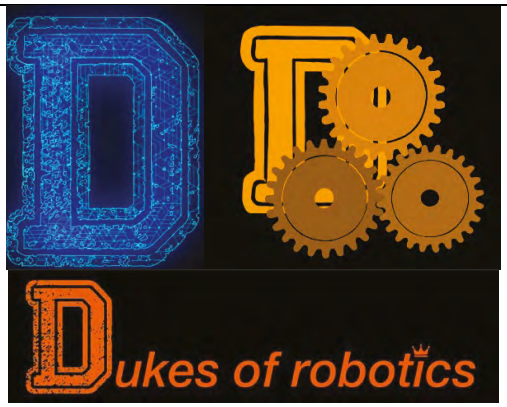
THREATS

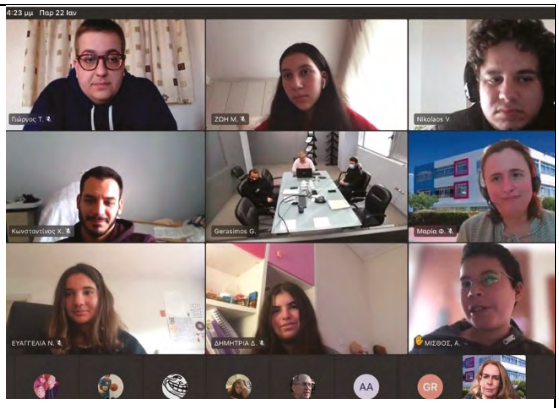
There was a concern raised by educators at first in relation to the fact that the industry members are not educators, and they might at times struggle to handle some challenging moments in case they occur. In practice, the industry members respected the fact that students were involved, thus, were keen to engage the school teachers to help them in that aspect.
There might also, at times, and considering a bigger collaboration scheme, be a need for either of two parties to allocate elsewhere resources, thus raising a risk of stability within the joint team. There is no serious commitment on either part neither does it make sense to be.

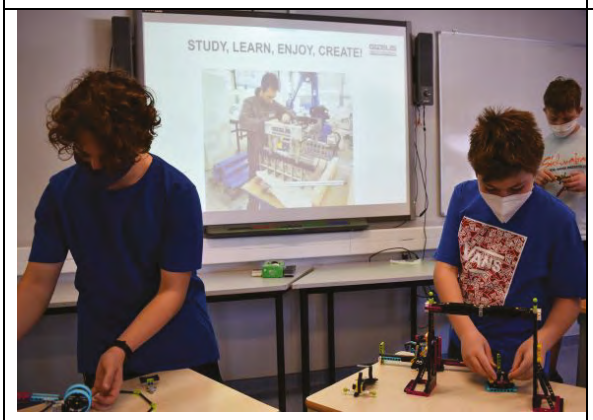
Any additional description/comments/suggestions/changes/expectations?

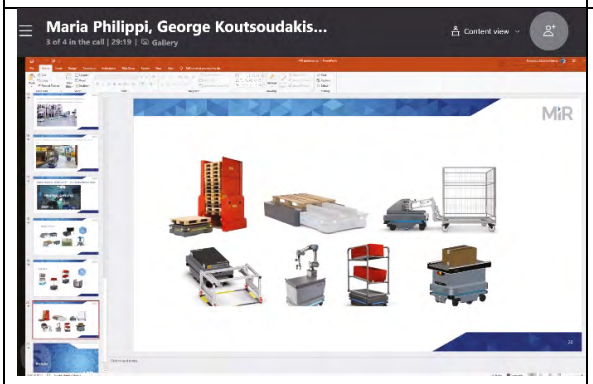
Involved teachers commented that a well-planned collaboration scheme in combination with a motivated and engaged industry entity may offer considerable value to STEM/STEAM school

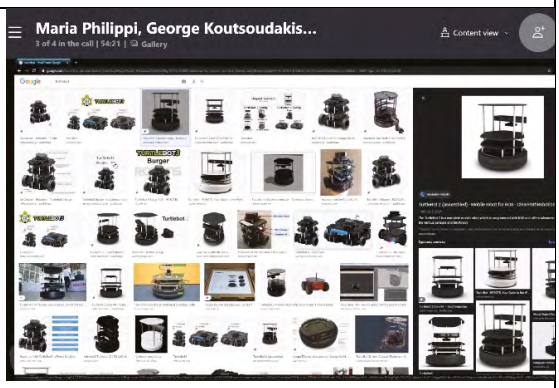
activities/projects while also emphasising on the E-ntrepreneurship element of the STEAME approach.











