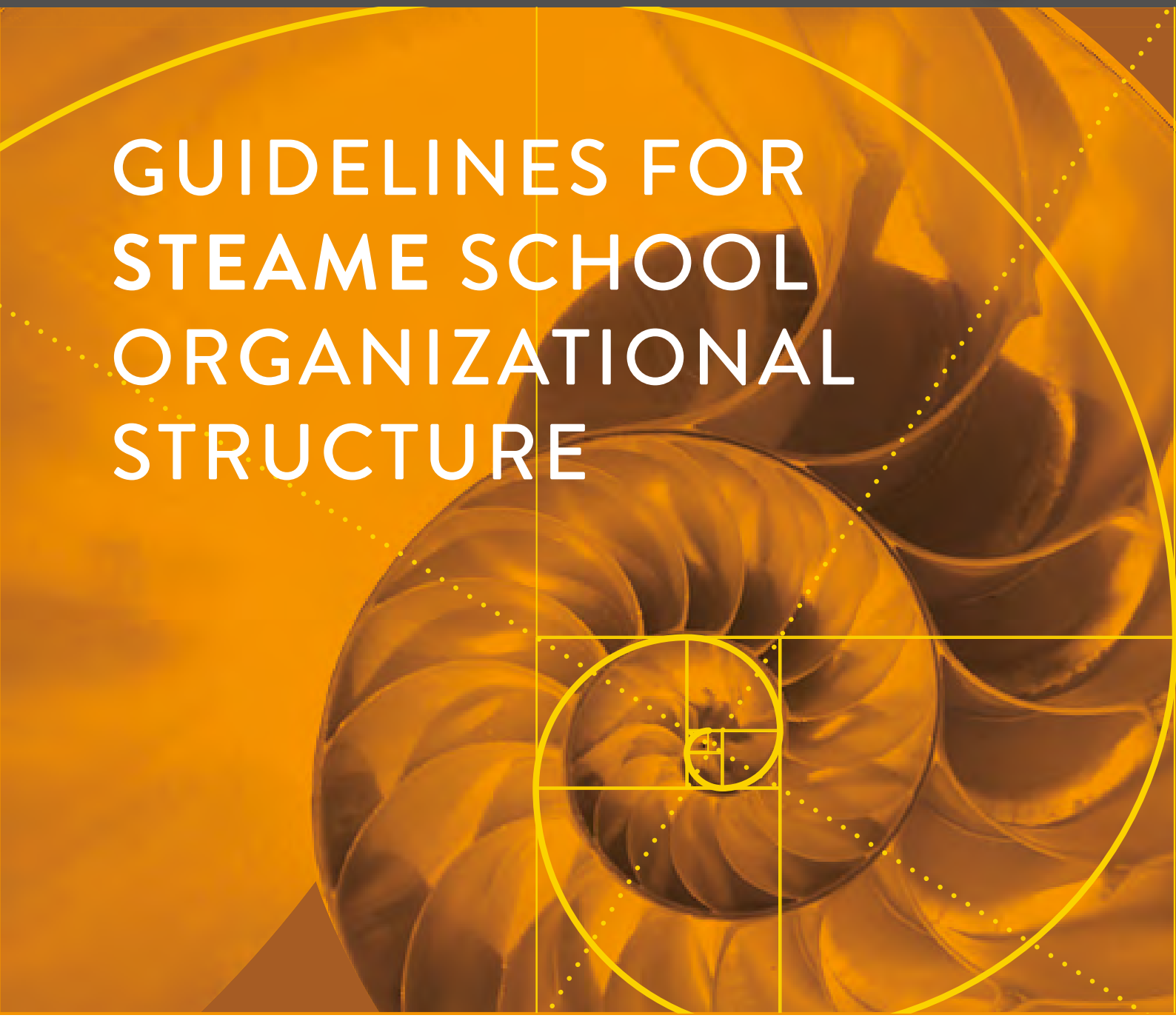
GUIDELINES FOR STEAME SCHOOL ORGANIZATIONAL STRUCTURE



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IO3: Guidelines for STEAME School Organizational Structure

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TABLE OF CONTENTS

Table of Figures:

INTRODUCTION

This e-book is providing the guidelines of organizational structure for STEAME schools initiating the introduction of a new paradigm shift in education. The guidelines provided are referring to changes in existing school organizational structures that can be realized according to the flexibility of current structures. These are called the TYPE A Schools. Part of the guidelines is also a proposed organizational structure for newly established schools so that they can support STEAME learning and creativity activities.

The O3. Guidelines for STEAME School Organizational Structure is a derivative and complimentary part to the books: O1. Guidelines for dynamic and adaptive STEAME curricula and O2. Guidelines for STEAME Activities in Schools for two age groups. Part of this product is also a Training course for Teachers, School Heads and Authority representatives, divided into modules. Further material and videos are provided in links.

The main target groups of these Guidelines are the school authorities, management, the head teachers, the teaching and administrative staff in schools and anyone interested in implementing STEAME activities and developing the STEAME methodology into schools (existing or new ones) with final target group the students of grades 7-12.

(GR) ΕΙΣΑΓΩΓΗ

Το παρόν ψηφιακό έντυπο παρουσιάζει τις κατευθυντήριες οδηγίες για την οργανωτική δομή ενός σχολείου STEAME στοχεύοντας στην εκκίνηση μιας αλλαγής προτύπου στην εκπαίδευση. Οι οδηγίες αφορούν σε αλλαγές σε υπάρχουσες εκπαιδευτικές δομές και οργανισμούς, συνυπολογίζοντας τα τωρινά επίπεδα ευελιξίας αναφορικά με της οργανωτική τους δομή. Αναφέρονται ως σχολεία ΤΥΠΟΥ Α. Μέρος των οδηγιών αποτελεί η προτεινόμενη οργανωτική δομή ενός νεοανεγερθέντος σχολείου ώστε να είναι ικανά να υποστηρίξουν τη μάθηση STEAME και ένα σύνολο δημιουργικών δραστηριοτήτων.

Το 3ο Παραδοτέα. Οδηγός για την Οργανωτική Δομή του STEAME Σχολείου αποτελεί συνέχεια και συμπληρώνει τα: Παραδοτέο 1.Οδηγός για δυναμικά και ευπροσάρμοστα Προγράμματα Σπουδών STEAME και Παραδοτέο 2. Οδηγός για STEAME Δραστηριότητες σε Σχολείο για δύο ηλικιακές ομάδες. Κομμάτι του παρόντος είναι και ένα σεμινάριο επιμόρφωσης εκπαιδευτικών, διευθυντών σχολείων και εκπροσώπων των αρχών, χωρισμένο σε ενότητες. Περαιτέρω υλικό και βίντεο είναι διαθέσιμα μέσω των αντίστοιχων συνδέσμων.

Η βασική ομάδα στόχευσης τον κατευθυντήριων οδηγιών είναι οι σχολικές αρχές, η σχολική διοίκηση, οι διευθυντές και το εκπαιδευτικό και διοικητικό προσωπικό αλλά και γενικότερα όποιος επιθυμεί να εφαρμόσει δραστηριότητες STEAME και να αναπτύξει τη μεθοδολογία STEAME εντός των σχολείων (υπαρχόντων ή νέων) με τελική ομάδα στόχευσης τους μαθητές της δευτεροβάθμιας εκπαίδευσης.

(IT) INTRODUZIONE

Questo e-book fornisce le linee guida della struttura organizzativa per le scuole STEAME avviando l'introduzione di un nuovo cambio di paradigma nell'istruzione. Le linee guida fornite si riferiscono a cambiamenti nelle strutture organizzative scolastiche esistenti che possono essere realizzati in base alla flessibilità delle strutture attuali. Queste sono chiamate le Scuole di TIPO A. Parte integrante delle linee guida è anche una proposta di struttura organizzativa per le scuole di nuova costituzione in modo che possano supportare le attività di apprendimento e creatività di STEAME.

L'O3. Linee guida per la struttura organizzativa della scuola STEAME è una parte derivata e complementare ai libri: O1. Linee guida per i curricula STEAME dinamici e adattivi e O2. Linee guida per le attività STEAME nelle scuole per due fasce d'età. Fa parte di questo prodotto anche un corso di Formazione per Insegnanti, Dirigenti Scolastici e Rappresentanti delle Autorità, suddiviso in moduli. Ulteriori materiali e video sono forniti nei link.

I principali gruppi target di queste Linee guida sono le autorità scolastiche, il personale di direzione, i dirigenti scolastici, il personale docente e amministrativo nelle scuole e chiunque sia interessato ad implementare le attività STEAME e sviluppare la metodologia STEAME nelle scuole (esistenti o nuove) con il gruppo target finale di studenti delle classi 7-12.

(PL) WSTĘP

Ten e-book zawiera wytyczne dotyczące struktury organizacyjnej szkół STEAME inicjujących wprowadzenie zmiany paradygmatu w edukacji. Przedstawione wytyczne odnoszą się do zmian w istniejących szkolnych strukturach organizacyjnych, które mogą być wprowadzane w zależności od elastyczności obecnych struktur. Są to tak zwane Szkoły TYPU A. Częścią wytycznych jest również proponowana struktura organizacyjna dla nowo powstających szkół, aby mogły lepiej wspierać działania związane z uczeniem się i kreatywnością STEAME.

Część O3. Wytyczne dotyczące struktury organizacyjnej szkoły STEAME są motywowane i uzupełniają części: O1. Wytyczne dotyczące dynamicznych i adaptacyjnych programów nauczania STEAME i O2. Wytyczne dotyczące zajęć STEAME w szkołach dla dwóch grup wiekowych. Częścią tego produktu jest również podzielony na moduły Kurs Szkoleniowy dla Nauczycieli, Dyrektorów Szkół i Przedstawicieli Władz Oświatowych. Dalsze materiały i filmy znajdują się w linkach.

Głównymi grupami docelowymi niniejszych Wytycznych są władze szkolne, kierownictwo, dyrektorzy, kadra nauczycielska i administracyjna w szkołach oraz wszyscy zainteresowani wdrażaniem działań STEAME i rozwijaniem metodologii STEAME w szkołach (istniejących lub nowych), przy czym ostateczna grupa docelowa to uczniowie klas 7-12.

(BG) УВОД

Тази електронна книга предоставя насоките за организационна структура на STEAME училища, иницииращи въвеждането на промяна на парадигмата в образованието. Предоставените насоки се отнасят до промени в съществуващите училищни организационни структури, които могат да бъдат реализирани съобразно с гъвкавостта на вече съществуващите структури, наричани училища тип А. Част от насоките е и предложената организационна структура за новосъздадени училища, така че те да могат да подпомагат STEAME дейностите за учене и творчество.

Книгата „O3. Насоки за организационна структура на STEAME училища“ са производна и допълнителна част към книгите „O1. Насоки за динамични и адаптивни учебни програми STEAME“ , и „O2. Насоки за училищни STEAME дейности за две възрастови групи“. Част от този продукт е и курс за обучение на учители, училищни ръководители и представители на властта, разделен на модули. Предоставени са и връзки към допълнителни материали и видеоклипове.

Основните целеви групи на настоящите насоки са училищните власти, ръководството, директорите, преподавателския и административният персонал в училищата и всеки, който се интересува от прилагането на STEAME дейностите и развиването на STEAME методиката в училищета (съществуващи или новосъздадени) с целева група учениците в 7-12 клас.

(ES) INTRODUCCIÓN

Este libro electrónico proporciona las reglas generales de la estructura organizativa para las escuelas STEAME iniciando la introducción de un nuevo cambio de paradigma en la educación. Las reglas generales proporcionadas se refieren a los cambios en las estructuras organizativas escolares ya existentes que se pueden llevar a cabo de acuerdo con la flexibilidad de las estructuras actuales. Son las así llamadas Escuelas TIPO A. Una parte de las reglas generales representa una estructura organizativa propuesta para las escuelas recién establecidas de forma que éstas puedan soportar el aprendizaje y las actividades creativas STEAME.

El libro „O3. Las reglas generales para la estructura organizativa de la escuela STEAME “son una parte derivada y complementaria a los libros: „O1. Reglas generales para currículos STEAME dinámicos y adaptables “y „O2. Reglas generales para las actividades STEAME en las escuelas destinadas a dos diferentes grupos de edad “. Además, una parte de este producto constituye un Curso de formación, dividido en módulos para profesores, representantes de directores de las escuelas y autoridades. Materiales y videos adicionales aparecen proporcionados en los enlaces.

Los principales grupos meta de estas Reglas generales son las autoridades escolares, la gerencia, los directores, el personal docente y administrativo de las escuelas y cualquier persona interesada en implementar las actividades STEAME y desarrollar la metodología STEAME en las escuelas (existentes o nuevas) cuyo grupo meta final son los estudiantes de los grados 7-12.

(FR) INTRODUCTION

Ce livre électronique fournit les lignes directrices de la structure organisationnelle pour les écoles STEAME initiant l'introduction d'un nouveau changement de paradigme dans l'éducation. Les lignes directrices fournies font référence à des changements dans les structures organisationnelles existantes des écoles qui peuvent être réalisés en fonction de la flexibilité des structures actuelles. Celles-ci sont appelées les écoles de TYPE A. Une partie des lignes directrices est également une structure organisationnelle proposée pour les écoles nouvellement créées afin qu'elles puissent soutenir les activités d'apprentissage et de créativité STEAME.

L'O3. Lignes directrices pour la structure organisationnelle de l'école STEAME est une partie dérivée et complémentaire des livres : O1. Lignes directrices pour les programmes STEAME dynamiques et adaptatifs et O2. Lignes directrices pour les activités STEAME dans les écoles pour deux groupes d'âge. Une partie de ce produit est également un cours de formation pour les enseignants, les chefs d'établissement et les représentants de l'autorité, divisé en modules. D'autres documents et vidéos sont fournis dans des liens.

Les principaux groupes cibles des présentes lignes directrices sont les autorités scolaires, la direction, les chefs d'établissement, le personnel enseignant et administratif des écoles et toute personne intéressée par la mise en œuvre des activités STEAME et le développement de la méthodologie STEAME dans les écoles (existantes ou nouvelles) avec le groupe cible final, les élèves de la 7e à la 12e année.

(DE) EINLEITUNG

Dieses E-Buch bietet die Leitlinien für die Organisationsstruktur von STEAME-Schulen, die die Einführung eines neuen Paradigmenwechsels in der Bildung einleiten. Die bereitgestellten Leitlinien beziehen sich auf Veränderungen in bestehenden Schulorganisationsstrukturen, die entsprechend der Flexibilität der bestehenden Strukturen realisiert werden können. Diese werden TYP-A-Schulen genannt. Teil der Leitlinien ist auch eine vorgeschlagene Organisationsstruktur für neu gegründete Schulen, damit sie STEAME-Lern- und Kreativitätsaktivitäten unterstützen können.

Die O3. Richtlinien für die Organisationsstruktur von STEAME-Schulen ist ein abgeleiteter und ergänzender Teil der Bücher: O1. Leitlinien für dynamische und adaptive STEAME-Lehrpläne und O2. Richtlinien für STEAME-Aktivitäten in Schulen für zwei Altersgruppen. Bestandteil dieses Produkts ist auch ein in Module gegliederter Schulungskurs für Lehrer, Schulleiter und Behördenvertreter. Weiteres Material und Videos werden in Links bereitgestellt.

Die Hauptzielgruppen dieser Leitlinien sind die Schulbehörden, die Schulleitung, die Schulleiter, das Lehr- und Verwaltungspersonal in den Schulen und alle, die daran interessiert sind, STEAME-Aktivitäten umzusetzen und die STEAME-Methodik in Schulen (bestehende oder neue). Als abschließende Zielgruppe sind die Schülerinnen und Schüler der Klassenstufen 7-12 festgelegt.

CHAPTER 1. OVERVIEW AND CONTEXT

This intellectual output aims to develop Guidelines for Organizational Structures of schools considering the fact that this may be a transition stage for almost all Educational Systems in Europe. These guidelines are produced in a multilateral cooperative way aiming at producing an output with European added value. To ensure sustainability of the proposed guidelines we developed the STEAME Observatory, a tool mainly for schoolteachers supporting a dynamic and adaptive STEAME Curriculum in schools. To the best of our knowledge there are no such guidelines currently available.

Organizational structures exist in certain countries meeting the needs of the authority or region, in some cases based on private school development initiatives and in others piloted within public schools . All these cases are considered in these guidelines. The challenge and consequently the innovation of this project is to provide guidelines for changes in existing school organizational structures that can be realized according to the flexibility of current structures. This will be called the TYPE A Schools. Part of the guidelines is also a proposed organizational structure for newly established schools so they can support STEAME learning and creativity.

The present guidelines constitute the ultimate result of IO3 as a logical continuation and complimentary part to I*O1. "Guidelines for dynamic and adaptive STEAME curricula"* and I*O2. "Guidelines for STEAME Activities in Schools for two age groups"*. Part of this output is also a Training course for Teachers, School Heads and Authority representatives divided into modules.

1.1 TARGET GROUPS

The main target groups of these Guidelines are the school authorities, managers, head teacher/s and teaching and administrative staff in schools implementing STEAME education in two main types of schools:

TYPE A Schools (how to modify structures in existing schools)

Considering the output O1 and O2 the partners propose guidelines with scenario options for minor and major organizational structural changes that today's school could make to enable them to run STEAME activities. These guidelines are formed following round table meetings with teachers, school principals and authority representatives organized through the Multiplier Events. Therefore, for different scenarios the guidelines indicate the level of possible adaptation.

TYPE B Schools (how new schools should be structured)

The project partners believe that no new school should be built using the standard type of infrastructures and organizational structures. New schools need to consider STEAME type activities and should be designed satisfying some minimum specifications. This activity uses all the outputs and discussions to propose a type of organization structure and an optimum infrastructure design. We provide a sample design created by a professional designer and relevant technical specifications , as part of these Guidelines.

1.2 MAIN RESULTS

The main results of these Guidelines were produced according to the following activities:

- O3-A1: TYPE A Schools (how to modify structures in existing schools)
- O3-A2: TYPE B Schools (how new schools should be structured)
- O3-A3: Discussions with school authorities to determine the level of possible adaptability under current structures or flexibility to change

- O3-A4: Training course for Teachers, School Heads and Authority representatives with supporting training materials, modules and guidelines for teachers.

1.3 KEY ELEMENTS

These Guidelines include some main elements generated throughout the above activities:

- Conducting surveys across all partner countries with common questionnaires – both online and via dedicated interviews and round table sessions.
- Part of the data collection was also the organization of focus groups by partners inviting teachers, school authorities, administrative staff, education experts, innovation experts, teachers' trainers, pedagogical institutes, universities, and other educators, policy makers, school associations and other interested parties. The average number of participants was ten. training modules with a training package of materials and learning plans including learning outcomes, introduction and broad description of the context and goal of the area/ topic addressed, methodology and approaches for the module training presentation, instruments, tools, supporting materials, resources, pedagogical/learning sequencing and activities plan.
- Based on the discussions with school authorities, policy makers, school heads, and other relevant stakeholders a policy recommendations summary is provided in these Guidelines.

Thus, all the above elements provide analysis and conclusions with recommendations for the structural organizations, design, management, approaches and methodologies to be applied in a holistic way so that the school is following STEAME model of education.

In the following chapters you can find the key elements of the STEAME School of the Future which is also directly related to the transformation in education moving from

EDUCATION 1.0 -> EDUCATION 2.0 ->EDUCATION 3.0 -> EDUCATION 4.0

This is the complementary part of the complete "STEAME: Guidelines for Developing and Implementing STEAME Schools" which includes:

- Model of STEAME Schools
- Guidelines for STEAME Activities in Schools
- Guidelines for cooperation between teachers of different disciplines
- New organizational structures for STEAME schools
- Training of Teachers to help them to adapt
- Dynamic Change in Curricula, Tools, Methods.

1.4 STEAME SCHOOL OF THE FUTURE

STEAME school mark the evolution of the schools within the scope of the next generations of education moving from Education 1.0 to Education 4.0:

EDUCATION 1.0

- Authoritarian
- The student is the passive recipient
- Teacher centered system the teacher gives knowledge as the absolute leader in the classroom
- Technology is forbidden in the classroom

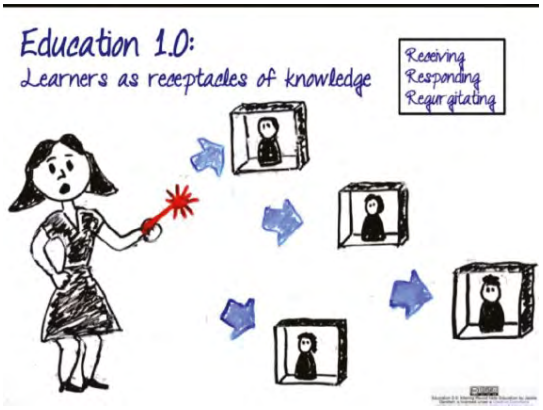


Figure 1.1: Education 1.0

EDUCATION 2.0

- Communication and collaboration are starting to grow
- Exam-based approach -the result is the examination -Memorization of knowledge
- An underestimated student-centered approach, we call it but do not apply it.
- The schools are still talking about hours of teaching. But they should talk about hours of learning!!!
- Invasion of technology and social networking
- Technology is applied to the classroom as a trend indicator, but the class continues to have the same structure

Figure 1.2: Education 2.0

- Complete confusion - students know the technologies better than teachers
- No design for what is used and what is not
- Many choices, but there is no money for buying and applying, uncoordinated technology correlation with the curriculum the system cannot properly follow the evolution of technology
- There is no teacher training, data is everywhere, Google Search is faster from traditional libraries - the web knows more than our teacher WE WERE NOT READY FOR COVID 19
- Students give technical knowledge to their teachers.

EDUCATION 3.0

- Student Centered approach
- The teacher is transformed into a Coordinator/facilitator, advisor, learner and practice guide
- The student is researching
- Flip classroom method applies
- More dialogue, technology is everywhere, the student is self-learning and everywhere.
- The classical style classroom no longer exists
- Lesson Plans are now called… Learning Plans

Figure 1.3: Education 3.0

EDUCATION 4.0

- Co-creation and innovation in the center
- Whenever and Wherever
- Flipped classroom applied (Hybrid Learning Environments)
- Interactive practical exercise–F2F or Distance
- Learning is done at home or outside school, while in school students develop skills
- Development of personalized teaching and learning
- Learning Plans are now called Learning & Creativity Plans
- The technology is free or/and easily accessible, increased use of virtual reality, artificial intelligence, etc.
- Continuous evolution and innovation and therefore a need for development of Competences and Skills so people become Adaptable to Change
- The teacher is now coordinator, facilitator, mentor
- Inquiry, creativity, interdisciplinary and cooperative approaches constitute the learning environment.