The Validation of the STEAME-ID Program: Prof. Ivan Apostolov High School

School: Prof. Ivan Apostolov High School	Industry: AIRATE	Project: Innovative start-up	Period: October 2020 - May 2021

S	T	Eng	A	M	Ent
☒	☒	☒	☐	☐	☒

#	Steps of Activities	Activities by School		Activities by Industry	
Stage A: Goal - Objectives – Methods - Rules					
1	vision, mission, goals, objectives	X	school project goals-objectives	x	industry project goals-objectives
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3	teams building	X	school team	x	industry team
4	methodologies - tasks - timeline	X	school-based methodologies	x	industry-based methodologies
5	rules of communication-cooperation	X	joint rules	x	joint rules
6	monitoring of cooperation	X	school monitoring	x	industry monitoring
Stage B: Design of the Cooperation - Outcome - Communication					
7	meetings for design	x	internal face2face or remote	x	internal/general face2face or remote
8	meetings on the field (if needed)	☐		x	special areas of industry
9	design of the outcome (model/artifact/product/services)	x	design of the project outcome	x	customization of existing product/service or new design
10	intellectual property rights	☐	derived from school outcome	☐	general agreement & industry properties
11	communication-dissemination plan	☐	joint design	☐	joint design
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22	internal/external dissemination industry	x	joint organization of events	x	joint organization of events

Briefly comment about the STEAME-ID Cooperation Template and/or your cooperation between School-Industry:

STRENGHTS

e.g. What could be the strongest asset? Why did you feel satisfied?

The cooperation between the school and industry/business entities in prof. Ivan Apostolov school is embedded in the overall curriculum and subjects mainly in two profiles of studies – "Entrepeneurial" and "Software and hardware sciences" in grades 10-12. It is part of the school strategy and the fact that the school is recognized innovative school by the Ministry of education in Bulgaria which serves as a good practice for other schools. Students work on real case studies provided by business representatives. They have regular meetings and sessions. In addition, students in 11th grade participate in competitions of Junior Achievement with their own business plans and prototypes of products. During the process they are mentored by entrepreneurs and have regular sessions for guidance and advice. This helps them develop such skills as teamwork, leadership, creativity, risk taking, presentation skills, prototyping, and gain knowledge in specific fields – engineering, technical, finance,

marketing, operations, etc. The overall experience shows that young entrepreneurs and start-ups are willing to work with the students and get ideas and suggestions by them as more creative and familiar with the current trends, customer needs, behaviour of the new generation, expectations and approach to attract new customers. In this particular project the entrepreneur presented his five businesses and experience of what it takes to be successful entrepreneur. He provided students with a challenge to be solved and then mentored them is several sessions to prepare their own business plan and a prototype to participate in the program and annual competition of Junior achievement where student teams from the whole country compete in front of a jury for an award in different categories and further participation in EU-wide entrepreneurship competition.

WEAKNESSES

e.g. What could be improved? Did you have enough resources/time/quality?

The process requires commitment mainly by the teachers. Students are motivated and willing to contribute and work on such projects. School curriculum is difficult to be changed fast and it requires certain administrative efforts, process and agreements between the involved teachers. Business, from another side agrees to work with students under the limitations of their lack of experience so the final results are mainly related to the initial stage of product and business development where students can generate ideas and provide feedback, suggestions. The business representatives and managers are willing to support students and teach them as mentors, coaches, teachers. There should be a very rigid schedule since the very beginning – in the start of the school year there should be a clear agreement and plan for cooperation and specific tasks, responsibilities, results, expectations and timeline. In this process there should be commitment among the school management, the main teacher/s involved and the representative of the industry (at least one project manager, owner, manager from the company). The sessions are planned with different intensity according to the project and the overall process.

OPPORTUNITIES

e.g. What could be an advantage? What could be a uniqueness?

The increasing need of industry for fresh thinking and talent and the new law for education in Bulgaria have put great focus on the involvement of high school students in business. In upper secondary education – grades 11 and 12- students have to choose a profile of their studies such as Entrepreneurship, IT (Software and hardware sciences), Humanities, Science, Foreign languages, etc. This requires very precise career guidance and orientation for students. Thus, the role of business and industry in general is crucial. In our school the industry-school collaboration has been a practice for more than five years. Initially it was only sporadic sessions and lecturers from business fields but now many of the teachers in the profiles Entrepreneurship and Software and hardware sciences have industry background. Students need more interactive way of teaching and engagement and motivation.

The project-based learning is implemented mainly with the participation of business organisations, start-ups, industry experts, managers and entrepreneurs who act as mentors, advisors and challengers for students. They provide business cases and give them certain challenge to work on during the school year and/or semester. Some of the projects involve profound research, conducting interviews, desktop research, generation of ideas, business concepts and ultimately students prepare their own business plans to participate in competitions where managers and business owners are their mentors. The strict management and coordination of the process is led mainly by a group of enthusiastic and experienced teachers with the permission and support by the school administration and management.

THREATS

e.g. What obstacles did you face? There was a resistance to innovations?

The current situation puts limits on the scope of work and collaboration with most of the school year being distance learning. Some of the businesses went through tough period and the cooperation with schools and other education institutions is not a priority, some firms went out of business. This caused difficulties finding the right partners. All activities and projects were modified and adjusted for online and distant work. Alignment among students-teachers-managers was tough and the timeline was changed regularly.

Any additional comments/suggestions/changes/expectations?

Work process and organisation

Since the beginning of the school year the school prepares a plan for work with industry with a timeline, goals, overall objectives, tasks, responsibilities, evaluation, dissemination, etc. It is supported by the management and led by a group of at least two-three teachers in specific subjects such as Entrepreneurship, Marketing, IT subjects, etc. Design thinking is central part in the process. Students get to know this problem solving and creativity approach.

These projects and involvement of the business is done within new subjects and practical field work that is part of the school curriculum and aligned with the new organisation of the education system in Bulgaria.

Teachers who lead the process are the main actors and they have industry background and experience, network of connections, expertise.

The process is in grades 10-12.

Grade 10: students are introduced to entrepreneurship and business. They have a series of sessions (online or physical) ith industry representatives and experts. They gain new knowledge and skills and work on small short-term projects mainly providing some ideas and/or doing market or another type of research, creating surveys, conducting interviews with matter experts, peers, teachers, managers, etc.

Grade 11: students are split into teams who work on their own business plans throughout the year following the program of Junior achievement and participating in series of competitions for financial management, green economy and sustainability, entrepreneurship, etc. At the end of the year they present their business plans and prototypes in front of jury during the annual national competition which might get them to the European level competition among schools. In the process they have sessions with industry experts, entrepreneurs, managers, coaches who provide them with guidance and advise how to improve their projects and have better chances to win. In these sessions entrepreneurs share their success and failure stories, show their prototypes (MVP – minimum viable products) and discuss business plans and models. The sessions are divided with at least one in each month, within the classes or after school.

Grade 12: Students proceed with their applications to universities and career guidance supported by the industry and business. They work on small projects and focus mainly on their career development. There is a subject Career development within the curriculum which provides them with the time slot every week to discuss, take tests, do exercises, games, prepare CV, motivation letters, personal statements, etc.