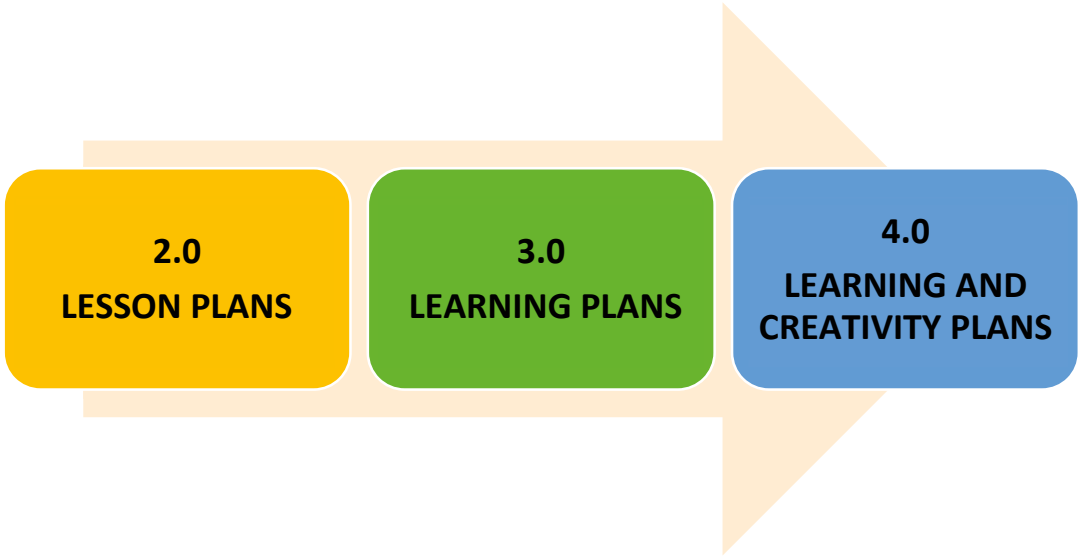


Figure 1.4: Education 2.0 to 4.0 – From lesson plans to learning and creativity plans

CHAPTER 2. RESULTS FROM THE SURVEY

One of the final products and goals of the project STEAME was to provide guidelines for changes in **EXISTING** organizational structures that can be realized and adapted according to the flexibility of these structures. Another aim was to provide guidelines on how **FUTURE AND NEWLY CREATED** schools could be designed to allow the implementation of **STEAME activities.**

=> The project defines the elements to be changed in existing schools' structure for STEAME and to structure new ones based on best practices and input from the online survey and the focus groups conducted by the partners in the project.

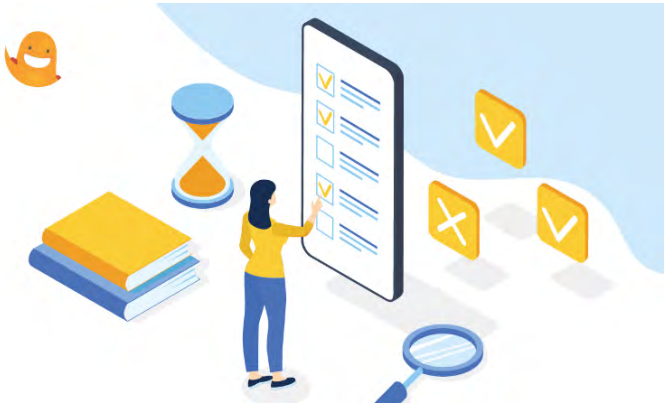
2.1 OVERVIEW OF THE ONLINE SURVEY RESULTS

The surveys were conducted for two months duration in all partner countries with the same approach and questionnaire using local languages in translation.

The following representatives participated:

122 responses by:

- **83 teachers**
- **16 students**
- **9 principals**
- **10 parents**
- **School staff incl. EU project managers – 4**



The process followed was:

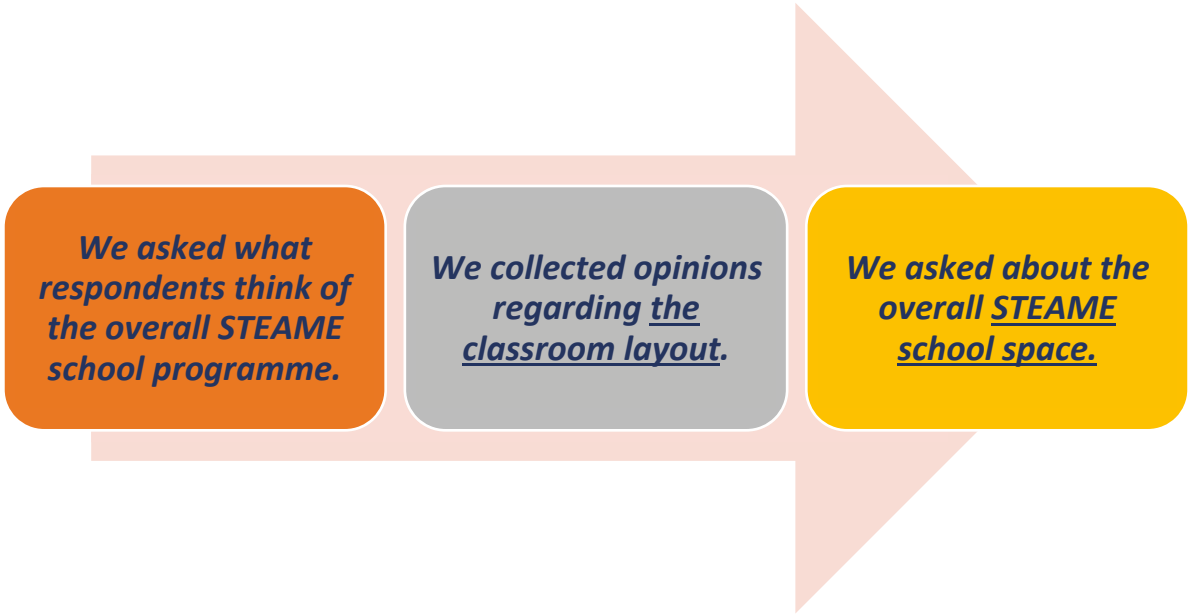


Figure 2.1: Process of the Survey

2.2 MAIN CONCLUSIONS:

The main components to be modified and adapted to the new model are the school space, classroom design, teaching and learning approach and methodologies applied in class, new ways of assessment. In all these aspects the respondents replied as follows:

2.3 SURVEY RESULTS ABOUT THE STEAME SCHOOL SPACE

- *Most of our respondents (73%) think that it should cover the STEAME Learning and Creativity plans.*
- *Almost 70% of the survey respondents think that the key success factor is the structured group work within the* project-based learning *and student groups for idea generation, discussions and networking.*
- *76% of the respondents support the space for personalized learning, individual research activities, assisted by online or offline content (texts, graphs, pictures, audio and video content).*
- *78% of our respondents think that the design should support the STEAME teaching mode to support critical thinking, technology-enabled collaboration, teacher's led instruction for each grade.*

2.4 SURVEY RESULTS ABOUT THE CLASSROOM DESIGN

- *75% of our respondents think that the STEAME program should shape the education process and the classroom design, not the other way around. Some think it is a two-way process.*
- *Most of our respondents (60%) to the survey think that to achieve blended learning the STEAME classroom should be a large room, with open space interior design and all this part of a flexible infrastructure.*
- *93,4% of the respondents think that the classroom furniture has to be moveable in order to enhance layout flexibility.*

- **More than 75% think the STEAME program should shape the education process and the classroom design**

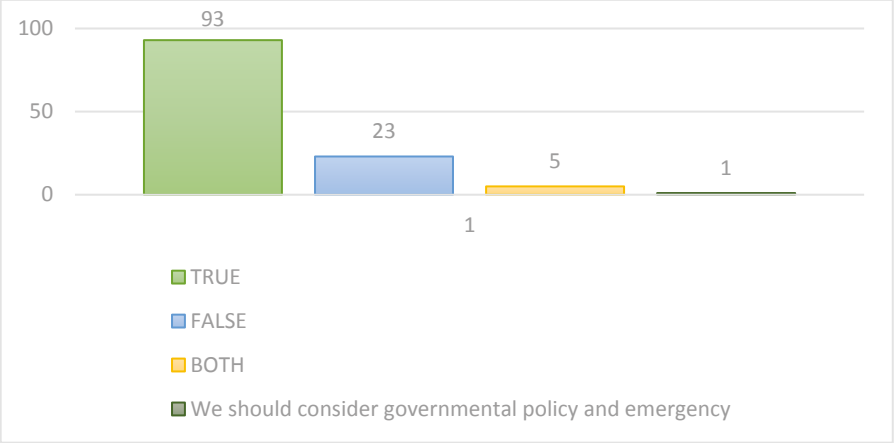


Figure 2.2: Should the STEAME program shape the education process and the classroom design? - Graph of results

To achieve blended learning the STEAME classroom should be:

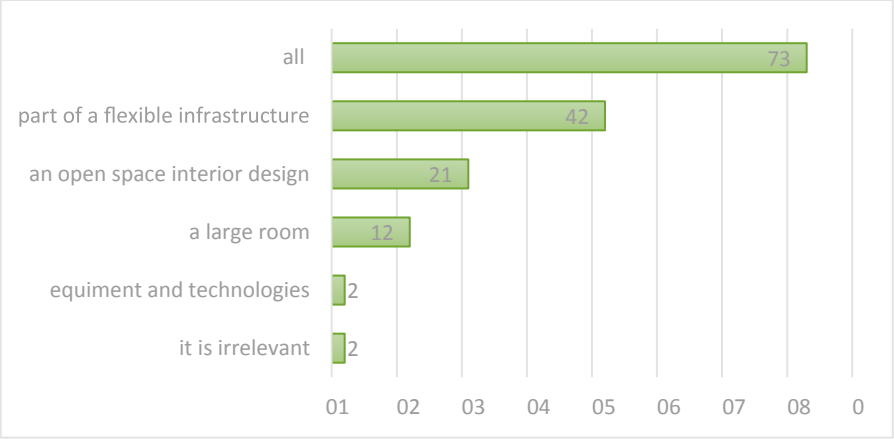


Figure 2.3: To achieve blended learning the STEAME classroom should be... - Graph of *results*

The overall opinion is related to the need for a holistic approach and the school spaces and organizational structure could hold specific arrangements and nomenclature to meet the needs of the new model. The classroom layout could also be aligned with the outcomes of STEAME and blended learning approaches.

Another key conclusion is related to the Learning and Creativity plans created purposefully for STEAME as opposed to the traditional Learning plans. It is shown on the graph below:

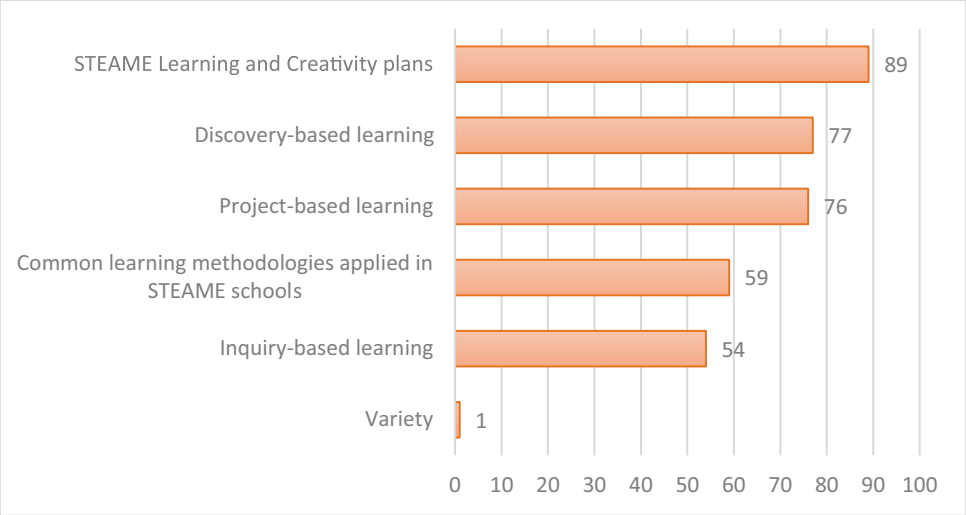


Figure 2.4: School spaces can hold specific nomenclature to cover the needs of... – Graph of results

The survey results suggest that the classrooms are purposefully designed for STEAME as presented below:

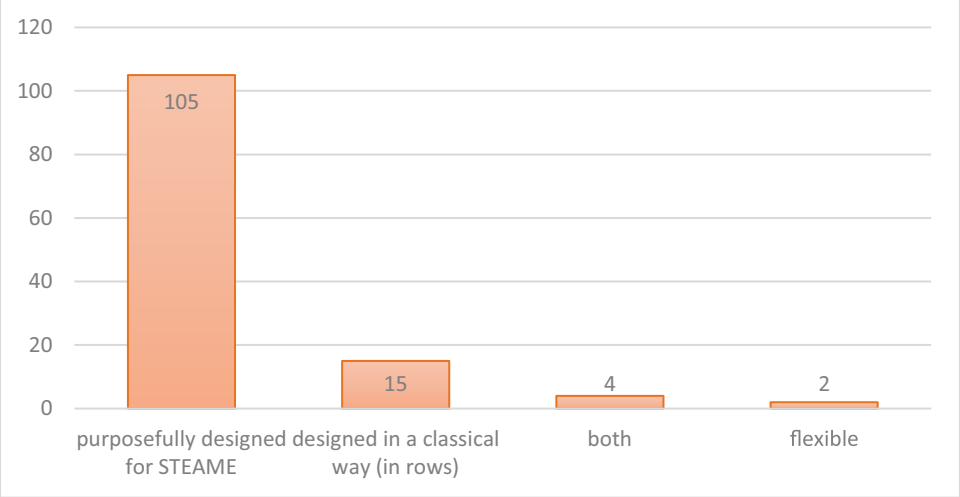


Figure 2.5: The classroom should be... - Graph of results

In terms of the architecture and furniture one common feature is shared by most of the respondents: flexibility and open-space design.

The organizational structure also includes suggestions for digital/computer spaces and labs as digital skills of students and teachers are key success factors for STEAME. Moreover, it is recommended to aim for interdisciplinary approach with humanities, inter-grade and -classes collaboration, teachers' collaboration.

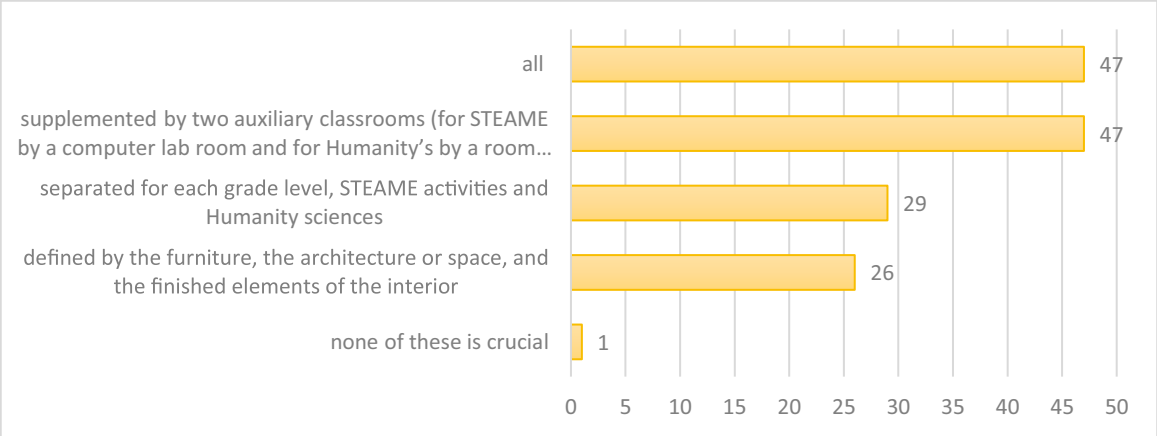


Figure 2.6: The classrooms should be... - Graph of results

At the same time the results suggest that the organization of the SPACE in the STEAME school is mainly determined by different learning environments/zones for idea generation, discussions, teamwork, prototyping (in the labs), etc.:

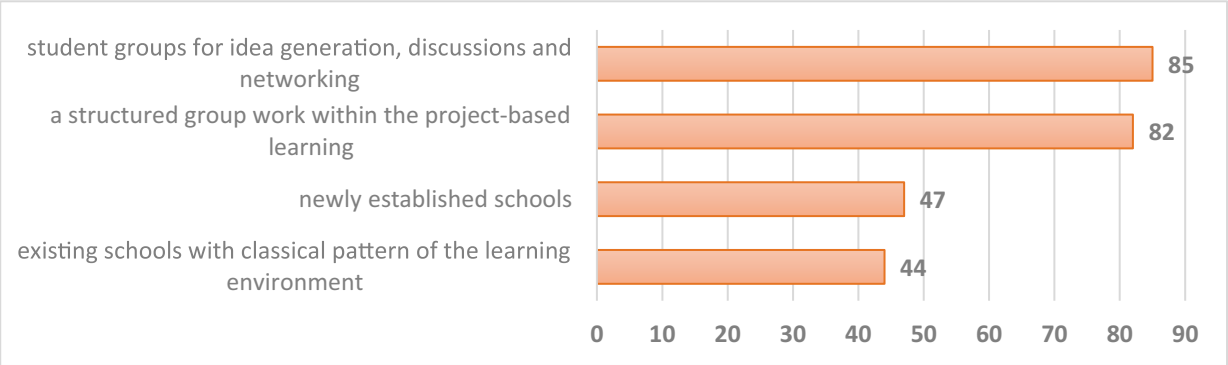


Figure 2.7: The organization of the space in the STEAME school is mainly determined by different learning environments in... - Graph of results

The main goals of such structures of the new/re-organized STEAME schools are to support and encourage:

- critical thinking
- technology-enabled education process
- development of digital skills
- interdisciplinary approach
- new role of the teacher as a facilitator and moderator as opposed to instructor and tutor
- student-centered approach
- creativity and innovation
- integration of the whole process with the study spaces.

The assessment process is also adjusted and changed so that students are graded based on their creations/products and final results, without the traditional exams but rather outcome assessment and creativity assessment. Teachers need training for the change of mode of facilitating the learning and assessment, too. It is also suggested that the assessment is made as a co-assessment between teachers as they need to learn to work together in different fields with groups of students.

In terms of the spaces and the classrooms layout, they meet the needs of the students and their motivation is a central point. Enhancing creativity and teamwork and productivity and motivation is the underlying aim of the new type of schools.
Examples of modern technologies to be applied: robotics room, 3D printing sector, STEAME materials, rooms for creations, design software, others.

The final conclusions lead to the following:

The STEAME education model shapes the education process and is implemented and managed in a holistic way.

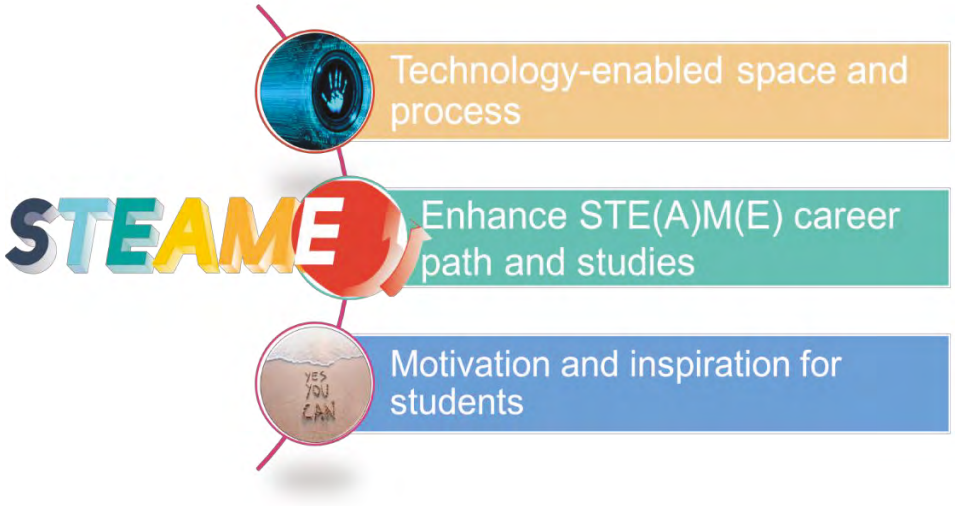


Figure 2.8: STEAME education model

CHAPTER 3. RESULTS FROM THE FOCUS GROUPS

The below summary of the results from focus groups is based on the activity done in the partner countries. This consolidated, European level report is based on the national focus group reports prepared and provided by the partners of STEAME.

The results from the focus groups form provide a collection of information and suggestions on how existing schools can be restructured for STEAME activities and how future schools to be designed to run STEAME activities. In total five focus groups were implemented from the following five partner countries: Italy, Greece, Cyprus, Bulgaria, and Poland. The consortium took a hybrid approach when conducting the Focus Groups, having 53 participants online and 18 physical participants. The total number of focus group participants was 71. Lastly, the participants' backgrounds varied from school teachers, school principals, HE teachers, students, teacher trainers, architects, education policy makers, decision makers, school administrative and management staff, parents and other key stakeholders to IT experts.

The questions that were asked aimed to encourage participants to share their experience, expertise, opinion and recommendations regarding the main elements and features in existing schools' structure that are subject to change to support STEAME activities and guide the creation of organizational and architectural structure and design of new STEAME schools.

The focus groups validated and elaborated further the main findings and conclusions with recommendations drawn from the surveys. Below are listed the questions of the focus groups along with a summary of the main discussions.

1. ***The STEAME program should shape the education process of the school and the classroom design.***

All participants agreed that the STEAME programme should shape the entire educational process in the school. This would ensure that teaching by separate disciplines and standardized curricula, which is still carried out in schools, could be finally surpassed or modified. A part of the participating teachers mentioned some skepticism reported by many of their colleagues to these changes. Difficulties in finding the acceptance to implement every process of change to STEAME schools and dynamic school curriculum were observed. For this reason, they expressed that the main challenge will be the implementation of STEAME schools and activities and the cooperation of teachers, rather than the

design of the classrooms and the school itself. Also, some of the participants argue that this process should be also further supported by the school principals or school heads who are capable of making a change.
Furthermore, the importance of interaction was highlighted by participants in Greece. Schools should be open to cooperation and collaboration, by linking the local and the international community. Therefore, internationalization is considered an important element for future schools. It was also suggested that the schools' timetable could be more flexible, for example, except for the basics, each student could choose how to create his/her own timetable according to his/her interests, thus the timetable itself can also be adapted to the STEAME philosophy.