Evaluation

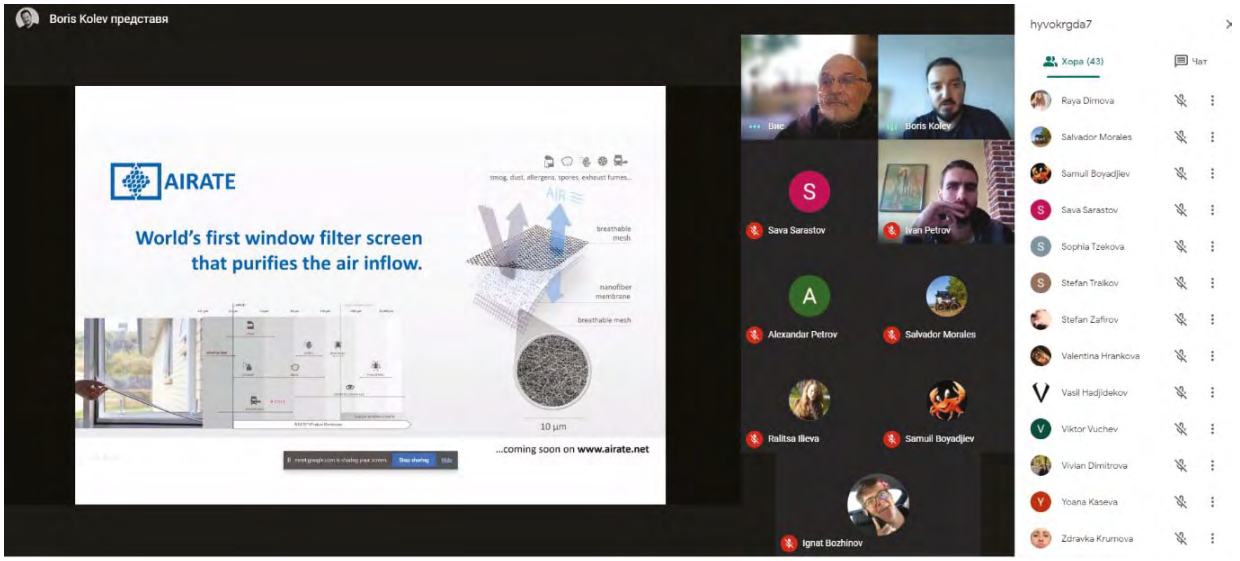
Evaluation is done within the subjects and classes of the involved teachers. There is certain criteria for their skills, knowledge, final projects. It is done on a scale of 2-6 and teachers put a common weighted and averaged grade. English language skills are crucial as it is English language school. The main aspects f evaluation are:

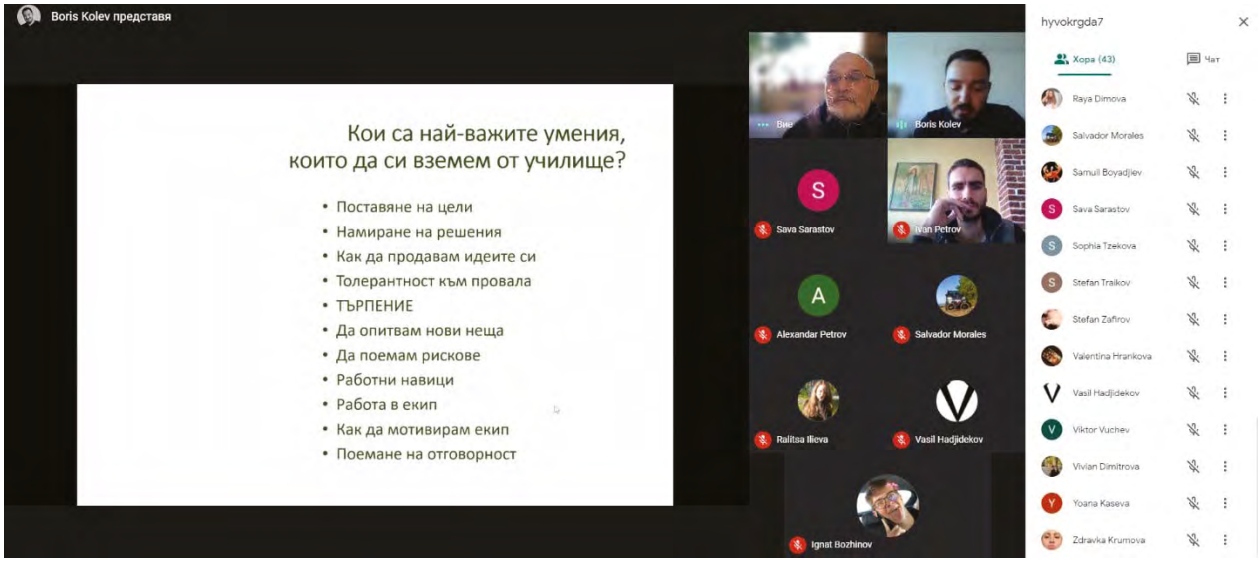
- Knowledge gained in the field
- Transversal skills – empathy, leadership, teamwork, analytical, presentation, creativity, project management, etc.
- Technical skills for prototyping and testing.