"I consider that the goal is for students to love basic research, and this can be done through STEAME activities" - focus group participant

2. ***The classroom layout should be aligned with the outcomes that school principals and teachers aim to achieve when implementing STEAME and blended learning.***

Most of the participants agreed with this statement. First, it is the overall aim of the school and the team and most importantly – students' motivation. Thus, the new methodologies and approaches should be combined and aligned with the design of the school – i.e., if they will learn by project-based learning then students need space for teamwork and equipment to support the work on projects and experimentations. Moreover, some Italian teachers described schools visited outside Italy, where the environments are certainly more in line with a STEAME teaching and learning: schools equipped with laboratories and 'working spaces' where students realize 'products' and provide services directly to the public. An Italian Vice-Principal of a high school mentioned the innovation of his school structure, where even just coloring the walls has substantially changed the environment, making it more comfortable for adolescents to work and study in.

3. ***The STEAME classroom should be a large room, with open space interior design and all this part of a flexible infrastructure***

All participants agreed on the fact that open spaces are more creative and represent open minds, which helps students to be more innovative. Some of the major skills that students should build in the 21st century are flexibility and critical thinking. Classroom's flexibility contributes to building these skills. Moreover, getting students to work in groups, requires large flexible spaces to allow freedom of movement so as not to hinder their interaction, which in confined classrooms with fixed furniture and layout, often creates confusion. All participants think that to achieve blended learning, STEAME classroom should be a large room with open space interior design.

"The classroom infrastructure should be flexible, but we should certainly include smart and flexible desks where students can work. This cannot change". – focus group participant.

In addition, some participants mentioned that open space should be combined with labs and IT equipment and space could be further divided for different tasks/activities in a creative environment. Furthermore, many Italian participants even though they strongly agreed that flexibility in school structure would be the ideal environment for STEAME schools, they expressed their concern in

implementing STEAME activities in Type A schools; schools' structures are old as they were built years ago and have undergone little maintenance. The current size of the Italian classrooms certainly does not allow for large open spaces.
In addition, some participants from Greece mentioned that forming their experience in both open and close spaces is always necessary to create the corresponding mentality to both students and teachers. Thus, a suggestion was made for having a combination of spaces (large open spaces and small close classrooms) that are shaped in a way that inspires students to be creative. A Cyprus participant suggested that in existing old school structures, a dual model learning system can be applied, standard system in the morning, and STEAME learning in the afternoon, formalizing the whole learning concept through a new operation of all-day schools.

4. ***The classroom furniture has to be moveable in order to enhance layout flexibility.***

- All the participants agreed that furniture is moveable.
- The chairs are colorful with the ability to spin around so that children can interact with one another.
- Light and individual desks so that they can be moved and rearranged easily. Also, the desks of students should have such a shape so that when we put them together, they will create polygons enabling teamwork. Lastly, they should have wheels.
- Mobile whiteboards or replace completely the traditional black or white boards by a set of digital boards and displays well visible from any place in the classroom, where the teacher or students should come with their own tablets.
- Moving walls to help the division of spaces and the carrying out of different tasks and activities simultaneously. Also, this way rooms can be smaller and/or larger when necessary.
- An Italian engineer/teacher set out the idea, launched in his school, of transparent walls that, however, did not meet with much approval by his colleagues.
- Separate spaces/zones in the open space.
- Proper lighting and air conditioning in every space.
- Soundproof spaces.
- Teachers should be able to take any seat (if standing is inconvenient) to perform their work.

It was noted by some participants that many solutions can be found with a lot of inventions that can be of low cost to implement them in TYPE A schools. Also, students could be involved in this process of creating solutions. Almost everyone agreed that classrooms should be designed for STEAME. Participants also mentioned that the classroom should be more flexible and more thoughtfully designed. However, the classical way of students sitting by a desk should be in the same context. Other elements mentioned are repeated above in the report. Bulgarian participants mentioned that old and new approaches can be applied, at least for some years. It depends on how type A schools (existing schools) are willing to adjust to the STEAME design. Most of the schools in Bulgaria are traditional and will need work to adjust. They also highlighted the importance of teachers as key factors who should be open-minded and collaborative, ready to take up new roles and work together with students.

5. ***In terms of type of classrooms and how to be designed:***

Many ideas and opinions emerged with this question. Focusing on Italy, most participants believe that STEAME teaching and learning could also be implemented using IT tools so that it can be useful for the humanities. Alongside IT laboratories however, all classrooms should be equipped with mobile computer tools such as tablets or portable computers. On the other hand, when moving our focus to Bulgaria, the participants mentioned that it is better to have the STEAME space/zone/corner separated, as science requires some equipment and technology to be used. However, no matter if the studies are STEM/STEAME/Humanities the attitude is the same – students need motivation and innovative ways of learning to attract their attention. Lastly, participants from Greece agreed that the merge of STEAME activities and Humanity sciences would need classroom reconfiguration, which would require more personnel and higher room density (space per student). The reconfiguration could also be easier than changing the whole class; it might be accomplished with the help of technology, e.g., AR/VR labs. Technology can have a crucial role in this flexibility.

6. ***Regarding the overall <u>STEAME school space</u>***

Participants agree with the survey result by stressing the importance of creativity in learning. Therefore, the school spaces should be designed to adapt to the specific moments and phases of the Learning and Creativity Plans: - space for teachers' meetings and planning; - technology-aided rooms for students' activities (inquiry and discovery- collaborative tasks); - laboratories and workshops for creative productions; - conference rooms for meetings, also with community members and business representatives. Next, it was stressed again that it is more important to have the right attitude and teach in a novel and interesting way. Some participants from Greece were not sure if they can distinguish the first two (project-based learning & inquiry-based learning) with the last one (STEAME Learning & Creativity plans). Participants also said that there is no clear distinction between these models, for example, project-based learning includes research and exploratory learning along with the concept of project, and in this sense, it includes all other forms of learning as presented in the question. Whichever, STEAME Learning & Creativity Plan gives the opportunity to students to choose which path to follow, however all forms of learning will include research procedure or a discovery at the end. As a result, if a class setting covers one of the aforementioned, it covers all others too.

7. ***Project-based learning and teamwork***

All participants in the focus groups agreed that working in groups is beneficial for teachers and students. Group work for generating ideas, discussions and networking should also be the basis of the organization of the STEAME school space. Lastly, Bulgaria has expressed some concerns since newly established schools are very hard to create in Bulgaria. In the big cities there are many private schools who lead the trend and apply innovative design and approaches. The classical schools can be rearranged and adjusted (Type A schools). In both types, students are the leading party. Therefore, STEAME requires mostly teamwork, creativity and generating ideas.

8. What spaces should be available in STEAME schools?

It was mentioned that there is a need for three or four separate classrooms where students will be able to work and implement research, the participants called them "working classrooms". Such classrooms could also be used by teachers to discuss with their colleagues for other various projects (preferably STEAME projects) to be implemented. Other participants mentioned the importance of having a space where students or teachers can meet in a "relaxed" environment to get to know each other, some even called it a "school pub for students and teachers". This will be especially useful for teachers to meet and discuss their interest or teaching methods to achieve collaboration within the teachers to implement STEAME learning plans to students. **Students should feel welcome in the surrounding space and feel excited to be present there**. Even if that includes a small kitchen to cook their own meals etc. Also suggested was the possibility to have such a space that are all together but work separately:

Figure 3.1: Example of how STEAME schools' spaces could be

Some further ideas shared:

- Tablets with cases in a box. Routers in classrooms if not wi-fi.
- 3D printers
- Computer lab with Virtual Reality capability

Some participants reported their experience in visiting schools with huge libraries where there were spaces for both the activities of consulting physical texts and the presence of computers for online searches. Within them there were also spaces for small groups enabling the consultation of learning offline, a practice that digital natives are not so accustomed to but allows for blended learning and better responds to the requirements of multiple intelligences and learning styles. Moreover, many participants agreed that the above should be available but aligned and used for the purposes of STEAME. It is also recommended to use the approaches of some leading universities and give students such tasks and activities to better prepare them for higher education treating them like adults. Group work should be combined with individual tasks especially for some experiments, exercises. This is also in response to the individual learning style to be considered.

9. ***The participants in the focus groups shared their ideas leveraging and complimenting the ideas from the surveys***

All the participants agreed with the shared ideas. Schools should be modern, colorful with flexibility to organize the process and most of all – identify the needs of their students. The process should be faced as a whole, and the classroom should reflect that. Teachers should know their students and be flexible to adjust. However, some *concerns* and *suggestions* were made:
One participant from Greece indicated from her personal experience that: "The level of success depends on the culture of each country. The student's and the teacher's culture have the most significant role. For this reason, we have to adapt a model derived from a certain country to successfully implement it in another country". That is why many participants stressed that research on how effective the model we implement in our own country, is important. Lasty, many participants from Italy mentioned their concerns to the difficulties encountered on a daily basis in Italian schools. Some complained about the lack of cooperation of colleagues who prevent STEAME subjects from being treated as a whole, while others have also expressed the difficulties arising from the organization of school time in Italian schools. For STEAME teaching and learning it is necessary to have students in attendance for several hours and in Italy only primary schools provide full-time. Secondary schools may be open to students and teachers for extracurricular activities, but curricular activities are scheduled in the morning. Therefore, to implement STEAME projects on a regular basis, it would be necessary to restructure not only the schools' spaces but also the schools' timetables.

10. ***In terms of the design of the space and the classrooms the participants expressed the following suggestions:***

- Classrooms should have a corner with small couches and rug. The rug should not be in the whole classroom as it will be difficult for the furniture to be moved around.
- More storage spaces fixed either in one place or with the ability to move around.
- The classrooms should be aired properly, to have the proper lighting and be soundproof to avoid distractions.
- Organization of materials in boxes
- A corner for hands-on activities. It is ok to be messy there.
- Classrooms that can expand.
- Easy movable furniture for re-arranging the working space.
- The classrooms should be as modular and mobile as possible.
- Several building blocks-elements of different kinds and shapes that can be linked together to enable students to achieve the modeling of several artifacts.

Participants also shared what emerged from the survey. For example, the experiences that children manage to do with participation in Erasmus projects was discussed. The opportunities that these students have, even at a very young age, are those that help change or rather evolve their lives and enable them to achieve success beyond school. Particularly a student form Cyprus mentioned that along with his teacher he managed to win competitions by doing the work for the competition in "gap hours" during school days. Later he highlighted that if such activities were implemented and adapted into the regular school timetable, we can imagine it could bring exceptional outcomes rather than doing work by trying to find time in-between gap hours.

On the other hand, some participants point out that some obstacles emerge when these projects are proposed inside their schools, mainly due to the difficulty among the more stable teaching staff of accepting changes, which may destabilize their long-standing practices.

In general, it is extracted that STEAME links the skills students develop with the needs of future professions and it is important to enable them to succeed in their future workplace. In that sense, the STEAME teaching approach can provide life changing opportunities and post-secondary success. Technology may enhance the effectiveness and success of such an approach if used appropriately. It is evident that when talking about STEAME, Technology, the 2nd letter of the acronym would play a major role.

11. ***Would you share your experience and/or best practices of STE(A)M(E) model of schools? What is their organizational structure and design?***

BEST PRACTICES/EXAMPLES you can share:
Some private schools in Bulgaria are ahead – in most of them there are modern science and computer labs, colorful furniture, chairs, students sit in a circle and have space for free time, homework, individual and group work. Teachers have their "doors open" attitude to listen to students, give consultations, spend time after classes with them, help and work together on projects. They very often take the role of coaches and the study process is blended – do work in class and then coach/mentor the teams online after classes. From the focus group in Greece, the following practices were extracted: The organizational structure of a STEAME school can have multiple aspects. The first aspect is the timetable. Students except for certain courses, included in the national curriculum, should have the opportunity to choose extra-curricular courses and be able to work in groups independently, either inside or outside their school's space. The content and topics of these extra-curricular courses should be flexible and always in line with real-world situations, so that they can be able to discuss and study them or even create topics that are related to current affairs. Ideas: ➢ Large writing boards ➢ Easy ways of placing posters, infographics or other artifacts created by students but also there can be digital interactive touchscreens, placed horizontally or vertically that can be used for multiple activities. ➢ Often change the layout of a classroom just like the four seasons of the year. Some major concerns came to the surface from the Polish participants about the constraints in implementing STEAME schools: A typical school cannot afford separate rooms for physics lab, chemistry lab, robotics lab etc., because it needs all available rooms for teaching. Labs are potentially dangerous (e.g., chemical substances) or subject to vandalism, this requires supervision which is not available. There is a general issue with granting access to school spaces for students not supervised by a teacher. Usually, classes are locked during breaks. A solution for this could be a VR Laboratory.

3.1 OTHER COMMENTS AND SUGGESTIONS:

- "The most important thing for me is to, firstly, set a set of guidelines on how we can implement STEAME schools or activities in existing schools and how to meet the peculiarities that exist in the school environment within each European country."
- The designing of the future STEAME schools should be done carefully.
- STEAME schools are for all students, not only for gifted students.
- One suggestion to start implementing STEAME activities in schools is for each teacher to implement STEAME activities with his/her class and participate with their own will in STEAME projects. "Create the future STEAME schools' step by step."
- Another suggestion is to create an afternoon STEAME school. Or create a half school day implementing STEAME activities.
- Another suggestion was to create a school where students come at 8 in the morning and leave at 5 in the afternoon (an all-day school). The afternoon hours will be to implement only STEAME activities. Also, the kids should have a lunch break at 1-2 where they can eat in a catering kitchen and have a proper lunch. Of course, the implementation of this will require great costs.
- There is much interest in the STEAME model of school because everyone agrees that this would have an absolutely positive impact on both the teachers and the learners.
- existing constraints should be considered, we need realistic, feasible solutions.
- More flexibility in the whole education system is urgently required.

3.2 CONCLUSIONS

The Focus group was a great way for getting meaningful insight on how existing schools can be restructured for STEAME activities and how future schools should be designed to run STEAME activities. Many great suggestions for improvement were made and many ideas were discussed. Certainly, the focus group has helped to specify the next steps and improve the quality of the outputs. Especially important was that we got the chance to see the specific features and difficulties faced in schools and education systems in each country of the consortium. Overall, the focus group implementation was successful with a lot of interesting ideas shared.

The main conclusions and recommendations concern the project idea. Local authorities could be informed on the results of this project and heavily consider the design of the STEAME school that will be part of the tangible results of the project. Already existing schools should be improved to welcome flexible furnishing and transform spaces into more appropriate learning and teaching environments; future schools should be built according to this new innovative design.

Teachers could be open-minded, flexible, generating ideas and listening to their students. Students should be encouraged to give ideas for the school design, too. Student council should be organized enhancing the collaboration between the staff of the school and the teachers to apply new models, design, methodologies and participate in any experiments and testing of new models.

The project coordinator said: *"The school of the future is the learning home of the students and students have the right to choose their home".*

CHAPTER 4. THE STEAME TRAINING COURSE FOR TEACHERS, SCHOOL HEADS AND AUTHORITIES

4.1 MAIN PURPOSE

The STEAME training course is developed for the main target groups of teachers, school heads and authority representatives. By definition, STEAME education concerns a learning approach involving a variety of realms of meaning i.e. Science, Technology, Engineering, Arts, Mathematics and Entrepreneurship. The whole approach stems from the need to connect education with the real world and not consider it as an isolated luxury that has been devised just to be an added burden to human beings.

This need, that is to interconnect a broad variety of realms of meaning and action, demands the involvement of a broad range of human capital with diverse cognitive background and competencies, in the spirit of the contemporary practice where construction and creation demands a broad range of contributors.

In the context of traditional education, we had teachers that were experts in a field of study and one of their major roles was to elaborate and provide activities for developing skills and competencies in that particular field. But now, with the immense amount of knowledge and the multidimensional requirements of competencies for the complex world we live in, the situation is different. Thus, an answer to respond to this challenge, is to develop teams of collaborating teachers representing or equipped with a variety of background and competencies. The present modules aim exactly at identifying methods, culture and disposition for such collaboration.

Furthermore, the modules aim at identifying the pros and cons of such approaches of achieving the collaboration between the facilitators of learning. Moreover, they aim in developing competencies for improving the positive aspects and remedying or even nullifying the negative or risky aspects. It is a key component of the Guidelines giving hands-on experience and materials for preparing the staff of schools on how to design, structure and implement STEAME educational models.

4.2 TARGET GROUPS

Teachers, school management and authorities are the main target groups. The process of educational transformation is a long and complex one with a lot of stakeholders, decision makers and parties involved in it. Also, the direct beneficiaries of such changes/transformation are the children who are very sensitive and responsive to change and easily affected. The training course is designed in a very practical way so these main groups can easily apply the suggested process of Modules which also represents the main elements, content and steps to be followed in order to organize, design, structure and manage STEAME schools.

Some of the main skills we aim to develop are:

- Improve their digital skills for on-line collaboration & learning environments
- Use new digital tools in hybrid environments
- Use new and different strategies and methods to suit different learning modes
- Use Project-based Learning (PBL), Inquiry-based Learning (IBL), and Problem Solving in remote learning

4.3 RECOMMENDATIONS AND GUIDELINES HOW TO APPLY THE COURSE

The course is designed for implementation by professional trainers who have the expertise in STE(A)M(E) education and approach.

The key success factors for the implementation are as follow:

Figure 4.1: Key factors for successful implementation of the course

4.4 OVERVIEW OF THE MODULES

Each module has specific learning outcomes and materials to be used for training such as PowerPoint presentations and additional materials like templates, videos, tools, etc.

MODULES OF THE TRAINING program for teachers or other interested parties in the Development and Implementation of STEAME Schools

- Module 1 -2. How to construct L&C plans
- Module 3. How teachers can work together (18 steps prototype and other aspects)
- Module 4. How to help teachers and students work online (Hybrid environments)
- Module 5. How to support students in making oral presentations
- Module 6. How to write papers/reports (journal etc.)
- Module 7. How to work on projects (Inquiry Based Learning, Project Based Learning)
- Module 8. How to work on projects (Peer questions)
- Module 9. How to develop STEAME schools (Type A and Type B Schools, survey results)
- Module 10: Evaluating STEAME project/activities work of students
- Module 11-12: Course Assignment hands-on development of a L&C Plan

Template *for the Methodology and Structure of a Learning Plan for Presenting a Module for the STEAME course programme, module of 2 hours duration)*

Module Number and Area/ Topic: …

Introduction and Broad Description of the Context and Goal of the area/ topic addressed: …

Learning Outcomes: With the completion of this module the trainees will be able to:

1…

2…

3…

Content and Resources (providing information on the various constituents/ dimensions of the topic under consideration): …

Methodology and approaches for the module training presentation: …

Instruments/ Tools/ Supporting Material/ Resources to be used: …

(List of files, web links, videos, PPT…. use file names inserting the Module number)

Pedagogical/Learning Sequencing and Activities Plan: …

Introductory activities (creation of interest, reference to real value issues, relation to background experiences etc.).

Activity Number and broad Description:	
Development	
Materials	
Resources	
Estimated Time	
Environment/Room Setting	
Trainees' role	

Development activities

Activity Number and broad Description:	
Development	
Materials	
Resources	
Estimated Time	
Environment/Room Setting	
Trainees' role	

Note: You can add more activities if needed.

Practicing Activities (hands-on activity)

Activity Number and broad Description:	
Development	
Materials	
Resources	
Estimated Time	
Environment/Room Setting	
Trainees' role	

Evaluation of Learning Outcomes

Activity Number and broad Description:	
Development	
Materials	
Resources	
Estimate Time	
Environment/Room Setting	
Trainees' role	

Reflection and Closure activity:

In the link below, you can find videos (webinars) and material from the STEAME course:

https://steame.eu/steame-training-course/

Module 1-2. How to construct L&C plans

Introduction and Broad Description of the Context and Goal of the area/ topic addressed: This module will provide training on the Sessions of the STEAME Learning and Creativity Plans, two examples from different subjects/topics and partners, and a small session to construct simple L&C plans by participants.

Learning Outcomes: With the completion of this module the trainees will be able to:

Content and Resources (providing information on the various constituents/ dimensions of the topic under consideration):

Methodology and approaches for the module training presentation:

The methodology used for this module training presentation focuses on hybrid teaching and learning environments and consists of 3 sessions:

1. Presentation of the of the Structure-Sessions STEAME Learning and Creativity Plans
2. Discussion about two examples from different subjects/topics and partners
3. Collaborative construction of simple L&C plans by participants

Instruments/ Tools/ Supporting Material/ Resources to be used:

Pedagogical/Learning Sequencing and Activities Plan:

How to help teachers and students work online (Hybrid environments)

Introductory Session 1

Activity Number and broad Description: Presentation of the Structure-Sessions STEAME Learning and Creativity Plans	
Development	
Materials	
Resources	
Estimated Time	15’
Environment/Room Setting	Either in presence or online
Trainees’ role	interactive

Methodology Session 2a

Activity Number and broad Description: Discussion about the 1st L&C Plan example	
Development	
Materials	

Resources	
Estimated Time	20
Environment/Room Setting	Either in presence or online
Trainees' role	interactive

Methodology Session 2b

Activity Number and broad Description: Discussion about the 2nd L&C Plan example	
Development	
Materials	
Resources	
Estimated Time	20
Environment/Room Setting	Either in presence or online
Trainees' role	interactive

Practicing Activities (hands-on activity) Session 3

Activity Number and broad Description: Example 1 with selected activities from 2 L&C Plans (Italy): Project for development of soft skills L&C activities	
Development	
Materials	
Resources	
Estimated Time	45'
Environment/Room Setting	Either in presence or online
Trainees' role	interactive

Evaluation of Learning Outcomes Session 4

Activity Number and broad Description: Summative gamified by all participants	
Development	
Materials	
Resources	
Estimate Time	10’
Environment/Room Setting E	ither in presence or online
Trainees’ role	interactive

Module 3. How teachers can work together (18 steps prototype and other aspects)

Learning Plan *for Presenting Module 3 for the STEAME course programme, of 3 hours duration.*

Learning Outcomes:
With the completion of this module the trainees will:

1. Be able to identify the major facilitators that must be taken into consideration in determining and designing STEAME activities for students at secondary school level.

2. Be able to specify their (the major facilitators) role and responsibilities.
3. Be able to concentrate on the role and responsibilities of the sub-team of teachers that will be involved in the process of designing and implementing the STEAME activities.

4. Be able to refer, to illustrate and to apply in class competencies for collaboration in order to promote actions and arrangements for preparing, formulating and implementing action plans for learning.
   Such competencies include:
   - Contact, cooperation and reflection with the workers shaping the real world.
   - Provision of incentive and motivation to the learners.
   - Determining and formulating, in cooperation with other facilitators, problems of interest to the real world
   - Support and guide, in cooperation with other facilitators, the students for gathering information
   - Support and guide, in cooperation with other facilitators, the students for handling a problem or project
   - Support and guide, in cooperation with other facilitators, the students for using a variety of topics (in the context of STEAME) in developing and representing models for the promotion of solutions and results to the issues under consideration
   - Support and guide, in cooperation with other facilitators, the students in developing creative and innovative approaches or models for the promotion of solutions and results to the issues under consideration.
   - Assess cooperatively the work of the students and provide comments and suggestions taking into consideration the contribution of the various STEAME constituents.
   - Review and reflect cooperatively (learners and learning facilitators).

1. Be able to discuss and exchange ideas with other learning facilitators on:
   - Constructing learning plans with mutual content, complementing the aspects, concepts and processes that have common interest or value
   - Assessing the various activities so that they have mutual value and
   - Exploiting audiovisual and digital aids

Content and Resources (providing information on the various constituents/ dimensions of the topic under consideration):
The STEAME Project: https://steame.eu/
In Particular its Outputs:
O1. Guidelines for dynamic and adaptive STEAME curricula
O2. Guidelines for STEAME Activities in Schools for two age groups
O3. Guidelines for STEAME School Organizational Structure

The STEAME Observatory: https://steame.eu/steame-observatory/
Learn STEM: http://www.learn-STEM.org
Integrated STEM teaching State of Play: (http://steamit.eun.org).

Methodology and approaches for the module training presentation:

- Collaborative learning: brainstorming, debates, co-design and planning
- Constructionism: inquiry based and project-based learning
- Developing case studies and worksheets
- Investigating researching using the web
- Maieutic: Socratic method of questioning

Instruments/ Tools/ Supporting Material/ Resources to be used:

- STEAME project open access environment, in particular the STEAME observatory
- Posters, videos, photos, ppt presentations

Pedagogical/Learning Sequencing and Activities Plan:

Introductory activities (creation of interest, reference to real value issues, relation to background experiences etc.)

Activity 1: Brainstorming on the consideration of the issue of "How teachers can work together" in the context of promoting and implementing STEAME schools' organizational structure	
Development	Brainstorming by considering the need of more than one person in order to achieve better outcomes. Reference to Aristotle: 'the whole is greater than the sum of its parts'. A discussion is enacted of what can be achieved by considering two or more situations or personalities or other concepts that can produce/ create another entity with a number of added value properties The examples proposed are: a. Horse and donkey giving rise to a mule b. Hybrid cars c. The theory of chaos and a related poster Discuss possible combinations of teachers and others that are involved in the development of an appropriate STEAME activity, as well as the roles and responsibilities of each of them.
Materials	The poster on the chaos theory from the STEAME observatory https://steame.eu/wp-content/uploads/2020/12/Have-you-heard-about-CHAOS-Theory-infographic-poster.pdf
Resources	On the web descriptors: donkey, Horse, mule e.g., https://www.luckythreeranch.com/lucky-three-ranch-training/mule-facts/
Estimated Time	15 min
Environment/Room Setting	In the case of a class: Circular arrangement in order to facilitate discussion In the case of online presentation: Provisions for chatting
Trainees' role	Participation in the discussions.

Development activities

Activity 2: Discussion of various combinations of teams working together, taking into consideration the needs that give rise to the STEAME approach. In this context refer to teams that have to work for problem solving project work, construction activity, Game Activity, Cultural activity and so on	
Development	Consideration of the traditional approaches for co-teaching. Refer to what happens in traditional teaching and particularly in Schools of Students with Special needs:

	Reflection on the extent of the restrictive model arising from these in the context of STEAME. Reflection-Discussion on the following issues **How can teachers work together?** What is the range of this question? • Teachers working with other teachers? • Teachers working with other entities in the context of the school? (Students, heads, parents, etc.) • Teachers working with experts in various fields? (Universities, Industry, NGOs, etc.) • Teachers working with organizations that are promoting/ introducing to the world of life and work? (Galleries, Museums …) What skills/ competencies do we expect from teachers in order to promote the idea of "working together"? How do we develop/ encourage/ cultivate such skills/ competencies? PROVIDE A quiz for the participants Examples: Discussions on some ideas of collaborating teams in developing approaches for STEAME. Such teams can be supported by persons/ experts that are not necessarily teachers. Consideration of examples MATHeatre, MATHFactor The Monopoly game Tunnel of Eupalinos. The Ancient Samos and its water supply https://youtu.be/AJTwxCaOODM Refer to the Monopoly connecting Industry, mathematics and Business Refer to various kinds of STEAME activities. Extend the game to cover other issues as well, for example environmental issues and the need to introduce other dimensions in the game. The NASA STEM programme This discussion supports the need to promote the following activities that are providing material for the achievement of the objectives of this module
Materials	QUIZ 1 in Appendix 1
Resources	MATHeatre, MATHFactor see the webpage of EUROMATH EUROSCIENCE to find a number of examples https://www.youtube.com/watch?v=0BtpDpa55u4&list=PLpPvt2LgHCYfTulPlQkch1y7VW0I4ncje&index=8&t=301s The MATH – GAMES webpage:
Estimated Time	25 min
Environment/ Room Setting	In the case of a class: Circular arrangement in order to facilitate discussion In the case of online presentation: Provisions for chatting
Trainees' role	Discussion Answering the Quiz 1 in Appendix 1

Activity 3: Concentrating on the cases of collaboration between teachers, identify and refer to the objectives and steps involved for actions of having them working together.	
Development	From the previous discussions it becomes clear that collaboration between teachers is quite a necessity, particularly in the case of STEAME. So, the question: How can teachers work together? LIST 1 What skills and competencies should be developed in promoting this idea? LIST 2 What are the practical aspects that they should observe in order to achieve this goal? Discussion and suggestion of a series of actions that are helpful in moving in the direction of collaboration in the context of STEAME
Materials	LIST 1 and LIST 2 in APPENDIX 2
Resources	
Estimated Time	30 min
Environment/Room Setting	In the case of a class: Circular arrangement in order to facilitate discussion In the case of online presentation: Provisions for chatting
Trainees' role	Participation in the discussion Study LIST 1 and LIST 2

Activity 4: Discussion of examples using the L&C Plans in the observatory	
Development	What are the constituents/ structure of a Learning and Creativity Plan as it is presented in the Observatory? Consider a case of these and identify, study, discuss and reflect on this, taking into consideration the points presented in the previous parts of this presentation i.e., the elements of Stage I and Stage II. Furthermore, reflect on the extent/ degree that each trainee feels that he/ she is in a position to develop their own Learning and Creativity Plans
Materials	
Resources	The STEAME Observatory
Estimated Time	30 min
Environment/Room Setting	In the case of a class: Circular arrangement in order to facilitate discussion In the case of online presentation: Provisions for chatting
Trainees' role	Study of a case of an L&C plan Participation in the discussion

Activity 5 Identify some tips that have to be taken into consideration or are helpful for effective and fruitful collaboration of teachers	
Development	**Quiz 2** Write on a piece of papers your suggestions for Tips for supporting/ facilitating/ enabling the collaboration/ working together of teachers in the context of STEAME. Provide a list of such tips and discuss/ exchange ideas on them. **Worksheet 1** Identify elements that facilitate collaboration in the development of the L&C Plan (#) Presentations - Discussion
Materials	Quiz 2 and Worksheet 1 in APPENDIX 3
Resources	The STEAME Observatory Consider the examples of L&C Plans: (#)
Estimated Time	25 min
Environment/Room Setting	
Trainees' role	Answering quiz 2 Working on worksheet 1 Participation in the discussion

Practicing Activities (hands-on activity)

Activity 6: Develop case studies on a few topics by referring to the possible teams of teachers, their knowledge background and decide/ describe their role and responsibilities in the development of a Learning and Creativity Plan	
Development	Consider the participating list of trainees in this course taking into consideration their field area. Decide on two or three topics that you feel that are suitable for developing activities in the context of STEAME with the collaboration of other teachers. Select from the participants' list (preferably) or from the teachers in your school, one or two that you feel that you feel that they have common ground for working together on one of the topics you are thinking of. Exchange ideas with them on the feasibility of collaboration on developing activities in the context of STEAME, proposing topics and initial steps for work. Continue this exchange of ideas and proposals until you reach a point that you feel that you have enough ground of agreement and common understanding covering a topic, connection with the appropriate curricula etc., taking into consideration the list of tips suggested earlier. After reaching a consensus on the basic points start working for the preparation of a learning plan
Materials	Writing means
Resources	LIST 2 (APPENDIX 2)
Estimated Time	30 min

Environment/Room Setting	In the case of a class: Circular arrangement in order to facilitate discussion In the case of online presentation: Provisions for chatting
Trainees' role	Participation in the discussion Groupings of participants in order to develop collaborating ideas for the STAGES I and II presented in the LIST 2 (APPENDIX 2)

Evaluation of Learning Outcomes

Activity 7: Discussion and reflection of the role of the teachers in the process of working together. Consideration of self-evaluation processes of the teachers in this process. Consideration of issues of evaluating the extent of the impact on students' learning through the approach of teachers working together	
Development	**Quiz 3** What are the guiding principles for a successful preparation of a project or similar action requiring the involvement of more than one facilitator in the learning process in the context of STEAME? What are the important steps and actions that a team of teachers should undertake in order to design and process a learning plan in the context of STEAME? Reflection and Discussion
Materials	Writing means
Resources	Quiz 3 in APPENDIX 4
Estimate Time	20 min
Environment/Room Setting	In the case of a class: Circular arrangement in order to facilitate discussion In the case of online presentation: Provisions for chatting
Trainees' role	Answering quiz 3 Participation in the discussion and reflection

Discussion of various combinations of teams working together

Before we move to the main question of "How can teachers work together?" let us reflect and consider some examples where we have issues that are interesting to both real life and school curriculum and where we are expecting collaboration of a broad range of expertise. The issues can range from technological needs to games and cultural activities.

QUIZ 1

Write down some of your suggestions
In this process it is useful to identify:

- Topic of interest.
- Its relation to STEAME.
- Composition of Teams of collaboration and expected contribution from each member of the team.
- Associated Areas of the school curriculum.

LIST 1

Framework of capabilities of the teachers in the process of working together.
They should:

1. Be able to identify the major facilitators that have to be taken into consideration in determining and designing STEAME activities for students at secondary school level.

2. Be able to specify their (the major facilitators) role and responsibilities.

3. Be able to concentrate on the role and responsibilities of the sub-team of teachers that will be involved in the process of designing and implementing the STEAME activities.

4. Be able to refer, to illustrate and to apply in class competencies for collaboration in order to promote actions and arrangements for preparing, formulating and implementing action plans for learning.
   Such competencies include:
   - Contact, cooperation and reflection with the workers shaping the real world.
   - Provision of incentive and motivation to the learners.
   - Determining and formulating, in cooperation with other facilitators, problems of interest to the real world
   - Support and guide, in cooperation with other facilitators, the students for gathering information
   - Support and guide, in cooperation with other facilitators, the students for handling a problem or project
   - Support and guide, in cooperation with other facilitators, the students for using a variety of topics (in the context of STEAME) in developing and representing models for the promotion of solutions and results to the issues under consideration
   - Support and guide, in cooperation with other facilitators, the students in developing creative and innovative approaches or models for the promotion of solutions and results to the issues under consideration.
   - Assess cooperatively the work of the students and provide comments and suggestions taking into consideration the contribution of the various STEAME constituents.
   - Review and reflect cooperatively (learners and learning facilitators).

5. Be able to discuss and exchange ideas with other learning facilitators on:
   - Constructing learning plans with mutual content, complementing the aspects, concepts and processes that have common interest or value
   - Assessing the various activities so that they have mutual value and
   - Exploiting audiovisual and digital aids

LIST 2

Stages and points that are facilitating the process of collaboration of teachers
STAGE I: Preparation by one or more teachers plus experts/ entrepreneurs

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.

Some Actions that may be taken for stage I by the persons involved:

	Wider Environment/-Society plus the school staff	School Administration	Teacher 1	Teacher 2	… Teacher n
Step 1 of STAGE I	Identify an issue, idea, challenge	Specify the aspects of the issue as they relate to the learning process, discuss possible thematic areas	Propose ideas in related to his/hers subject area	Propose ideas in related to his/hers subject area	Propose ideas in related to his/hers subject area
Step 2 of STAGE I	Contact/ collaboration between the various actors to specify the various aspects, constituents of the problem.	Contact/ collaboration between the various actors to specify the various aspects, constituents of the problem … Connect this to elements of the official curriculum	Participate and elaborate on the discussions. Investigate on their repercussions on the curriculum of the topic in relation to the real world	Participate and elaborate on the discussions. Investigate on their repercussions on the curriculum of the topic in relation to the real world	Participate and elaborate on the discussions. Investigate on their repercussions on the curriculum of the topic in relation to the real world
Step 3 of STAGE I		As specified in Step 2. Determine general objectives. Discuss responsibilities. Prepare initial plan	Determine particular objectives and specify initial actions and needs. Exchange ideas with the other teachers	Determine particular objectives and specify initial actions and needs. Exchange ideas with the other teachers	Determine particular objectives and specify initial actions and needs. Exchange ideas with the other teachers
Step 4 of STAGE I	Collaborate with the school and the teachers, in particular, on further actions ranging from support economic to scientific	Collaborate on management and organization issues	Determine organizational and management issues and initial plan, through collaboration with the other teachers	Determine organizational and management issues and initial plan, through collaboration with the other teachers	Determine organizational and management issues and initial plan, through collaboration with the other teachers

STAGE IIa: Action Plan Formulation (Steps 1-18)

Preparation (by the teachers involved)

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)

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.

STAGE IIb: STEAME Actions and Cooperation in developing Creative Projects or other activities for school students

Brief Description/Outline of Organizational Arrangements / Responsibilities for Action

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

H	Guidance	Support Guidance	Support Guidance	16 (repetition 5-11)
I	Guidance	Support Guidance	Support Guidance	17
K	Creative Evaluation	Creative Evaluation	Creative Evaluation	18

So, the question: What should be some aspects that collaborating teachers should have as lighthouse in the process of guidance?

STAGE IIc: Remarks and Guiding Lines for Collaborative Guidance
Some Important Points that should be taken into consideration by the teachers collaborating in the process of guiding the students to take productive actions in the development of the project

The official Curriculum. The activities and support should be focused in promoting the goals of the official curriculum as a whole and also as it is reflected in the individual curricula of the topics where the collaborating teachers are experts.

Key Knowledge, Understanding and Success Skills. The project is focused on student learning goals, including standards-based content and skills such as critical thinking/problem solving, collaboration and self-management.

Challenging Problem or Question. The project is framed by a meaningful problem to solve or a question to answer, at the appropriate level of challenge.

Sustained Inquiry. Students engage in a rigorous, extended process of asking questions, finding resources and applying information.

Authenticity. The project features real-world context, tasks and tools, quality standards or impact. Or it speaks to students' personal concerns, interests and issues in their lives.

Student Voice & Choice. Students make some decisions about the project, including how they work and what they create.

Reflection. Students and teachers reflect on learning, the effectiveness of their inquiry and project activities, the quality of student work, obstacles and how to overcome them.

Critique, Revision and Assessment. Students give, receive and use feedback to improve their process and products.

Public Product. Students make their project work public by explaining, displaying and/or presenting it to people beyond the classroom.

APPENDIX 3

Quiz 2
Write on a piece of papers your suggestions for
Tips for supporting/ facilitating/ enabling the collaboration/ working together of teachers in the context of STEAME.
Provide a list of such tips and discuss/ exchange ideas on them.

Worksheet 1
Identify elements that facilitate collaboration in the development of the L&C Plan.

Module 4. How to help teachers and students work online (Hybrid environments)

Module Number and Area/Topic: Module 4. How to help teachers and students work online (Hybrid environments)

Introduction and Broad Description of the Context and Goal of the area/ topic addressed: This module will provide training on how to help teachers and students work online in hybrid environments.
Learning Outcomes: With the completion of this module the trainees will be able to:

1. Improve their digital skills for on-line collaboration & learning environments
2. Use new digital tools in hybrid environments

3. Use new and different strategies and methods to suit different learning modes
4. Use Project-based Learning (PBL), Inquiry-based Learning (IBL), and Problem Solving in remote learning

Content and Resources (providing information on the various constituents/ dimensions of the topic under consideration):

- STEAME - Project based methodology
- STEAME - Inquiry - based learning in STEAME
- STEAME - Problem Solving

Methodology and approaches for the module training presentation:

The methodology used for this module training presentation focuses on hybrid teaching and learning environments and consists of 4 sections:

1. Hybrid learning environment
2. STEAME methodology in a hybrid learning environment
3. STEAME learning and creativity activities in a hybrid-learning context
4. examples from two L&C Plans:

Project for development of soft skills L&C activities (lead: ITC Pacle Morante Limbiate) [approx. 30-40 min]

Hybrid activities of collaborative planning carried out by teachers of different subjects (possible digital platforms and websites to use: Edmodo, Gsuite, Spark)

Among the many digital platforms available, we have chosen Gsuite for education because it is the one we use on our daily teaching. Following are the functions we use both for distance and presence working.

1. Google Calendar to arrange meetings with the school community, with external stakeholders, experts (trainees will be shown how it works). (Distance and presence activities)
2. Google Meet to have online meetings (distance learning)
3. This function enables teachers: to share documents/videos/data etc., to create breakout rooms and work in small groups
4. Google Classroom that allows teachers of different subjects to cooperate, to communicate, to share ideas, give their opinion, answer different questions simultaneously and work on documents (e.g., project planning document) (distance and presence activities)
5. Google Drive that works as a repository for any material

The first step is the choice of the topic on which the different teachers have to work. After that, there can be a real or virtual discussion/brainstorming aimed at finding out which aspects of the main project can be explored and which teachers can be actively involved in their discipline and which teachers can support using a shared table like the following Planning (5 min). Hands-on activity with the trainees: Try to complete the table (3 min)

The involved teachers will complete the Learning and Creativity Plan STEAME_L&C-Plan_Template.docx (5 min). Consequently, teachers will create the groups among the students to work on the various activities of the Plan

Students' group activities focused on a chosen topic

As a demonstration, we have chosen the topic of “the train”. The subjects that could be involved are Science/Engineering, Art and Entrepreneurship. First of all, we have to start with a driving question that could be: *“How has the train been changing the world and how will it impact our lives?”*. The aim is to develop soft skills such as enquiry skills, problem solving, critical thinking, teamwork, collaboration and leadership, communication skills, presentation skills. The methodology that will be used is the Jigsaw that is a cooperative learning strategy that follows some steps:

1. divide students evenly into 3 groups of 6 students = these are called **Jigsaw groups** which are heterogeneous, that is there are two representatives for each subject involved: Science/Engineering, Arts, Entrepreneurship.

2. divide the content (the train) into 3 chunks of knowledge: past, present, future and then in each chunk some issues have to be analyzed in the 3 subjects involved: assign a chunk of content to every pair in the Jigsaw group. A chunk of content can be retrieved from various sources: a textbook chapter or an online resource. Students will be given guiding questions to help them study their chunk of content.
3. have students meet in **Expert groups**: these are made by students who have studied the same chunk of content. Within each expert group students compare their ideas and work together to prepare a kind of presentation to give to their Jigsaw group. During this step gaps in individual study can be filled, misconceptions can be cleared up. Within the blended learning environment, the presentation can be delivered either through posters on the wall, if in presence, or through Google Slides presentation during a video conference.
4. students return to their original Jigsaw groups. Now each pair of students in turn present their chunk of information and the rest of the group takes notes and asks questions. This is the realization of peer education.
5. Tools to be used by students for their activities in distance learning: Google Meet breakout rooms for group work
6. Google documents/ Google Slides for sharing content and collaborative writing assess all students on all the content through a quiz covering all the chunks. Students can be assessed individually, but in order to trigger competition, a group assessment can take place.
7. Each Jigsaw group creates a final product which will be their answer to the driving question.

Presentation of students' project using digital tools
Among the different tools (Google Sites, Google Slides, Genially, Sway)
students can use for the presentation of their results we have chosen

- Sway, and
- Genially.

Customised e-shop L&C activities (lead: Doukas) [aprox. 20-30 min]

- entrepreneur's part in learning activities (present & QA & best practices)
- brainstorming activity (use of same digital tool f2s and on-line)
- entrepreneur activity with the use of a gamified application
- digital quizzes
- development and presentation of students' project

Section 4. Reflection and Q&A time
Instruments/ Tools/ Supporting Material/ Resources to be used:

- www.oecd.org , www.commonsense.org etc.
- https://www.commonsense.org/education/articles/how-to-plan-for-hybrid-teaching-and-learning
- https://www.pblworks.org/blog/rethinking-distance-learning-and-how-make-it-work-all-students
- https://www.pblworks.org/blog/school-closures-using-pbl-remote-learning
- kahoot.it/game app
- infographics

Pedagogical/Learning Sequencing and Activities Plan:
How to help teachers and students work online (Hybrid environments)

Introductory Session 1

Activity Number and broad Description: Hybrid activities of collaborative planning carried out by teachers of different subjects, importance of teachers' and students' digital skills lessons learned, tips for a successful hybrid-teacher (creation of interest, reference to real value issues, relation to background experiences)	
Development	

Materials	www.oecd.org , www.commonsense.org etc.
Resources	
Estimated Time	15’
Environment/Room Setting	Either in presence or online
Trainees’ role	Interactive

Methodology Session 2

Activity Number and broad Description: STEAME framework of PBL, IBL, Problem Solving in hybrid learning	
Development	
Materials	www.pblworks.org
Resources	PBL, IBL, Problem Solving
Estimated Time	15’
Environment/Room Setting	Either in presence or online
Trainees’ role	Interactive

Practicing Activities (hands-on activity) Session 3a

Activity Number and broad Description: hybrid activities of collaborative planning carried out by teachers of different subjects	
Development	Presentation of Google Gsuite and tools
Materials	Computers, Laptops, IWB, projector
Resources	GSuite, Internet
Estimated Time	10’
Environment/Room Setting	Either in presence or online
Trainees’ role	Interactive

Activity Number and broad Description: students' group activities focused on a chosen topic	
Development	implementation of the Jigsaw method
Materials	notebooks, tablets, computers
Resources	Gsuite, Internet
Estimated Time	10’
Environment/Room Setting	Either in presence or online
Trainees’ role	Interactive

Activity Number and broad Description: presentation of students' project using digital tools	
Development	demonstration of the use of the digital tools
Materials	notebooks, tablets, computers
Resources	Genially, Sway, Google Sites
Estimated Time	10’
Environment/Room Setting	Either in presence or online
Trainees’ role	Interactive

Practicing Activities (hands-on activity) Session 3b

Activity Number and broad Description: Example 2 with selected activities from L&C Plan (Greece): Customized e-Shop	
Development	
Materials	Game app, Kahoot app, Infographics, Presentation app

Resources P	BL, IBL, Problem Solving, Pearson Edexcel International GCSE
Estimated Time 3	0’
Environment/Room Setting E	ither in presence or online
Trainees’ role	Interactive

Evaluation of Learning Outcomes Session 4

Activity Number and broad Description: Summative gamified by all participants	
Development	
Materials	
Resources	
Estimate Time 1	0’
Environment/Room Setting E	ither in presence or online
Trainees’ role	Interactive

Module 5. How to support students in making oral presentations

Module Number and Area/Topic: Module 5. How to support students in making oral presentations

Introduction and Broad Description of the Context and Goal of the area/ topic addressed: This module provides ideas and training on how to help teachers and school students prepare a valuable oral presentation

Learning Outcomes: With the completion of this module the trainees will be able to:

1. Improve their presentation skills.
2. Implement technology in preparing presentations.
3. Understand the right strategies to catch the attention of the audience. Learn to differentiate presentation tools depending on the target audience.
4. Understand your own limits in presenting scientific outcomes.