The role of the school:

The school is very flexible and the commitment to experiential learning and collaboration with the business is strong. It is a private school and the expectations from students and parents are quite high. Parents are also involved in the process and very often they are business and industry representatives and owners of businesses. The teachers are leading in the process. There is a team of teachers within each study profile/program who drive and coordinate the initiatives and collaboration. They have industry background and experience which is very helpful. It is very important to have a plan for action and overall strategy for collaboration, project-based learning and innovation in general and all staff and management should be engaged and/or involved and aware of it. In addition, all EU-funded projects are implemented within the scope of the strategy for innovation of the school and all supporting activities, tasks and results are guided by it.

Photos from the event:





The Validation of the STEAME-ID Program: ITCMORANTE – LIMBIATE

School: ITCMORANTE – LIMBIATE - ITALY	Industry: TECNOCASA FRANCHISING NETWORK	Project: A REAL ESTATE FRANCHISED AGENCY	Period:FEBRUARY – MAY 2021

S	T	Eng	A	M	Ent
☐	☒	☐	☒	☒	☒

#	Steps of Activities	Activities by School		Activities by Industry	
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industry

Briefly comment about the STEAME-ID Cooperation Template and/or your cooperation between School-Industry:

STRENGHTS

The cooperation between school and industry in ITC Morante is part of the implementation phase of a wider program called "Skills Development and Orientation Scheme " which applies to Grades 10-12 and which takes many forms. One of the main aims of the programme is to make students acquire the so-called soft skills,which can be applicable to different contexts. Among these can be listed those most requested of young people in the work environment: autonomy, creativity, innovation in managing the assigned task, ability to solve problems (problem solving), communication, organization, ability to work and know how to interact in a group (team-working), flexibility and adaptability, precision and resistance to stress. All the activities and projects related to the scheme

are included within a three-year school curriculum and adopted by class teachers that are autonomous in the design and implementation.
The collaboration with industries entails intership periods for students at the end of Grade 11 and and the realisation of project work activities during grade 12. Both experiences are configured as active training "methodologies", a real mode of learning that is carried out in continuity with the educational and curricular programs. It allows students to access the different realities of the world of work, to understand their own strengths and weaknesses, to discover their passions, to reflect on their own career path and, therefore, to make more appropriate and conscious choices for their future.

WEAKNESSES

Work-related Project work activities may be difficult to realize in a context of standard curricula with rigid scheduling of times and contents linked to disciplines and aiming at success in a state- defined exam, which is considered a priority policy for schools. There may be some resistance to innovation and collaboration also from the part of teachers, who may consider the time and effort spent on the project as a deprivation of the time to be spent on traditional teaching and practices. This consequently impacts on the quality of the projects.

OPPORTUNITIES

The cooperation scheme between school and industry is outlined in the *Operative Guide for the realisation of school-work exchanges* issued by the Italian Ministry of Education and it is mandatory according to law 107/2015. The guide specifies that the scheme can be adopted by different types of schools, prevalently tecnical or vocational institutes, but not only.

A further opportunity deriving from the collaboration between school and industry comes in the evaluation (assessment) phase. This is the responsibility of the teachers, who ascertain the process and the final result in terms of the acquisition of skills, but also character development and motivational aspects. However, in the case of internships and and projects of collaboration with enterprises the host or tutor company also contributes to the assessment of students' performance and acquired professional competences. This goal is achieved using different structured methods and tools, adapted to the path taken, such as student reports at the end of the internship, results of reality tasks, observation sheets, evaluation of external tutors, logbooks.

For the certification of final outgoing skills our school is supported by platforms created by the Regional School Office for Lombardy.

THREATS

Due to the ongoing pandemic caused by the Sars Covid 19 virus, the training internship activities for the school year 2020-2021 have unfortunately been suspended and replaced by various project activities defined by the teachers in all three Grades. Also the cooperation projects with the companies, for the current year, has by necessity been held on a remote mode. This means that the students have partly missed out a little on the opportunity of full training guidance and the development of skills that can be assessed and implemented in the labour market in a hands-on based context.

Any additional comments/suggestions/changes/expectations?