Content and Resources (providing information on the various constituents/ dimensions of the topic under consideration):

Learn and Creativity Plans or parts thereof as a source of inspiration for topics of presentation

Methodology and approaches for the module training:

Brainstorming on various aspects of presentation motivated but not restricted to the following list (after Erik Palmer: Well spoken).

PART 1: **General**

1. **Audience**
   - For this class, your audience is a group of intelligent adults interested in the course topic, but who do not necessarily know much about your specific project.
   - Other assignments in other classes might require you to gear your presentation to a very different type of audience. Consider this carefully as you prepare.
2. **Content**
   - Check assignment guidelines to make sure you meet all requirements.
   - Choose to present material that YOU find interesting and engaging.
   - Clarify any terms or ideas your audience might need explained or introduced.
   - Connect your topic to your audience's experiences and interests.
   - Exclude information that is not essential and avoid repetition and generalization.
3. **Organization**
   - Grab attention with an opening that makes your audience want to learn more. Strategies include a challenge, a provocative question, a powerful quote, a surprising statistic, an unusual or unexpected fact, a poignant story, or a "teaser."
   - Choose the best organizational strategy. Possibilities include chronological/sequential, problem & solution, compare and contrast, and topical.
   - Provide clear "signposts" to make it clear how you are transitioning to new ideas.
   - Give a powerful closing that quickly reviews major points and perhaps leaves listeners with a memorable thought, a call to action, or other engaging ending.
4. **Visual Aids**
   - Use a minimum of visual aids–only ones that are a) relevant to the talk, b) important (in that they don't just repeat what you say), c) accessible, both mentally and visually, and d) as simple as possible.
   - PowerPoint slides should make no sense without you; in other words, your audience should need you to explain what is on them.
5. **Poise**
   - Despite very natural fears of speaking in public, try to appear calm and confident.
   - Do your best to identify and avoid nervous tics and habits like playing with hair, adjusting clothing, rocking back and forth, continuously smiling or giggling, mangling notes, or saying "like," "um," or "uh."
   - Choose a way to stand that feels comfortable for you.

- Try to stand relatively still except for purposeful movement like gestures, crossing to a different location, and stepping forward or backward or side to side to emphasize points or transitions in your presentation.
- Try not to slouch, whether standing or sitting down.
- Don't dwell on mistakes, which happen to everybody.
- Some strategies to help you calm down and maintain poise include visualizing the room/audience and reviewing the speech in your mind, or taking three long breaths before you go up to present, and another after you're in place.

6. **Voice**
   - Speak loudly enough so that everyone can comfortably hear every word.
   - Enunciate (even over-enunciate if necessary) so each word can be heard.
   - Practice pronunciation (and possibly grammar) beforehand.
7. **Life**
   - Demonstrate your enthusiasm by putting life into your voice.
   - Emphasize some words and phrases with emotion and volume.
8. **Eye Contact**
   - Make near-continuous eye contact with your audience, surveying all individual faces as you speak in order to make people feel involved and also in order to see how they are responding. Use keywords, not complete sentences, on notes.
   - Familiarize yourself with your material so that you are not too dependent on looking at your notes as you speak. However, unless you are reciting a memorized passage for an assignment, you shouldn't feel the need to memorize every word of your speech and remember it perfectly. You should be able to discuss your points in a conversational style. Effective eye contact is often dependent on a skillful combination of "extemporaneity," "leadership," and "retrieval" (see terms below).
9. **Gestures**
   - Use hands, body movement, and facial expressions to convey or emphasize points.
   - Match motion to your words by holding up fingers when counting, using gestures to describe sound or motion, or prompting your audience–saying, "Raise your hand" while raising hand or "Look…" while pointing.
10. **Speed**
    - Practice so that you don't speak too slowly or too quickly out of nervousness.
    - Use pacing to enhance your message–some parts should be faster or slower.
    - Use pauses as a powerful tool for emphasis and dramatic effect.

PART 2: **Extemporaneity**

- Be familiar with material so that you can depart from your "script".
- When others are speaking, don't just wait for your turn to say something; listen carefully to what others say–a good discussion or Q & A should not be a series of isolated points, but should instead grow as participants respond to, debate, and add on to previous responses. Your audience will be more engaged if you genuinely consider and address their thoughts and concerns.

PART 3: **Leadership/Authority**

- You should be able to project in an oral or signed context the mastery you've achieved concerning the specific topic of your major research paper.
- Consider not just your narrow project or argument but also more general background regarding your broader topic that your audience might not know.
- Connect presentation to class concerns, and the interests of audience members.

PART 4: **Retrieval**

- When it comes to perfect memorization, there is no substitute for time and practice. Get a friend to read along as you recite to correct any small errors.
- Each part requires reflection and discussing specific examples. It is better if examples come from the actual audience taking part in the training.
- In doubt, examples prepared before can be used.

- As presentation is a practical skill a lot of attention will be given to practice and more practice and even more practice.
- The course finishes with a Reflection and Q&A time

Instruments/ Tools/ Supporting Material/ Resources to be used:

- STEAME L&C Plans
- Computer resources, PowerPoint vs. beamer
- Clicking devices
- Getting audience involved by electronic immediate polls

Pedagogical/Learning Sequencing and Activities Plan:

How to help teachers and students work online (Hybrid environments)

Introductory Session 1

Activity Number and broad Description: Hybrid activities of collaborative planning carried out by teachers of different subjects, importance of teachers' and students' digital skills lessons learned, tips for a successful hybrid-teacher (creation of interest, reference to real value issues, relation to background experiences)	
Development	
Materials	www.oecd.org , www.commonsense.org etc.
Resources	
Estimated Time	15'
Environment/Room Setting	Either in presence or online
Trainees' role	interactive

Methodology Session 2

Activity Number and broad Description: STEAME framework of PBL, IBL, Problem Solving in hybrid learning	
Development	
Materials	
Resources	PBL, IBL, Problem Solving
Estimated Time	15'
Environment/Room Setting	Either in presence or online
Trainees' role	interactive

Practicing Activities (hands-on activity) Session 3a

Activity Number and broad Description: Example 1 with selected activities from 2 L&C Plans (Italy): Project for development of soft skills L&C activities	
Development	
Materials	www.pblworks.org
Resources	PBL, IBL, Problem Solving
Estimated Time	30'
Environment/Room Setting	Either in presence or online
Trainees' role	interactive

Practicing Activities (hands-on activity) Session 3b

Activity Number and broad Description: Example 2 with selected activities from L&C Plan (Greece): Customised e-Shop	
Development	
Materials	Game app, Kahoot app, Infographics, Presentation app
Resources	PBL, IBL, Problem Solving, Pearson Edexcel International GCSE
Estimated Time	30’
Environment/Room Setting	Either in presence or online
Trainees’ role	interactive

Evaluation of Learning Outcomes Session 4

Activity Number and broad Description: Summative gamified by all participants	
Development	
Materials	
Resources	
Estimate Time	10’
Environment/Room Setting	Either in presence or online
Trainees’ role	interactive

Module 6. How to write papers/reports (journal etc.)

Module Number and Area/ Topic: Module 6. How to write papers in scientific journals

Introduction and Broad Description of the Context and Goal of the area/ topic addressed:
This module will provide training on how to write papers in scientific journals including STEAME Journal.

Learning Outcomes: With the completion of this module the trainees will be able to:

1. Learn an appropriate strategy for writing a scientific paper.
2. Develop and empower critical thinking.
3. Train coherence and logic in argumentative writing.
4. Write a well-structured and good quality paper.
5. Submit a paper to a scientific journal for the review process.

Content and Resources (providing information on the various constituents/ dimensions of the topic under consideration):
The following link provides detailed instructions on the STEAME Journal guidelines:
https://steame.eu/journal-of-steame-creations-for-and-by-school-students/

Methodology and approaches for the module training presentation:
The presentation on "How to write papers in scientific journals" is adaptable in various scientific journal scenarios.

Instruments/ Tools/ Supporting Material/ Resources to be used:

1. (Module_6_How_to_write_scientific_papers_E_ADAMIDI_IASA.ppt
2. http://web.mit.edu/2.tha/www/JournalArticleGuidelines.htm
3. A. Eldawlatly, "Writing Scientific Paper", Manual for Writing Scientific Paper Workshop, https://fac.ksu.edu.sa/sites/default/files/writing_a_scentific_paper_user_manual.pdf.
4. https://steame.eu/journal-of-steame-creations-for-and-by-school-students/
5. MIT OpenCourseware
   https://www.youtube.com/watch?v=G7p3lFMmDiQ

Pedagogical/Learning Sequencing and Activities Plan:
Introductory activities (creation of interest, reference to real value issues, relation to background experiences etc.)

Part 1- Definition of abstract	
Development	A good abstract summarizes the complete report content, including at least one sentence per section: purpose, technical approach, results, and conclusion. The Abstract does not lead into your Introduction – it is a stand-alone section of text. Readers typically decide whether to read a paper based on their impressions of the abstract. Consequently, the abstract can be the most important part of your manuscript.
Guide for writing a good abstract	•The best time to write the abstract is after the manuscript is completed. •The length of the abstract will be clearly stated by the journal and it is prudent to adhere to the length requirements. •Sentence writing should be concise and succinct in the abstract, given the length requirements. The abstract should: •provide an overview of the paper that makes sense when read alone and when read with the paper.

	•provide adequate information for the casual reader to understand what the manuscript is about. •Include information from each section of the manuscript, highlight or emphasize important data and conclusions. •Not contain information that is not included in the manuscript.
Abstract Pitfalls to avoid	•Wordiness •Providing too much or too little motivation for your project •Failure to include a relevant conclusion. •Poor abstracts contain abbreviations, chemical formulas, jargon, or references to the literature, tables, or figures. •Poor abstracts contain claims that do not correspond to findings in the report itself.
STEAME Journal Abstract guidelines	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 sections 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 could 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 could be strictly between 100–250 words, font style bold and size 11.
Keywords	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 are defined in the Instructions to Authors of the journal.

Part 2- Introduction Section	
Introduction	•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. •For STEAME Journal: 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.

Part 3- Methods Section	
Methods	Methods •The methods section conveys to the reader what experiments or interventions were performed to address the hypothesis or question that was formed for the study. •Methods should be described in enough detail so that the reader can judge whether the findings reported in the results section are reliable.

	•Enough detail should be provided to allow the reader to reproduce the experiment (statistical analyses, SW tools). •If the methods have been described in a previous publication, it is acceptable and advised to reference that publication and only briefly describe the method. However, if deviations from the published methodology occurred, this should be clearly stated and described. •If a new methodology is described, be sure to explain what experiments were conducted to test or validate the new methodology.

Part 4- Results Section	
Results	•Results section should state the findings of the experiments and not contain conjecture. •Avoid repeating introductory material and minimize experimental details since experimental details belong in the methods section. •Avoid lengthy analyses and comparisons to other studies, as those also belong in the discussion section. •Difference between data and results. Data are the facts obtained from the experiments and observations; results are statements that interpret the data. •Arrange the results section in a logical fashion, either chronologically, most-to-least important, in vitro to in vivo, etc., using descriptive subheadings. •For each subheading section, state the purpose of the experiment(s) being performed to guide the reader seamlessly through these sections. After stating the purpose, the data are provided in a clear, concise and logical manner. At the end of each subheading section, a statement is provided that summarizes and interprets the data, that is, provides the results (e.g., 'these data suggest that. . .'). •The results section should also clearly direct the reader to the related figures and tables that support the data. •It is important to avoid overlap between the text in the results section and the figures and tables. If data are described in a table or figure, there is no need to also list those data points in the text, as this is redundant. •Well laid-out and well-written results section should be simple to read and should provide a clear story of the data for the reader to interpret and make independent assessments and judgments. •In the Results section consider using tables or Figures developed. "The results are shown in Tables 1–4". •Each figure and table should stand on its own without reference to the text. This means that all abbreviations should be spelt out each time that they are used in the specific legend, or as a footnote.

Part 5- Figures	
Figures	All figures and tables could be embedded in the paper, following the instructions included in this section. 1. Tables and Figures should be referenced within the text and numbered individually in the order of their citation in the text. 2. A brief descriptive title should be displayed at the top of the table area, following the table number (e.g., Table I: ...) and at the bottom of the figure area, following the figure number (e.g., Fig. 1: …). Capitalize the first letter in a label only, not every word. 3. Units should be included in parentheses, e.g., Pressure (MPa), Temperature (K), SI notation.

	4. 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.

Part 6- Discussion section	
Discussion	•Describe only your major points (particularly if they are controversial) to explain and elaborate. 5 paragraphs example: •1st paragraph, summarize the results section and answer the question or hypothesis stated in the introduction •2nd /3rd paragraph, compare your data to existing literature. Explain unexpected findings. Describe patterns, principles, and relationships indicated by the results. Address if the results have theoretical or practical implications. Do the results help us to understand the broader topic? By addressing these issues, you will have provided the reader with additional insight into your study and how to place your results in context of the greater scientific field of study •4th paragraph, address limitations and/or weaknesses of the study and discuss why these limitations or weaknesses exist and how they may affect interpretation of the data. •The 5th paragraph should be the concluding paragraph. Provide a brief and global summary of the results and what it all means in context of the larger problem discussed in the introduction. Indicate the importance of the work by stating the applications of the work, recommendations suggested from the work, implications of the work or speculations about the importance of the work
Tips	•Do not restate the results. •Understate the conclusions rather than overstate them. •Write clear and logical paragraphs with introductory and concluding sentences.

Part 7- Conclusion Section	
Conclusion	• Summarize your findings and explain the implications of your work (including hard numbers with uncertainty estimates). • Describe the importance of your manuscript and mention possible future research. • You may also include Recommendations for improvements to the apparatus or method, or suggestions for future research on the subject at hand.
Pitfalls to avoid	• Conclusions contain no new data or findings. • Exceeding 1-2 paragraphs • Solely repeating major findings without adding significance or implications to those findings. • Do not replicate the abstract.

Part 8- Acknowledgements	
Acknowledgements	• List support from funding agencies. • Acknowledge individuals that contributed to the work but did not meet criteria for authorship. • Some journals ask for conflict-of-interest information, additional disclosure information, or specifically have separate sections addressing those topics.

Part 9- References	
References	•One of the most important parts of your paper is writing references in the proper reference style for each Journal. •STEAME example: 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 the end of this sentence for journals and books [1] [2].
Tools	• Mendeley Mendeley is a desktop and web program for managing and sharing research papers, discovering research data and collaborating online. https://www.mendeley.com/ • Endnote EndNote 20, essential reference management tool. https://endnote.com/product-details

Reflection and Closure activity:

Study with your students STEAME Journal guidelines and write a paper to be published.

Module 7. How to work on projects (Inquiry Based Learning, Project Based Learning)

Module 7. How to work on projects (Project Based Learning, Inquiry Based Learning, Problem Based Learning, Context Based Learning)

Introduction and Broad Description of the Context and Goal of the area/ topic addressed:
The module addresses Project Based Learning (PBL) as the main methodology involved in a STEAME project and explores three key PBL challenges to the effective implementation of a Learning and Creativity Plan that describes a STEAME project. That is, the module focuses on the Inquiry Based Learning (IBL), Problem Based Learning (PrBL) and Context Based Learning (CBL) methodologies, as the teaching and learning framework where a STEAME project is developed. Specifically, the module aims to inform teachers about the features and the components of the methodologies mentioned above, as well as how to use these elements in the successful planning of STEAME activities.

Learning Outcomes:
With the completion of this module the trainees will be able to:

1. Gain insight into the features and the components of the Project Based Learning methodology (Inquiry Based Learning (IBL), Problem Based Learning (PrBL) and Context Based Learning (CBL)) in STEAME education
2. Select important topics/contexts appropriate for investigation under the PBL
3. Set up an inquiry-based environment in which learning is driven by a process of inquiry owned by the students
4. Develop a project plan for integrating PBL into their lessons
5. Develop/Formulate the Essential-Driving Question to be investigated and to analyze the essential question into specific sub-questions that are related to the different curriculum subjects.
6. Design/Develop a variety of investigative activities that relate real-life contexts with the curriculum content
7. Design/Develop activities that challenge students and engage and motivate them to establish effective collaboration
8. Design/Develop activities that enhance students to develop problem solving skills as well as their self-esteem
9. Create a detailed Learning and Creativity STEAME Plan that addresses and integrates the components involved in the CBL, IBL and PrBL pedagogy, using the template proposed by the STEAME project
10. Evaluate and reflect on their Learning and Creativity Plans following specific criteria-framework
11. Monitor students and the progress of the project during PBL.

Content and Resources (providing information on the various constituents/ dimensions of the topic under consideration):

- The STEAME Project (http://steame.eu/):
    - O2. Guidelines for STEAME Activities in Schools for two age groups
    - https://steame.eu/steame-observatory/
      L&C Plan Template
- Planning Guide: Project Based Learning
- Cooper, R. & Murphy, E. (2021). Project Based Learning: Real Questions. Real Answers. How to Unpack PBL and Inquiry. Times 10 Publications.
- https://performingineducation.com/plan-project-based-learning/

Methodology and approaches for the module training presentation:
To ensure high effectiveness and transferability into practice, experiential workshop and simulation activities will be used for teachers' training. That is, teachers will be involved in collaborative and inquiry-based activities (group and peer investigative activities) to achieve the goals of the module. The methodology is highly practical and participative to foster mutual learning and cooperation among

participants. The focus is on learning in an interactive simulated environment of knowledge, applicable to the real contexts and/or in the classroom. Briefly, the module integrates the following approaches:

- Collaborative learning: Brainstorming, debates, co-design and planning
- Investigating/Inquiry based learning
- Exploration

Instruments/ Tools/ Supporting Material/ Resources to be used:
(List of files, web links, videos, PPT…. use file names inserting the Module number)
https://www.youtube.com/watch?v=dFySmS9_y_0
https://www.youtube.com/watch?v=dhwuQU2-g5g
https://www.youtube.com/watch?v=hnzCGNnU_WM
https://my.pblworks.org/projects
https://craftedcurriculum.com/20-of-the-best-project-based-learning-ideas-for-2020/
https://www.youtube.com/watch?v=sD7CZL9PpF4
https://www.youtube.com/watch?v=mAYh4nWUkU0
https://performingineducation.com/driving-questions/
https://www.youtube.com/watch?v=KYc6goFgTgI)

Pedagogical/Learning Sequencing and Activities Plan:
Introductory activities (creation of interest, reference to real value issues, relation to background experiences etc.)

Activity Number and broad Description: 1. Introduction to PBL A Collaborative brainstorming activity that aims to help teachers to gain greater insight into PBL methodology and its implementation in STEAME projects.	
Development	Teachers are working in groups of 2-4 teachers. Each group has to create a poster that represents the topic "Project Based Learning in STEAME education". The poster should include information for each of the following given sub-topics: "What is PBL", "Characteristics, components, methodology of PBL", "teacher/teachers' role", "students' role", "activity-format", "approaches involved", etc. (a) Teachers are asked to write down words, phrases, images, representations, key points, an example, an explanation, or quote on each post-it note that supports each sub-topic. Then, they stick each post-it note to the appropriate place on a paper-board (poster-size paper). (b) Teachers watch related videos and then each group discusses their poster. Throughout the video watching, teachers can refer back to their posters for additional ideas. (c) After completing their posters, teachers present them to the whole class and discuss. (d) Discussion with the whole class about the components of a PBL and the role of students and teachers in a project-emphasis on Inquiry Based Learning (IBL) and Project Based Learning (PrBL) as the main pedagogy involved.
Materials	Poster size paper 60cmX40cm, different colors of post-it notes, pen, markers
Resources	https://performingineducation.com/project-based-learning/pbl-basics/ https://performingineducation.com/project-based-learning-benefits/ https://www.youtube.com/watch?v=hnzCGNnU_WM https://www.youtube.com/watch?v=dhwuQU2-g5g

	https://www.youtube.com/watch?v=dFySmS9_y_0 https://www.youtube.com/watch?v=mAYh4nWUkU0 https://www.youtube.com/watch?v=sD7CZL9PpF4
Estimated Time	20 minutes
Environment/Room Setting	Group-work (2-4 persons in each group)
Trainees' role	Working individually and in groups- Brainstorming and group discussion/debate- Making concept map/poster

Development activities

Activity Number and broad Description: 2. The importance of the topic to be investigated This activity aims at helping teachers to select important topics/contexts appropriate for investigation under the PBL	
Development	Teamwork (2-4 teachers). Teachers study some of the L&C STEAME plans (https://steame.eu/steame-observatory/) and discuss the features that a topic could have in order to be considered good for investigation. They also watch related videos in order to inductively generalize the characteristics of a good PBL topic. They take notes, develop a concept map and present it to the class. Discussion with the whole class about the good topics/titles for projects and their characteristics-Summing-up.
Materials	Hard copies of L&C STEAME plans
Resources	https://www.teachthought.com/technology/a-better-list-of-ideas-for-project-based-learning/ https://craftedcurriculum.com/20-of-the-best-project-based-learning-ideas-for-2020/ https://steame.eu/steame-observatory/
Estimated Time	20 minutes
Environment/Room Setting	Group-work (2-4 persons in each group)
Trainees' role	Working individually and in groups- Brainstorming and group discussion/debate- Making concept map/poster

Activity Number and broad Description: 3. How to formulate the driving question. This activity aims at guiding teachers to formulate the driving question.	
Development	Teamwork (2-4 teachers). (a) Teachers study some of the L&C STEAME plans (https://steame.eu/steame-observatory/) and discuss the format of the driving question or topic involved. (b) In order to reveal the driving question from a topic, teachers search the internet and study other good topics and discuss why the related driving question is suitable for a project. Then, inductively make some conclusions about the driving question and its characteristics-Emphasis on Inquiry Based Learning Approach as a component of PBL.
Materials	Hard copies of L&C STEAME plans
Resources	https://performingineducation.com/driving-questions/ https://my.pblworks.org/resource/document/driving_question_tubric

	https://www.edutopia.org/blog/pbl-how-to-write-driving-questions-andrew-miller
Estimated Time	20 minutes
Environment/Room Setting	Group-work (2-4 persons in each group)
Trainees' role	Working individually and in groups- Brainstorming and group discussion/debate

Activity Number and broad Description: 4. Teacher's role during a PBL process	
Development	(a)Teachers take some ideas about helping students to stay on task during PBL (URL) and they make a list about what teachers have to do during a PBL process. (b) Discussion about how to use a project management template for monitoring the project
Materials	Paper notes
Resources	https://www.youtube.com/watch?v=KYc6goFgTgI https://www.edutopia.org/article/6-ways-guide-students-more-authentic-work-pbl
Estimate Time	20
Environment/Room Setting	Group-work (2-4 persons in each group)
Trainees' role	Working individually and in groups- Brainstorming and group discussion/debate

Activity Number and broad Description: 5. How to plan a STEAME project - Construct an L&C plan under the Project Based Learning methodology This activity aims at developing an L&C STEAME Plan for integrating PBL into teachers' lessons.	
Development	(a) Teachers watch videos about the steps involved in a project and make a flowchart about the main steps of planning a project. They also take information from the "PBL_planning_guide.pdf" (b) Discussion about how they can design Project-Based Learning activities (c) A PBL assessment rubric is presented to teachers-discussion about the rubric's scale and components. (d) Teachers work in groups to develop a Learning and Creativity Plan (L&C plan) with the use of all of the methodologies mentioned above. They use their flowchart to fill up the template of a L&C STEAME plan. They also can use a framework-guide for constructing the elements of their L&C plan on the basis of the STEAME L&C plan template. They have to consider the different subjects they teach at school for choosing their topic and driving question. Emphasis is given to the sub-questions-goals that could be connected to the curriculum, as well as the cooperation between teachers of different subjects. This activity is a simulation task that could take place at each teacher's school. (e) Teachers are asked to evaluate their L&C plan using this rubric-Reflection.
Materials	The template of L&C STEAME plan (digital and hard copy)

Resources	https://performingineducation.com/plan-project-based-learning/ PBL_planning_guide.pdf: http://tgrfoundation.org/wp-content/uploads/sites/14/2020/06/PBL-Planning-Guide-1.pdf https://www.youtube.com/watch?v=_3yAODXnAsg&t=381s/ https://my.pblworks.org/resource/document/project_design_rubric https://my.pblworks.org/resources (ProjectBasedLearningRubric.pdf, PBL_Evaluation_rubric.doc"
Estimated Time	40 minutes
Environment/Room Setting	Group-work (2-4 persons in each group)
Trainees' role	Working individually and in groups

Module 8. How to work on projects (Peer questions)

Module 8. How to work on projects (peer instruction)

Introduction and Broad Description of the Context and Goal of the area/ topic addressed: This module provides ideas and training on how to help teachers and school students work effectively on projects presenting outcomes of scientific investigations/experiments

Learning Outcomes: With the completion of this module the trainees will be able to:

1. Define project objectives.
2. Work out strategies to achieve the objectives.
3. Understand the possibility and necessity of finding supporting materials on the internet and beyond.
4. Implement technology in working on projects.
5. Improve their collaborative skills.