For the students the project provided an active method of learning aided by laboratory methodology despite little field experience in this particular occasion. It was conceived and designed by the school in collaboration with entrepreneurs operating in the territory with whom we have been cooperating for several years. In this case it is Tecnocasa Franchising Network (Tecnocasa Group) a network of franchised real estate brokerage agencies.
It was one of the ways of implementing school-work exchange, realised through the realisation of a real-life task, the creation of a Business Plan related to the establishment of a franchised activity in the real estate sector. The project was animated by students, with reference to an existing company (tutor company) which constituted the reference model to be emulated. The teaching methodology used problem solving, learning by doing, cooperative learning and role playing, constituting a valid tool for the acquisition of skills that can be spent in the labor market.

The project realised was suited to the technical-commercial character of our school with an administrative-commercial orientation, for which entrepreneurship, administrative culture and management control of the modern enterprise are key objectives.

The project activities allowed the students to learn new skills from an operational point of view, strengthening the knowledge and skills learned during their studies. Acting as young entrepreneurs, the students reproduced the working model of a real company in the laboratory, learning basic principles through action.

Activity steps implemented

Step 1: Under the guidance of their teachers, the students were initially confronted with a vision of the business culture, in order to develop the sense of interacting with the surrounding economic environment, respecting the fundamental knowledge of the concepts of business, enterprise.

Step 2: In the second phase a reference model in their territory was chosen. The fundamental role of this phase was that of the tutor company, which guided students to the definition of the business idea.

Doc. 1 – Project Outline

Step 3: The development of the Business Plan, intended as a document structured according to a precise scheme that summarizes the contents and characteristics of the business project (Business Idea). The preparation of the Business Plan is functional to the birth of a new entrepreneurial activity and must be supported by a feasibility analysis capable of providing a series of economic-business data, on which to draw guidelines for the establishment of the business. In this phase the students were confronted with the concepts of entrepreneurial formula, management organization, economic-financial budget. The project work, however, did not involve the further planning of the development phases and the creation of a simulated enterprise..

Doc. 2 – The Business Plan

Step 4: The students worked on the realisation of the Business Plan: the related documentation to support the start-up phase and the consequent accounting and administrative system of the company were drawn up as well as the franchising contract.

Doc.3 – Franchising contract

Evaluation

The skills on which the students were assessed fall into three different categories:
-Technical-professional skills, which involve the teachers of specific disciplinary areas
-Soft-skills, which are in great demand by companies and refer to the socio-cultural area, the organizational area and the operational area, making the student acquire the team-working and leadership skills, the assumption of responsibility, compliance with deadlines, spirit of initiative, ability to delegate by studying control mechanisms, to rationalize work, in order to form a "working personality", ready for inclusion into the workplace;
-Linguistic skills, regarding communication skills according to the context and purpose to be achieved.

Doc. 4 – self-assessment chart

The role of the school:
At an operational level, a referent teacher was appointed for the class who acted as internal tutor and liased to the external tutor company in the outlining of the project.

The teacher tutor, in the planning phase of the project activities, presented the general lines and the various phases of the project to the class teachers, who identified the times and methods of implementation according to the scheme proposed.
The path involved the activity of all the class teachers who contributed to making all students acquire theoretical and applicative knowledge, as well as cognitive skills suitable for solving problems, such as those to know how to manage in autonomy and progressively assume responsibility for the evaluation and improvement of the results to be obtained.

The role of the tutor company
The project did not involve, even if it would have been auspicable, an internship in the company. The business experience, in fact, was practiced at school, in class and in laboratories and reproduced all aspects of a real company, with the tutoring of the company experts.

Contrary to other collaborations that our school had in the past, where the realisation of the project was integrated with some students' interships in the company, this experience represented an opportunity to carry out work-related activities at school.
However, continuous contact with the tutor company was important; the meetings of the company tutors with the students strengthened the link with reality. The experience certainly allowed the students to develop their spirit of initiative and entrepreneurship, and contributed to their financial education.