Content and Resources (providing information on the various constituents/ dimensions of the topic under consideration):
Learn and Creativity Plans or parts thereof as a source of inspiration for topics of projects.

Methodology and approaches for the module training:
Peer Instruction is an interactive and adaptive student-centered curriculum. It is distinguished by enhanced adaptability to various educational situations.
PART 1: **General introduction to peer instruction.**

- Presenting technology enabling work without usual psychological barriers damping free ideas exchange (e.g., PINGO).
- Providing examples of “good questions”, i.e., questions which spark discussion.

This part is of general nature not restricted to working on projects.
For the rest of the module let us assume, by the way of an example, that the project to work on is called “Bitcoin, the gold of the internet era”. Expected outcome is a presentation of 50 minutes addressed to fellow high school students with some prior STEAME training but freshly exposed to cryptocurrencies ideas.

PART 2: Identifying goals of the project.

- Description of the main goal and defining border conditions.
- Segmenting the main goal into subtasks and analyzing possibilities to spread the work.

This part sounds easy, but it is not completely obvious. In our running example Bitcoin is a very broad topic and it has to be narrowed or at least appearing fields need to be identified. Possible points are the following:

- Historical aspect: origins of currencies, why is gold precious, is value an abstract idea?
- Geological aspects: where does the real gold come from? And where does bitcoin come from?
- Technology behind: the idea of blockchain.
- Mathematics behind: one-way functions, open cryptography, public and private keys, elliptic curves.
- Entrepreneurship part: discuss briefly if and how to invest in bitcoin. Is mining still effective enough?

These points are just samples. The topics are not disjoint. And it is good so, because we want STEAME education instead of a field-oriented education.
Once the subject is better described and understood, it can be divided in working packages.
IMPORTANT: assignments of working packages should be done internally in the project group rather than decided by an instructor.

PART 3: Identify strategies leading to the achievement of the goals.

- Strategies depend on available resources and experiences of the team. These should be identified first.
- The goal can be approached in various ways. Efficiency should be accompanied by confidence. Approaches clearly beyond the abilities of the project team should be abandoned.

In our working example the following strategies are possible:

- Divide work according to points identified above. Discuss within the team who feels most comfortable with specific subjects and working methods: internet research is different from visiting a library or seeking expert advice e.g., in the form of an interview.
- Team members not comfortable with assigned tasks deliver input delayed and of low quality or even missing the point completely. Make sure that everybody understands what is expected from him. This is crucial for productive work and satisfactory final outputs.
- Divide work in phases. After the preparatory phase it might turn out that assumed approaches do not work or require too much effort. Give the possibility to rethink the assignments.
- Adaptability and creativity are essential. Let team members feel free but not let them lose the cumulative responsibility out of the view.

PART 4: Working out the assessment.

- General rules for team-based learning apply. They include but are not restricted to:
    - Make sure that the group is properly formed and managed.
    - Make sure the students understand their accountability for individual and group work.
    - Seek to obtain immediate feedback from the students frequently.
    - Team should learn and develop in the process of working on a project. Personal skills, e.g., communication skills are often more valuable than dull knowledge.

In our working example students should collect and order data for the parts of the project they are responsible for. They should present already pre-selected data to their fellows for further utilization or discarding. For example, should it be explained that gold is created in supernova eruptions and that it was on the Earth at the time it was just forming. Or: are there historical analogies to blockchain technology available? Is it necessary to measure the value of bitcoin in traditional, fiat, currencies? Does it have value independent of earlier means of assigning material value? Was bitcoin created because of the 2008 financial crisis? What are the risks and what are the advantages of the new technology?
There are many directions in which the project might go. One has to decide if it touches more directions or rather goes deeply in one specific way leaving other parts of the story for future considerations.

PART 5: Final Phase. Self-assessment.

- Screen critically the results of the project before presenting them to the outer world/teacher for evaluation.
- Try to find weak parts of the results and if time permits go back to PART 2 and improve.

In our working example it is crucial to actually try out the whole presentation. Does it fit in the expected time frame? Are the ideas presented clearly? Does the presentation technology work properly and is made as far as possible independent of the individual's computer?
Screen the presentation for loose ends, e.g., announcing in the introduction “we will explain how…” and never actually doing it?

Module 9. How to develop STEAME schools (Type A and Type B Schools, survey results)

Module 9. How to develop STEAME schools (Type A and Type B Schools, survey results)

Introduction and Broad Description of the Context and Goal of the area/ topic addressed: This module will provide training on how to develop STEAME and organize the structure and design of two main types of schools: Type A - existing school organizational structures and Type B - new schools that are established.

Learning Outcomes: With the completion of this module the trainees will be able to:

1. Apply a new approach for structuring and organizing the learning process around STEAME model.
2. Design and arrange the classrooms and common spaces to implement STEAME.
3. Create new layouts and settings for hybrid learning and work of students with their teachers.
4. How to restructure existing schools and/or spaces in schools to nurture creativity and teamwork of students and teachers.
5. Organize new school structures and layouts.

Content and Resources (providing information on the various constituents/ dimensions of the topic under consideration):

{Link to the STEAME survey - forms.gle/Ne2ki8TEUd1XEsw9A}

Methodology and approaches for the module training presentation:

The methodology used for this module training presentation focuses on four main sessions:

1. STEAME organizational structure presentation based on the survey questions
2. Discussion of ideas and good practices for both types of schools – A and B
3. Brainstorming and creating a sample of STEAME school structure and design.

Instruments/ Tools/ Supporting Material/ Resources to be used:

Designing for a new teaching model in newly established schools: Intrinsic Schools - www.youtube.com/watch?time_continue=3&v=86oNk1dslPc&feature=emb_logo
intrinsicschools.org/apps/pages/index.jsp?uREC_ID=338858&type=d

Pedagogical/Learning Sequencing and Activities Plan:

How to develop STEAME schools (Type A and Type B Schools)

Introductory Session 1

Activity Number and broad Description: Session 1. STEAME organizational structure presentation based on the survey questions	
Development	
Materials	Presentation of the analysis of survey results
Resources	
Estimated Time	15’
Environment/Room Setting	Either in presence or online
Trainees’ role	interactive

Discussion Session 2

Activity Number and broad Description: Session 2. Discussion of ideas and good practices for both types of schools – A and B	
Development	
Materials	

Resources	
Estimated Time	30’
Environment/Room Setting	Either in presence or online
Trainees’ role	interactive

Practicing Activities (hands-on activity) Session 3

Activity Number and broad Description: Session 3. Brainstorming and creating a sample of STEAME school structure and design	
Development	
Materials	
Resources	
Estimated Time	30’
Environment/Room Setting	Either in presence or online
Trainees’ role	interactive

Evaluation of Learning Outcomes

Activity Number and broad Description:	
Development	
Materials	
Resources	
Estimate Time	10’
Environment/Room Setting	Either in presence or online
Trainees’ role	interactive

Module 10. Evaluating STEAME project/activities work of students

Introduction and Broad Description of the Context and Goal of the area/ topic addressed: This module will provide training on the STEAME Evaluation Rubrics used for the students' work according to the STEAME Learning and Creativity Plans, with four examples from different subjects/topics and partners.

Learning Outcomes: With the completion of this module the trainees will be able to:

1. identify and justify the three main aspects of the STEAME evaluation: the competences, the processes and the including assessment for each STEAME project,
2. apply the Evaluation Rubrics to STEAME projects.

Content and Resources (providing information on the various constituents/ dimensions of the topic under consideration):

1. The STEAM Evaluation Rubric
2. Sources of other examples of evaluation (e.g., PBL, IBL)
   - *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*

Methodology and approaches for the module training presentation:

The methodology of students' work evaluation for this module training is divided in three main aspects: the competences, the processes and the including assessment for each STEAME project. It is based on the three main STEAME methodology approaches of Project-based Learning (PBL), Inquiry-based Learning (IBL), and Problem Solving. The module has the following three Sessions:
Presentation of the structure and the content of the Evaluation.

1. Discussion about four examples from different subjects/topics and partners.
2. Collaborative evaluation of the proposed Evaluation Rubrics and final revision of the Rubrics.

Instruments/ Tools/ Supporting Material/ Resources to be used:

Pedagogical/Learning Sequencing and Activities Plan:

How to help teachers to evaluate students work

Introductory Session 1

Activity Number and broad Description: Presentation of the STEAME Evaluation Rubrics	
Development	
Materials	The document of the "Evaluation Rubrics", Presentation
Resources	
Estimated Time	10'
Environment/Room Setting	In presence
Trainees' role	interactive

Practicing Activities (hands-on activity) Session 2

Activity Number and broad Description: Session 2. Discussion about four examples from different subjects/topics and partners.	
Development	
Materials	The document of the "Evaluation Rubrics"

	Example 1: Jewelry e-Shop (students work) Example 2: Bridge_Tracker (students work) Example 3: Rocket Project (teacher work) Example 4: The Project of Projects (project done collaborative from participants during Module 7)
Resources	
Estimated Time	30’
Environment/Room Setting	In presence
Trainees’ role	Interactive (working in 4 groups for the 4 STEAME Projects)

Evaluation of Learning Outcomes Session 3

Activity Number and broad Description: Session 3. Collaborative evaluation of the proposed Evaluation Rubrics and final revision of the Rubrics.	
Development	
Materials	The document of the “Evaluation Rubrics”, Presentation
Resources	
Estimate Time	20’
Environment/Room Setting	In presence
Trainees’ role	interactive

Module 11-12. Course Assignment hands-on development of a L&C Plan

This module pair is a practicum activity where teachers are asked to develop their own STEAME Learning & Creativity Plans with the condition that at least two teachers of two different disciplines cooperate in order to develop it. Teachers need to use the STEAME L&C Plan Template.

CHAPTER 5. ORGANIZATIONAL STRUCTURE OF STEAME TYPE A SCHOOLS – EXISTING SCHOOLS

Based on the partners research, analysis of best practices, shared experience and ideas the following recommendations and guidance for re-organization and adjustment of the traditional existing schools is provided.

The existing schools have a traditional organizational structure with classrooms, classes of students from the respective grades. There is a variety of actions and changes that could be adapted to the existing classrooms and organization of the education process so that STEAME could be applied.

What should the STEAME classroom look like – students in rows, teachers writing on chalkboards, textbooks and so on? Technology and modernity of our times will transform the school and the classroom. In the STEAME classroom, students and teachers are empowered to apply blended personalized learning and teaching. Through STEAME didactic technologies, time, classroom space, and teachers themselves become more flexible and adaptable. Students set their own goals and monitor their own progress under the umbrella of data-driven, targeted instruction and coaching. It means that students and teachers could have access to a structure for achieving relative curricula independence.

The key success factors for successful implementation of STEAME in existing schools is the commitment by school heads/management and staff together with the main participants in this process – the teachers.

In terms of organization of the education process and the classes there could be the following main elements for successful implementation of STEAME:

- Cooperation among teachers and integration of STEAME subjects in the school timetable for simultaneous teaching. Partnership with external parties and industry.
- The schools' timetable could be more flexible, for example, except for the basics, each student could choose how to create his/her own timetable according to his/her interests.
- To create the right mentality of both students and their teachers.
- Motivation for students and nurturing their creativity is a key success factor.
- Application of modern and new teaching approaches and methodologies – project-based learning, inquiry-based learning, discovery-based learning and other methodologies common for STEAME.
- Flexibility of teaching, timetable, content and application of Learning & Creativity plans as opposed to the lesson plans – e.g., traditional classes in the morning and STEAME – in the afternoon.
- New ways of assessment – based on results/outcomes of projects, creativity, presentations, 360 degrees assessment, etc.

There are some very good examples and practices to be considered when redesigning the existing schools.

The mission of STEAME schools is to challenge the next endeavors in students' lives, and to initiate the introduction of a new paradigm in education. The fundamental characteristic of this approach is to

help students understand who they are, what their interests and values are, what their abilities are, and also their skills and talents. Teachers in the classroom can guide and motivate students as needed.

The STEAME learning and training space is a joint classroom and there are three designated spaces for students and teachers to work – STEAME space, Science space and Creative space.

In terms of classroom design and layout:

- Desks and tables can be rearranged not in rows but clustered for teamwork in the classrooms
- There could be corners in the classical rooms for different STEAME activities and work – e.g., research corner, the corner for creation and ideation, and other activities regardless of the subject that will be used for the creation or the research or other elements of the project.
- Equipment and digital technologies can be added in the rooms to support the technology-enabled and blended learning process – e.g., internet, laptops/tablets, monitors, computers, smart boards etc.
- Only one or few dedicated rooms for STEAME classes can be modified with rearranged rows and equipment.
- Alignment of the changes with the overall strategy, aim and management of the school – e.g., with the decision of the school authorities, principals, etc.
- Good practice from Italy: even just coloring the walls has substantially changed the environment making it more comfortable for adolescents to work and study in.
- The process should be faced as a whole, and the classroom should reflect that as well.
- Use of the existing science and computer labs and space.
- Low-cost solutions can be applied and students can be involved in the process for ideas, too.

The design of schools and classrooms is a relatively easy and straightforward part of the process of change and modification towards STEAME.

As this personalized technology – driven approach is quite new, the STEAME schools' premises need to be designed as such from the head start.

With regards to the existing school campuses. They should be adapted in order to meet the STEAME model.

What does the STEAME classroom look like in a few steps?

- It is a large room, open-space interior design, and flexible infrastructure, because within the STEAME classroom for blended learning each place has its own identity;
- The classroom is designed in such a way as to allow teachers and students to organize in-class activities exactly what it needs to be;
- The nomenclature of the different spaces in the school is important to be clearly specified because the role of Project-based, Inquiry-based, and Discovery-based learning that are the three basic learning methodologies applied in STEAME schools, is critically important to be allocated properly;
- The classrooms are to be separated for each grade level, for STEAME activities and the Humanity studies, as well. Besides, two auxiliary classrooms (for STEAME - a seminar room and for Humanities - a Lab) are also necessary;

- The organization of the space in the STEAME school is determined by the different learning environments, and each environment is defined by the furniture, the architecture or space, and the finishes, for example:
    - Introspective space for personalized learning, individual research activities, assisted by online or offline content (texts, graphs, pictures, audio and video content) digitally delivered via Chromebooks;
    - Exchange space for collaborative learning with peer delivered content;
    - Direct instruction space for limited number of students (10 to 12) focused around a whiteboard, smartboard, flipchart, and/or projector for direct delivery of educational content by the instructor;
    - Studying space of soft seating informal environment where independent individuals or groups'' (in small groups) learning can take place;
    - Feedback space for the teachers in the STEAME learning process.

The STEAME classroom supports critical thinking collaboration with technology-enabled, teacher's led instruction for each grade; it is to be designed for structured group work within the project-based learning curricula; a specific classroom space could be available for big ideas' discussions and connections;

The classroom should be designed in such a way as to support independence and personal space for individual work;

The classroom space supports students' assessment and possibility for measurement of their personal and collective progress;

The design of the classroom supports the STEAME teaching mode for providing life-changing opportunities and post-secondary success;

STEAME classroom supports the roadmap for all other interdisciplinary educators.

The learning environment for STEAME education can be as important to the students' success as quality instructions and course curricula. And in today's world, that means outfitting students and teachers with the right set of resources

1. **The STEAME program facilitates design, not the other way around.**

The physical space can align with the principles of student agency, and teacher's flexibility, and choice that are at the core of the new model. The moment the students' and teachers' interaction is determined with STEAME Curricula and blended learning, then the space could be planned accordingly.

2. **The classroom layout is aligned with the outcomes that schools' principals and teachers aim to achieve, when going STEAME and blended oriented.**

If the School is STEAME and blended oriented to promote student and teacher agency, then the classroom should be redesigned to give many options and locations to teach and learn. The classroom layout would facilitate the outcomes that are expected.

3. **Furniture is moveable in order to enhance layout flexibility.**

Desks, tables, and whiteboards on wheels can be arranged in various ways to create the classroom environment and layout that works best for any situation. Also, fewer walls help create an open, collaborative school environment. Depending on the model(s) that have been chosen, Principles and teachers may not need to make extensive changes to the current classroom layout.

Not every STEAME and blended classroom needs to end up looking like an open office space.

5.1 EXAMPLE OF RE-DESIGN AND RE-ORGANISATION OF AN EXISTING SCHOOL TO STEAME SCHOOL

The below described and analyzed example proves the concept of STEAME model for existing schools. It is based on the best practice by one of the partner schools “Prof. Ivan Apostolov” private high school in Sofia, Bulgaria. The school applied what is suggested and found out throughout the project development to showcase how it would be done in reality.

Figure 5.1: Photo of the School

It can serve as an example and a process to be adopted. One of the key success factors, proved to be the support, commitment and engagement in the process by the school authorities and the management. In addition, there was unanimous agreement by the teachers to be trained and involved in the process – in the subjects related to the new model – science, technology, engineering, arts, mathematics, entrepreneurship. The implementation of STEAME started in the school year 2020/2021. It was applied in the science classes with interdisciplinary projects developed during the school year mentored and guided by the teachers in entrepreneurship, technology and arts.

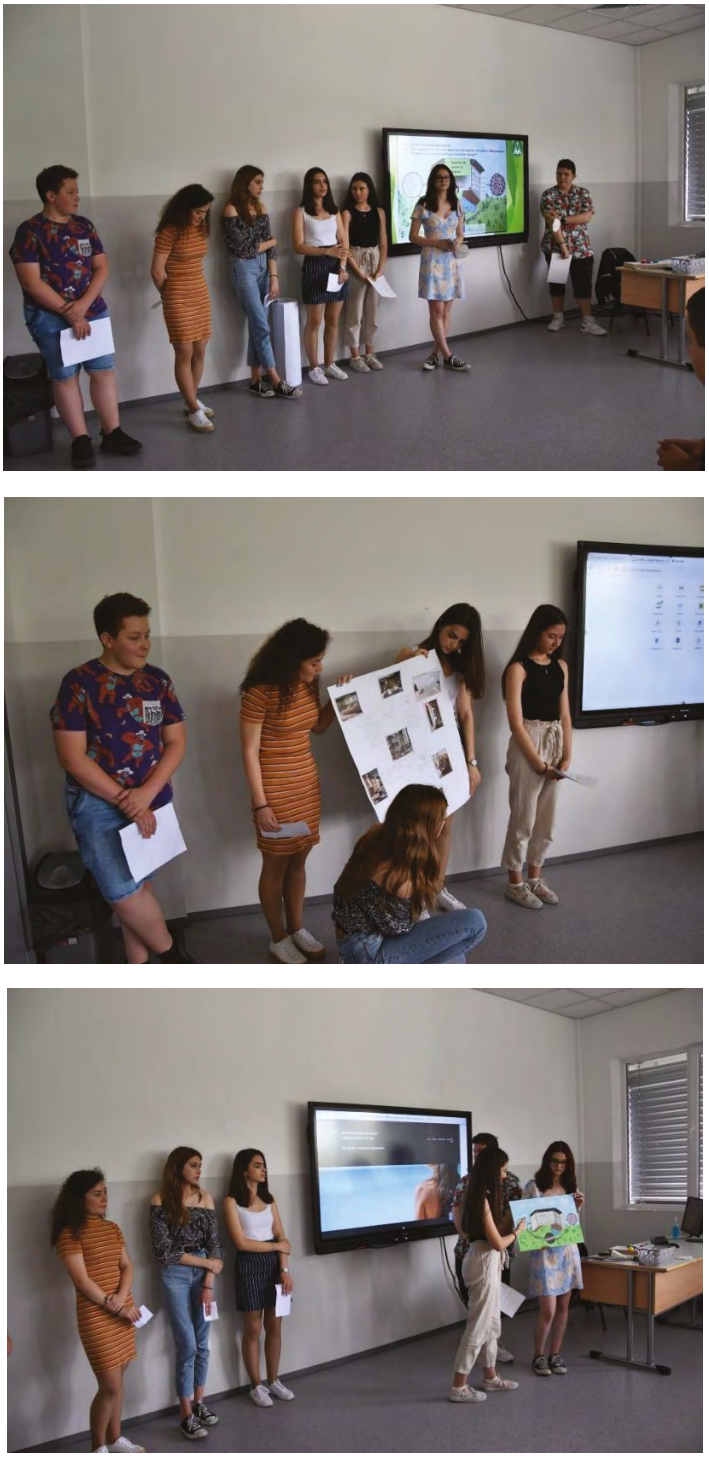


Figure 5.2: Photos from the STEAME implementation in existing school

STEAME zones

Classrooms are purposefully rearranged to allow teachers and students to organize in-class activities exactly what it needs to be. The school rearranged the rooms, using also open space interior design, and flexible infrastructure, so that each place has its own identity within the STEAME classroom for blended learning

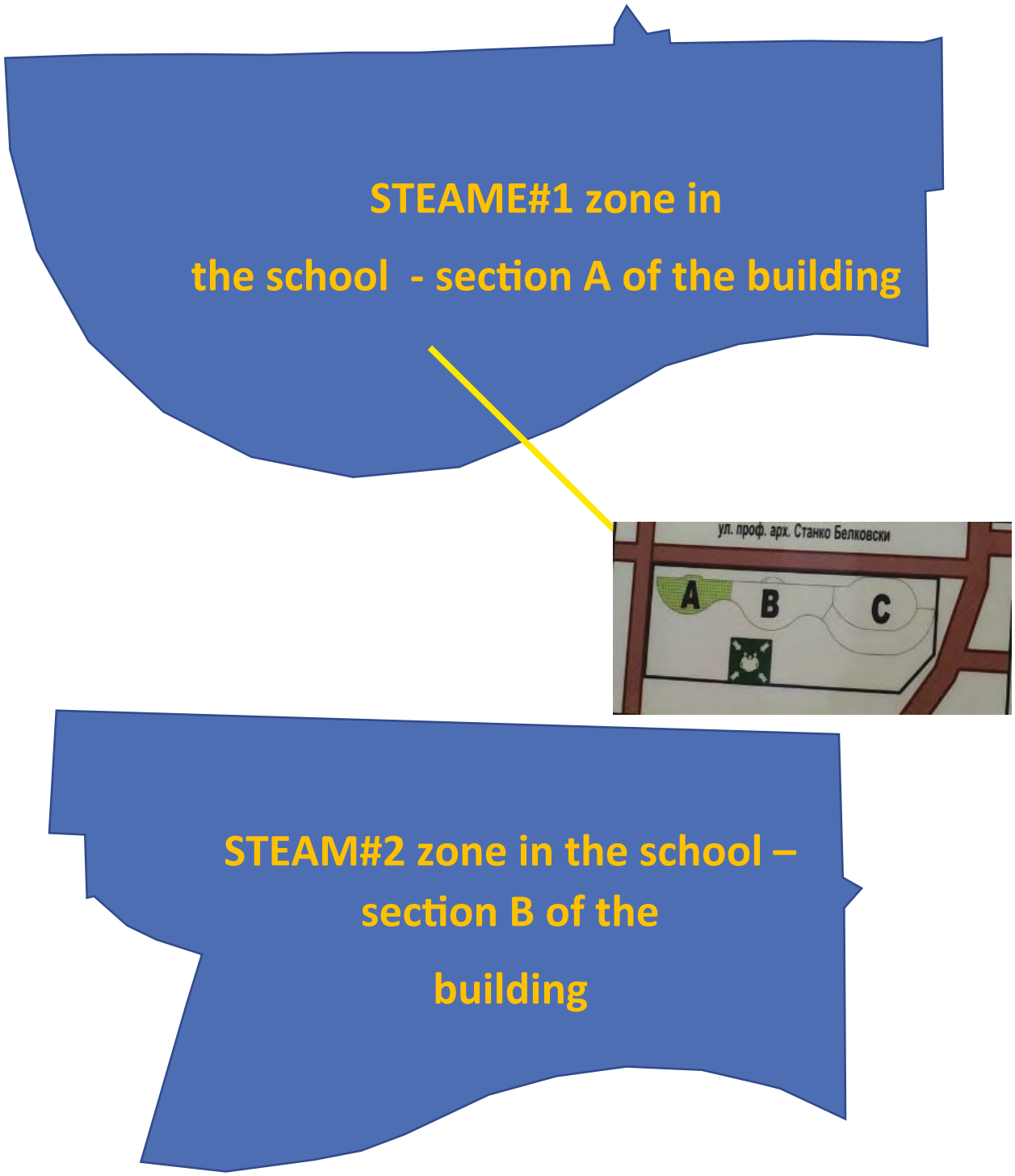


Figure 5.3: STEAME zones in School

The nomenclature of different spaces in the school is clearly specified, because the role of Project-based, Inquiry-based, and Discovery-based learning that are the three basic learning methodologies applied in the modern STEAME school is important to be allocated properly.

Space distribution in the STEAME zones

The STEAME learning and training space is a joint classroom infrastructure and there are three designated spaces for students and teachers to work – STEAME space, Science space and Creative space.

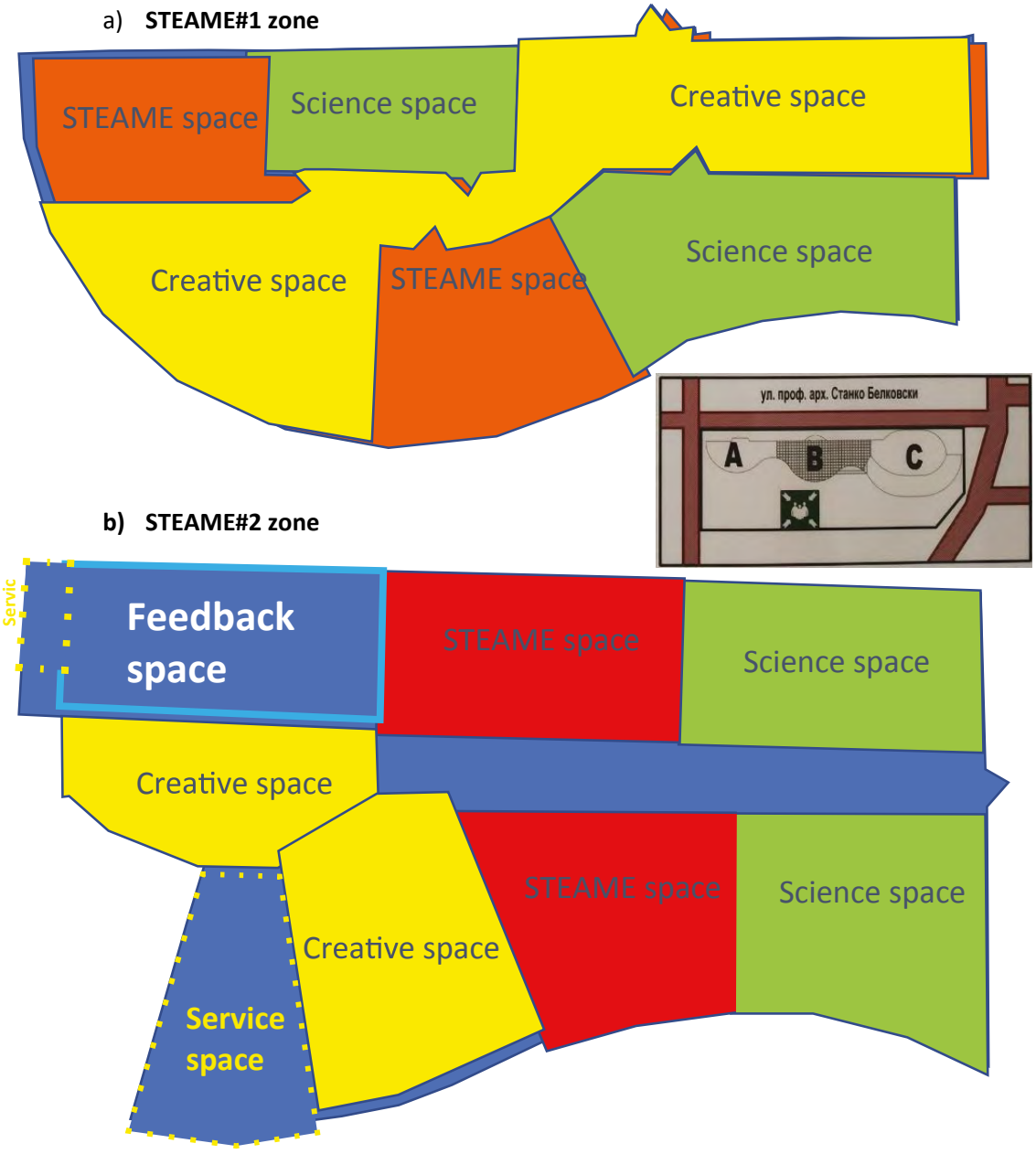
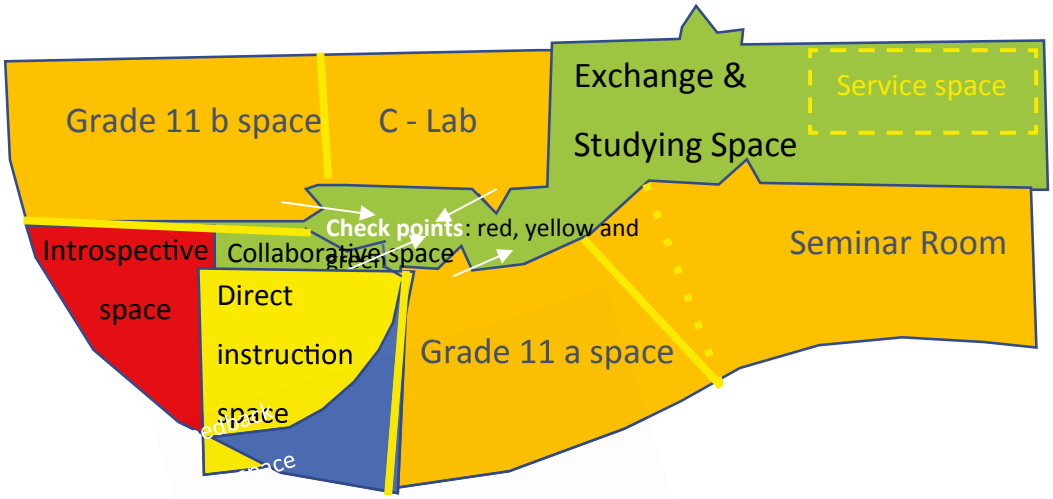


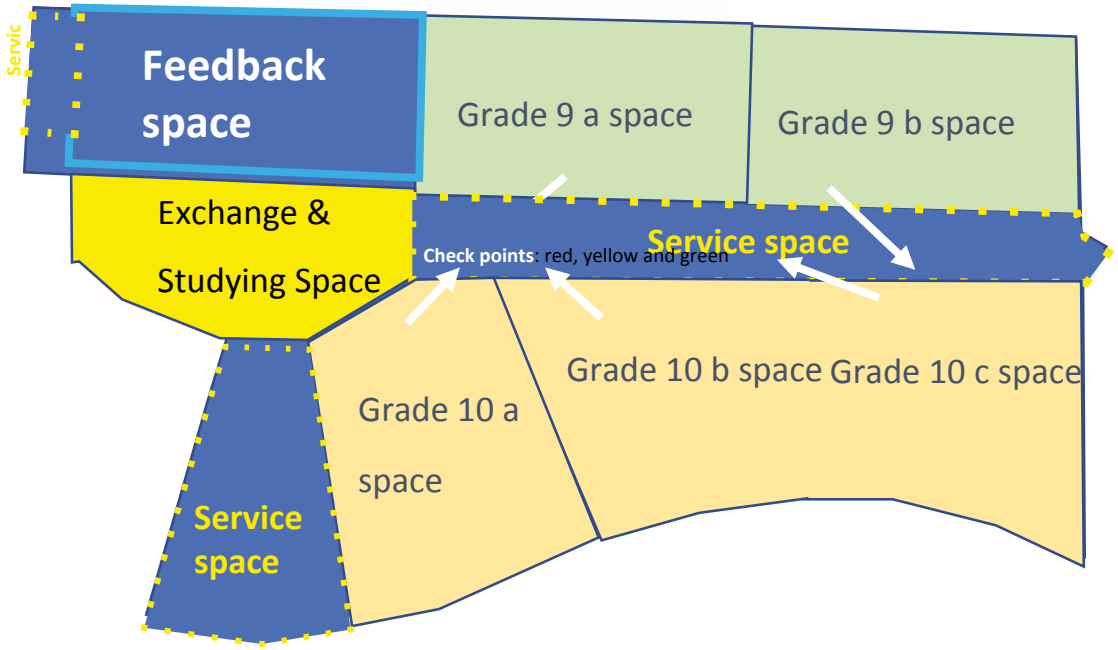
Figure 5.4: Organization of the space in the STEAME zone for Cooperative learning

The classrooms are separated for each grade level, and for STEAME activities and the Humanity sciences, as well, but they are supplemented by two auxiliary classrooms (for STEAME - by a seminar room and for Humanity's by a Lab)

a) **STEAME#1 zone**



a) **STEAME#2 zone**

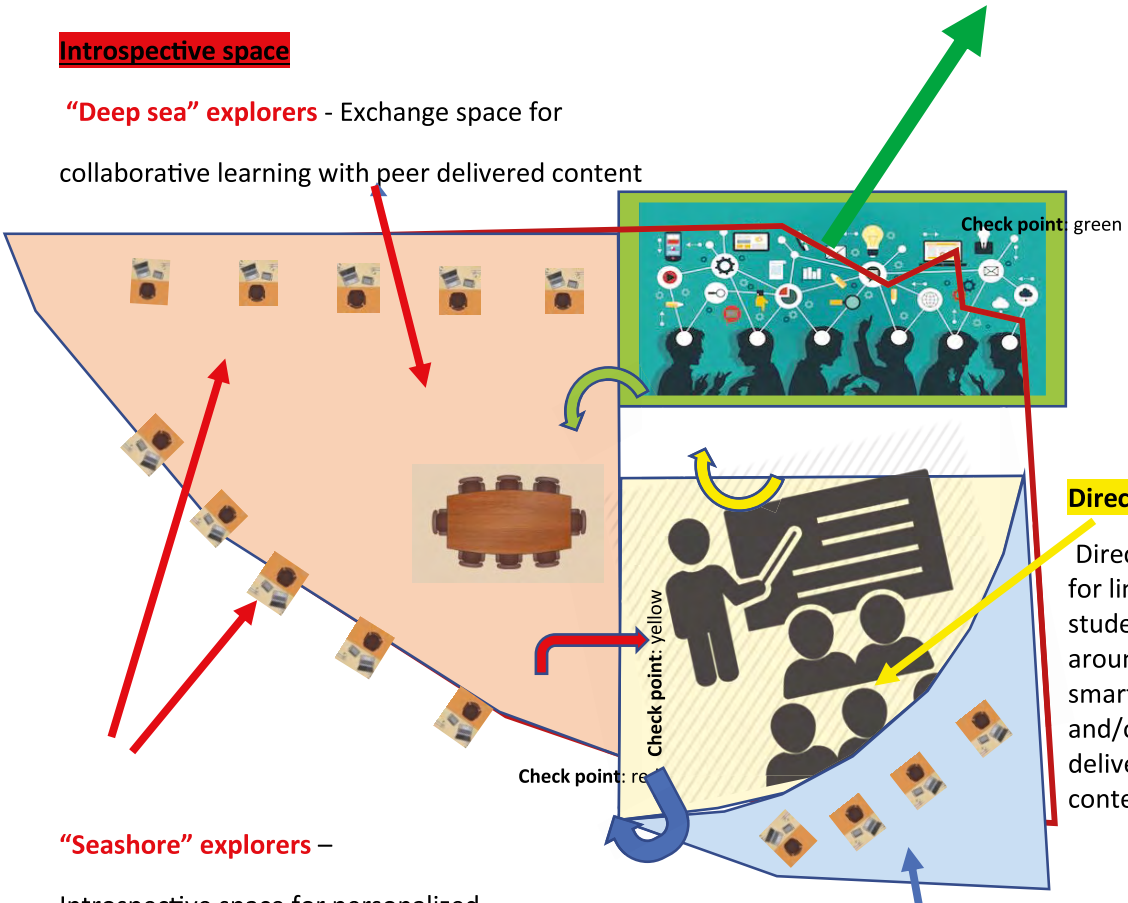


1. Organization of the STEAME process in the Creative space for Cooperative learning for students in 9th / 10th / 11th grades

Exchange & Studying Space-
Exchange space for collaborative learning: studying space which is soft seating informal environment where independent individual or group (in small groups) learning can take place

Introspective space

"Deep sea" explorers - Exchange space for collaborative learning with peer delivered content



Direct instruction space

Direct instruction space for limited number of students (10 to 12) focused around a whiteboard, smartboard, flipchart, and/or projector for direct delivery of educational content by the instructor

"Seashore" explorers –

Introspective space for personalized learning, individual research activities, assisted by online or offline content (texts, graphs, pictures, audio and video content) digitally delivered via Chromebooks

Feedback space -

Feedback space for the teachers in the STEAME learning process

In the above case, the main recommendations and guidance identified during the work on the STEAME project, were successfully applied and all key target groups were involved – teachers, students, school authorities and staff. Their commitment, efforts, work and collaboration contributed to the final outcomes and the new model that is applied and will be sustained after the project ends.

5.2 IMPLEMENTATION OF LEARNING AND CREATIVITY PLANS OF THE STEAME PROGRAM IN SUMMER SCHOOLS.

Summer School in Agros, Cyprus:

During the period of July 2021, at the Hotel "RODON" in Agros a summer school organized by the Cyprus Mathematical Society, took place. In the summer school, elementary, middle school and high school students participated for a week attending Mathematics classes and participating in various other activities.

Within the framework of this school, learning and creativity plans of the European project "STEAME" were implemented with groups of elementary and high school children.

Specifically, the plans "A glass of hot chocolate" were implemented (with the modification, due to the summer, to "A glass of cold chocolate"), "An education museum in our city" and "The colonization of Mars".

Through the implementation of the learning and creativity plan "A glass of cold chocolate" the children should organize a charity bazaar for their school on a theme of their choice. The students had to discover which glass (material) keeps the chocolate cold for the longest time, study the cost of preparing a glass of cold chocolate and compare it with the selling prices of the corresponding drink from the cafes. At the same time, each group had to create an advertising poster for its bazaar and craft the glasses, according to the theme they had chosen.

The project "An educational museum in our city" raised the issue of security in a museum consisting of convex and concave polygons. Children had to identify the smallest number of cameras needed to monitor each point in the museum, verify their findings using simple LED circuits and do market research on the cost of purchasing and installing the cameras. Finally, they had to use binary code to write their own message at the entrance to the museum. Students learned about convex and concave polygons and the straight propagation of light, learned to build a simple electrical circuit and to build with a scale. They also learned to convert numbers from the decimal system to binary and vice versa.

Through the learning and creativity project "The colonization of Mars" the children had to answer various questions about the possibility of colonization of the planet Mars by the human species. Such questions were: Why would we need to leave Earth? Why would we choose Mars as a new place to live? How would we leave Earth? How would we land safely on Mars? What would we need there to survive (facilities, buildings, materials)? The children studied the questions and through activities and constructions, they tried to answer them. Specifically, the children made a poster about why the human species should leave Earth at some point and why to choose Mars, built a model of a rocket and a parachute and studied their motions, made a model of a space base on Mars and they also studied ways of securing the necessary materials and conditions for life (water, oxygen, energy, food). Through their work, the children were introduced to the concepts and laws of Physics (principle of conservation of momentum, air resistance, final velocity, energy conversions), studied chemical processes for the production of oxygen and water from materials found on Mars, explored by biological side of how it would be possible to grow plants on Mars and in Mathematics they located the nets of various normal solids and constructed these solids using an appropriate scale. They also dealt with the binary number writing system by creating their own message in a binary system. Moreover, they designed the emblem of the space base they built. Finally, each group had to present to the plenary the model they had made and answer the questions that had been initially asked.

In all cases of implementation of the learning and creativity plans, the children were enthusiastically involved in the activities and worked in their teams creatively.

Some picture of the implementations:

Figure 5.5: Photos from the STEAME activities implementation in Agros summer school

Summer School in Paphos, Cyprus:

Forty (40) students, aged 14-17, participated in the “Colonizing Mars” learning and creativity plan during a summer Space and STEAME summer camp. The Space and STEAME summer camp took place in Paphos, Cyprus, July 13-14, 2021, hosted by the Paphos Innovation Institute.

In this summer School the “Colonizing Mars” Learning and creativity plan was implemented. A broad description of the “colonizing Mars” project is described in the previous paragraph. In more detail, the ‘Colonizing Mars’ project involves a set of hands-on compelling STEAME activities that are designed to engage all students in learning and implementing key disciplinary content with an engaging Mars context. The activities focus on curriculum mathematical and science concepts that are combined with aspects of NASA science and engineering, related to the colonization of Mars and the support of humans living there. This includes Mars transit technology and Mars environmental research and life support. In general, the ‘Colonizing Mars’ project activities allow students to design, test, analyze and manage a space mission, following all steps from initial concept activation to the construction of a base on Mars. Also, it provides opportunities for the development of problem-solving skills and critical thinking skills, which are needed for the designing, and organizing a space mission, as well as for investigating related information in order to build a model of a space base. Three main activities were included in the "Colonizing Mars" project, in which students worked in groups to complete various tasks. In the first activity, entitled "Why on Mars?", students were asked to think about the possible reasons for leaving Earth in the long run and why Mars could be an option for resettlement.

Furthermore, students were asked to look for information about life on Earth and the possibility of colonizing Mars, in order to reflect on their ideas and to create a poster, presenting the statement "In case we have to leave Earth, we will choose Mars, because…". The second major activity, which focused on planning a mission to Mars, involved three different tasks: (a) “The journey from Earth to Mars”, (b) “Landing to Mars: An Eggstronaut Parachute Challenge”, and (c) “Landing to Mars: Sending a message on a parachute”. In the first task, students had to design and construct a rocket that would travel to Mars, launch the rocket and video record its movement. In addition, students had to analyze the rocket motion, using the “Tracker” software and to describe the rocket’s movement. In the second task students were to construct a parachute for safe landing of the eggstronaut, release the eggstronaut parachute and video record its motion. Using the “Tracker” software, students had to study and describe the parachute motion. In the final task of this activity students had to create their own message on a parachute using the same code that NASA’s Jet Propulsion Laboratory (JPL) designers used for the parachute that helped Perseverance land safely.