The Validation of the STEAME-ID Program: School from Cracow (Poland)

School: High School Nalkowska, Cracow	Industry: Financial	Project: Gold of the 21st century	Period: 18-20 May 2021

S	T	Eng	A	M	Ent
☒	☐	☐	☐	☒	☒

#	Steps of Activities		Activities by School		Activities by Industry
Stage A: Goal - Objectives – Methods - Rules					
1	vision, mission, goals, objectives	☐	school project goals-objectives	☐	industry project goals-objectives
2	level of commitment - agreement	☐	school leadership commitment	☐	industry leadership commitment
3	teams building	☐	school team	☐	industry team
4	methodologies - tasks - timeline	☐	school-based methodologies	☐	industry-based methodologies
5	rules of communication-cooperation	☐	joint rules	☐	joint rules
6	monitoring of cooperation	☐	school monitoring	☐	industry monitoring
Stage B: Design of the Cooperation - Outcome - Communication					
7	meetings for design	☐	internal face2face or remote	☐	internal/general face2face or remote
8	meetings on the field (if needed)			☐	special areas of industry
9	design of the outcome (model/artifact/product/services)	☐	design of the project outcome	☐	customization of existing product/service or new design
10	intellectual property rights	☐	derived from school outcome	☐	general agreement & industry properties
11	communication-dissemination plan	☐	joint design	☐	joint design
12	required resources' allocation	☐	students/educators work PDs and school resources	☐	staff work PDs and industry resources
Stage C: Development of the Outcome					
13	meetings for development	☐	internal face2face or remote	☐	internal/general face2face or remote
14	meetings on the field (if needed)			☐	special areas of industry
15	required resources' allocation	☐	students/educators work PDs and school resources	☐	staff work PDs and industry resources
16	development of the outcome	☐	school outcome	☐	industry outcome
17	feedback - test - evaluation	☐	from students/educators	☐	from industry staff & professionals
18	finalize of the outcome	☐	school outcome	☐	industry outcome and joint finalization
Stage D: Communication & Dissemination of the Outcome					
19	meetings for implementation of the dissemination	☐	internal face2face or remote	☐	internal/general face2face or remote
20	communication resources	☐	students/educators work PDs and school resources	☐	staff work PDs and industry resources
21	preparation of dissemination material	☐	school materials	☐	industry materials
22	internal/external dissemination	☐	joint organization of events	☐	joint organization of events

STRENGHTS

It is important to show life from various perspectives. Any creative deviation from school routine is welcome.

WEAKNESSES

It is not clear who and when checks various items in the list. Some activities beg to be considered jointly.

OPPORTUNITIES

Students are confronted with very little of interdisciplinary teaching. This approach triggers their curiosity and engagement.

THREATS

The scheme does not fit well all joint activities. This leads to confusion. A one-time meeting needs other boxes than a collaboration intended for weeks or considered as a reoccurring event.

Any additional comments/suggestions/changes/expectations?

Recommendations:

- School should prepare an electronic, attractive information material for perspective partners with possible variations for example for chemistry-medicine, physics-technology, entrepreneurship etc.
- There must be space for **joint** activities!
- Clearly state if the intended partnership is going to be stable and sustainable or rather occasional.
- Clearly define age of involved students as groups of different ages have various STEAME competencies.
- Organization of the partnership is crucial to add most value.
- Clearly appoint and name in the for contact persons on both sides.
- Possibly simplify the structure: Preparation, Development including improvement cycle, Reflection.

An idea for a further project: bridges between the world of education and the world of work are rare, facilitate their alignment in the future for example by developing a matching platform. For this standard framework of collaboration is highly appreciated!
Filled by the Entrepreneurship Instructor and Couch Piotr Wróbel

Photos from the event:

12. Evaluation of STEAME L&C Plans

For the purposes of this project, a Learning and Creativity (L&C) Plan Template was developed to assist the participants in collecting required information on a structured and uniformed way. The **L&C Plan Template evaluation** was assigned to 16 participants (partners of the project) and focused on the following points:

1. Concerning the “Content and structure of the L&C Plan Template”, the evaluation includes 10 Likert scale questions.
2. Concerning the "Resources for the development of the STEAME Learning and Creativity Plan Template", the evaluation included 2 Boolean questions.
3. Four open questions for suggestions are completing the evaluation.

L&C Plans were developed from all the partners during the IO2 process. **L&C Plan Peer Evaluation** was used as method to evaluate the L&C Plans completed by each author. STEAME Evaluation Committee assigned each L&C Plan to two evaluators. Also 4 L&C Plans are evaluated by the participants of the C1 Training Course. The L&C Plan Peer Evaluation was focused on the following points:

1. Concerning the “Content and structure of the L&C Plan”, the evaluation includes 5 Likert scale questions (see attached).
2. Four open questions for suggestions are completing the evaluation.

More details available in the STEAME QA Report about “L&C Template and Plans Evaluation”.

STEAME

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