The third major activity focused on the construction of a space base on Mars. Two main tasks were included, the “Exploration of Mars” and “The designing of a base on Mars”. Specifically, students were asked to explore the geography and geology of Mars, the atmosphere, the climate, etc., through various websites or videos, to gather information about the construction of their three-dimensional base model on Mars. In their group discussion, students mentioned some essential buildings and other infrastructure that the inhabitants of Mars would need, which have to be included in their construction. These were a hospital, a flight control tower, corridors connecting the buildings, oxygen storage, supermarket, accommodation, fuel tanks, water tanks, rocket launch base, etc. Furthermore, students designed a flag and an emblem for their Mars’ base.

For the completion of the project activities, students worked for a total of 10 hours in a period of two days, 5 hours per day. At the end of the second day, students presented and described their construction to the audience. They, also, expressed their feelings and views about the project, using an online questionnaire.

For the completion of the project activities, students worked for a total of 10 hours in a period of two days, 5 hours per day. At the end of the second day, students presented and described their construction to the audience. They, also, expressed their feelings and views about the project, using an online questionnaire.

Opinion of the students about the implementation of “Colonizing Mars” STEAME learning and creativity plan:

According to the facilitators’ observations and students’ answers on the questionnaire, while working on the project students felt happy, excited and focused. Sometimes they felt tired and stressed, because they had to deal with a lot of information in a limited time. They mentioned that the project was “interesting” and “enjoying”, and it enabled team bonding. It was also “fun” and gave them “an opportunity to be creative”. It was “awesome”, especially the part about building the base.

Project activities helped in gaining a lot of information about Mars and space in general, e.g., what is needed to live on Mars, pros and cons of leaving earth/colonizing Mars, the atmosphere and geology on Mars, sources of energy, infrastructure, transport, communications systems, food sources etc. In addition, students reported that they have learned to work on a scale, to make models of buildings using paper or foam board and to construct a model of a town. Their favorite part of the project was building the Mars base, the construction of the rocket and the parachute, and the Tracker Physics

program for tracking the motion of an object in a video. Furthermore, students liked most the making of an emblem and the using of the binary code for writing a message as well as the decoding of a message written in a binary code. According to their opinion, “all the parts of the project were absolutely interactive, contagious and really interesting, making the whole experience really unique!”. However, due to the limited time, they did not like the fact that they had to hurry to finish. More time and the inclusion of more sophisticated activities that require advanced critical thinking, mathematics, physical and digital technology, are some of the students’ suggestions for improving the learning plan. Furthermore, students recommended the usage of interactive applications, such as Mentimeter and Kahoot, for a better understanding and practice. In addition, the project could include more challenges that are competitive, e.g., which rocket would go higher and then draw plausible conclusions about the characteristics of each flight (e.g., forces-gravity, resistance of air, etc...). For the presentation of the base on Mars, an application or even a game could be used that would be more attractive (e.g., colonization of Mars - from the Play Store). Finally, “Traveling into a black hole”, “Theory of relativity” and “Gravitational waves”, were some challenging topics the students mentioned for future investigations.

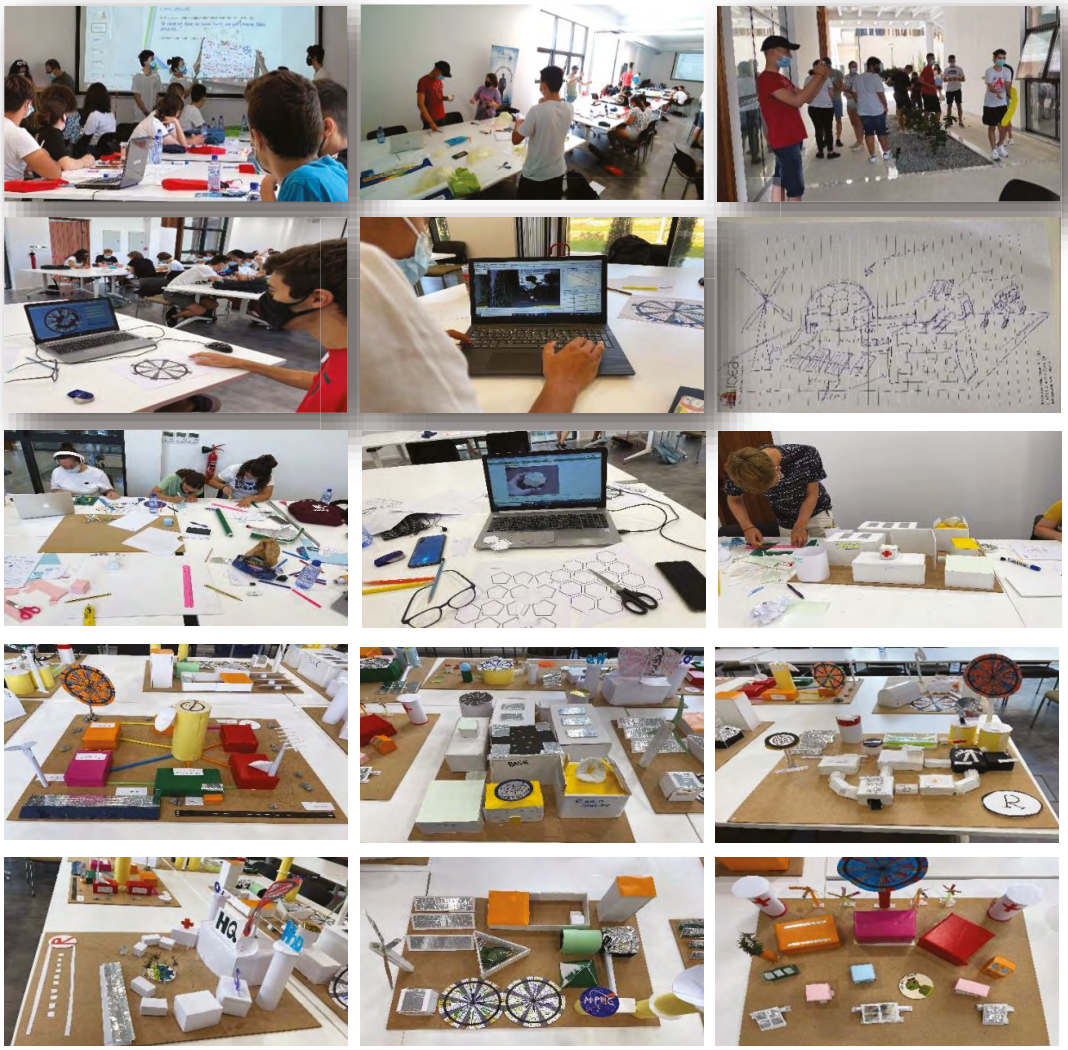


Figure 5.6: Photos from the implementation of STEAME activities in Paphos summer school

5.3 IMPLEMENTATION OF LEARNING AND CREATIVITY PLANS OF THE STEAME PROGRAM IN SCHOOL HOURS – ITC AND PACLE ELSA MORANTE OF LIMBIATE SCHOOL.

The Learning & Creativity plan "All equal, all different" was implemented in November 2021, in a second class (grade 10) of the Tourism Course of the ITC and PACLE Elsa Morante of Limbiate. The driving question was: “Does the length of the leaves of the Prunus pissardii plant follow a precise law of frequency distribution?”

Initially the science teacher introduced the topic of the kingdom of plants to the students, focusing on their characteristics, with the use of textbooks and videos. After this introduction, the students went to the large garden of the school where the research of the plant "Prunus pissardii" and the collection of the leaves of this plant began (about 1500 leaves were collected).

Subsequently, in the IT lesson, the re-processing of the data began. Initially, the students, divided into groups, measured the length of the leaves and rearranged the data in paper form. Then a discussion began with the IT teacher to find the most effective way to insert the collected data into an excel sheet with its graphic representation. After a series of proposals the students decided, also guided by the teacher, to create two excel sheets: one (detail) in which each group inserted the collected data according to the length classes. In the same sheet the "summation" formula was used to obtain the totals for each length class. This total was automatically reported in the general sheet 1 (with a simple link between worksheets). Sheet 1 also includes a chart that was created dynamically as data were inserted into the detail sheet.

As homework, the mathematics teacher assigned research on the mathematician Gauss and the Gaussian curve.

In the following lesson, the teachers of mathematics and computer science together held a brief class discussion during which the results of the research carried out by the students emerged.

The mathematics teacher focused the attention on the characteristics of the Gaussian curve and invited students to make a parallel with the graph obtained with their work with the leaves. They realised that the two graphs basically coincided. To further demonstrate this, students were asked to calculate the mode, median and arithmetic mean that, in the Gaussian curve, must coincide.

On this occasion, students had to think about how to do the calculations using the excel sheet. This activity completed the general worksheet.

This was followed by a lesson with the co-presence of all three teachers who participated in the L&C plan in which a discussion began during which students were invited to look for links between the work done and the real world.

To the amazement of the students, who until then had thought that they had simply calculated the lengths of the leaves of a plant with some mathematical calculations, they realized that this type of activity is also carried out for the search for scientific data that then provide the basis for making choices or to discover diseases or other. An example above all that greatly affected students refers to

how the parameters related to blood tests are determined. The ranges that appear in blood tests derive precisely from a study based on the analysis of the Gaussian curve.

The results of the work were then summarized and shown on a poster created with the Spark Adobe program.

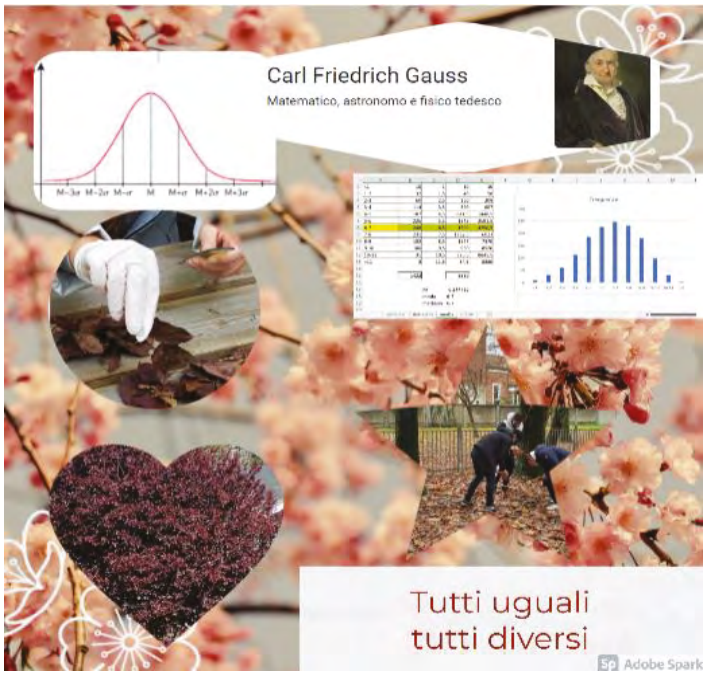


Figure 5.7: Poster of the results

Figure 5.8: Photos from the implementation of STEAME activities in school hours

CHAPTER 6. ORGANIZATIONAL STRUCTURE OF STEAME TYPE B SCHOOLS – NEWLY ESTABLISHED SCHOOLS

6.1 GENERAL FEATURES

When designing and organizing new schools following the STEAME model, one should consider the following features:

- Overall modern and non-traditional layout and architecture – open space, moving and transparent walls, colorful furniture and design, AR/VR and other advanced technologies, etc.
- Compliance with the specific conditions of the climate, regulations, education system, etc. not in rows but clustered for teamwork – e.g., rooftops suitable for snowy countries (not with flat and glass roofs), indoors space for hot climate, etc.
- Movable furniture, open space, colorful design, new shapes of classrooms – e.g., horse shoe, zones (hexagons) for different activities – e.g., S, T, E, A, M, E; individual work, group work, research, idea generation, prototyping, space for teachers' meetings, etc.
- Technology-enabled rooms and spaces – e.g., 3D printing, robots, drones, advanced technologies.
- Spaces and rooms should accommodate also Humanities and other studies besides STEAME. However, as a main model, STEAME should be a leading concept for the design.
- Proper lighting and air conditioning in every space, soundproof spaces, etc. to provide proper and comfortable conditions.
- Technology and science labs and zones/spaces should be available for use.

The design of new STEAME schools should follow the overall strategy for innovation in this direction and should be purposefully designed and organized for this educational model.

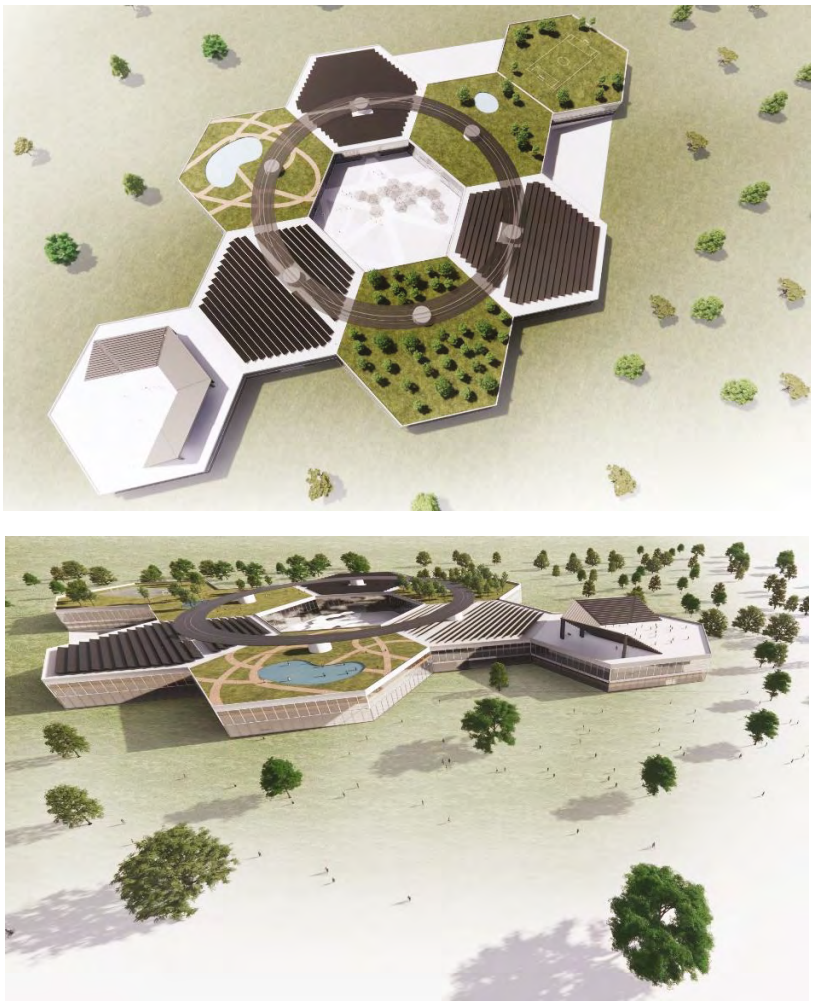


Figure 6.1: A design proposed by the STEAME project for a future school

In terms of organization of the education process and the classes there should be the following main elements for successful implementation of STEAME:

- Innovative ways of teaching, new roles of teachers as mentors/coaches/facilitators, project-based learning, inquiry-based and discovery-based learning, teamwork and individual work, etc.
- Cooperation with companies, external organizations.
- Cooperation among teachers and interdisciplinary approach – e.g., classes led by two or more teachers, simultaneous classes, flexible timetable with no fixed duration, start and end time.
- Students should feel welcome by their surroundings and feel excited to be present in such spaces.
- New ways of assessment – 360 degrees by peers, teachers, teammates; assessment based on results and creativity, research work, individual and teamwork.
- The teaching approach and methodologies should encourage STEAME activities, career, interest for research, science, math, etc.
- Teachers should apply novel ways and approaches. They need preparation and training as well as continuous support by the management, administration and school as a whole.
- The mindset for creativity and innovation is a key success factor.

An animation video of the STEAME School of the future can be found in the STEAME Observatory at www.steame.eu .

6.2 THE STEAME SCHOOL OF THE FUTURE DESCRIPTION

The building is conceived as an arrangement of Hexagonal Cells, organized around a central hexagon/athrium. The cells have a diameter of 100m and consist of three 6m-high floors (basement, ground and mezzanine) which are internally interconnected through smaller atria. The core part of the building is formed by six cells representing all STEAME subject centers (Science, Technology, Engineering, Arts, Mathematics, and Entrepreneurship) with corresponding laboratories in the basement. Each hexagon includes three interconnect amphitheaters with the ability to function as larger auditoriums if required. Additionally, each hexagon hosts a number of Learning Stations, Satellite Labs and Learning Centers allocated on the mezzanine and ground floors. The internal open-sky courtyard is the focal point of the project featuring kiosks and recreation areas. The basement space corresponding to the courtyard hosts a series of VR rooms.

Two additional Hexagonal Volumes are adjoined to the central core of the building hosting the administration building and the Sports Centre Facility. The main amphitheater of the project is part of the administration building and occupies the basement and first floor levels whereas the upper level is reserved for offices. A food court and the STEAME café are situated at the lobby of the main amphitheater. This hexagonal cell also features an open-air amphitheater on the roof. The sports center facility hosts a series of multifunctional playfields, a running field and a gym. These two volumes of the building have their own receptions and lobby areas and can serve the local community by operating out of working hours, when the core building is closed.

The roof presents the fourth level of the building and hosts a series of functions like green areas, a playfield, an amphitheater and a large number of photovoltaic panels aiming at offsetting the carbon footprint of the project.

Circulation

The circulation of the building revolves around the atrium in all floors, providing unobstructed views to the courtyard and inner spaces of the building. Vertical movement is achieved through a series of six cores (including elevators and staircases) arrayed in each hexagonal cell. The cores extend to the roof providing easy access to all levels. The main entrance of the building is situated on the ground floor, next to the main amphitheater of the administration cell. The entrance lobby and reception doubles as an exhibition space extending to 10m in height. The mezzanine level features a low-speed train allowing students to transit or work in groups on-board. Finally, the roof circulation is covered by a canopy offering a rooftop promenade for training or leisure purposes. Secondary access for servicing purposes allows vehicles to descend and reach the basement lobbies to support the laboratories, the sports center and the main amphitheater needs.

6.3 INNER SPACE STRUCTURAL CONTENT AND SAMPLE DESIGNS

BASEMENT

MAIN LABS

- B1.1 Main Biology Lab
- B1.2 Main Chemistry Lab
- B2.1 Main Physics Lab
- B2.2 Main Mathematics Lab
- B3.1 Main Construction and 3D printers Lab
- B3.2 Main Environmental Lab
- B4.1 Main Robotics Lab
- B4.2 Main Computing and Software Lab

- B5.1 Main Prototype Development Lab
- B5.2 Main VR Center Lab
- B6.1 Main Skills and Talent Development Lab
- B6.2 Main STEAME Communication Lab

- Additional VR rooms
- Learning stations
- Entry into amphitheaters
- STEAME THEATER

GROUND FLOOR

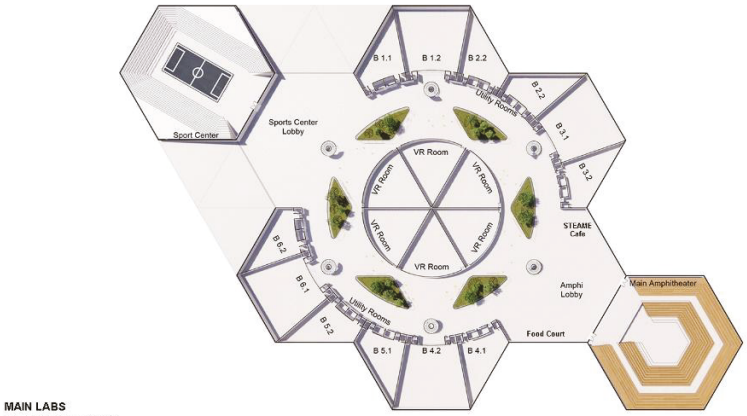
- G3.1 Biology-Chemistry S-Lab
- G4.1 Physics-Mathematics S-Lab
- G5.1 Industry Liaison Office
- G5.2 Virtual Business Center
- G1.1 Robotics – Computing –Multimedia S-Lab
- G1.2 Sound-proof student meeting room
- G2.2 Construction- Environmental S-Lab
- G2.1 Sound-proof student meeting room
- G3.2 Sound-proof student meeting room
- G4.2 Sound-proof student meeting room
- Individual Learning Stations as private u-shape booths
- Open space movable furniture for small group work by students
- Courtyard
- Reception area
- Entry into amphitheaters

FIRST FLOOR

- Open space flexible movable furniture for student groups
- Co-creation Train moving …with group sitting stations
- Learning Centers/Rooms
- Additional Learning Stations
- Entry into amphitheaters
- Slow Moving STEAME train
- Administration offices

ROOF

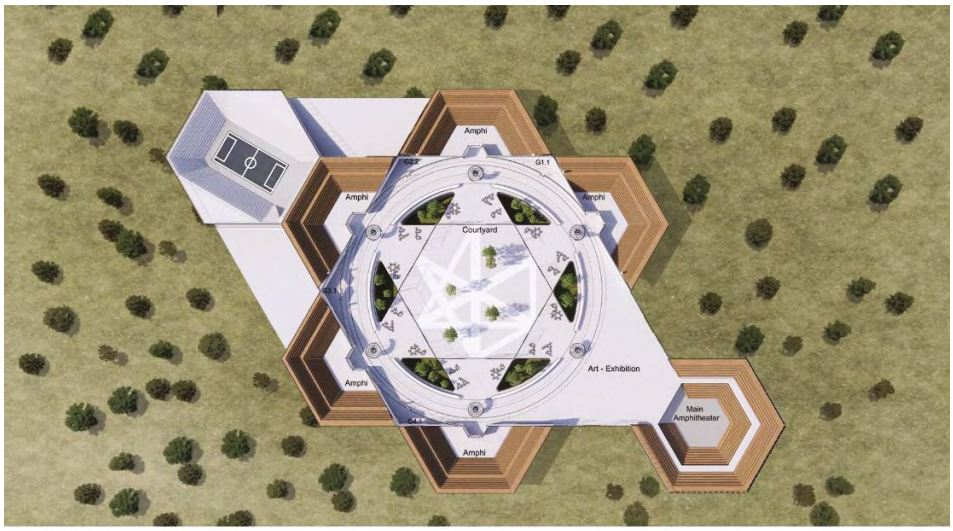
- Recreation spaces
- Cafeteria
- Garden and Lake
- Photovoltaics
- Football court
- Athletic field
- Open Amphitheater



MAIN LABS
B1.1 Main Biology Lab
B1.2 Main Chemistry Lab
B2.1 Main Physics Lab
B2.2 Main Mathematics Lab
B3.1 Main Construction and 3D printers Lab
B3.2 Main Environmental Lab
B4.1 Main Robotics Lab
B4.2 Main Computing and Software Lab
B5.1 Main Prototype Develpment Lab
B5.2 Main VR Centre Lab
B6.1 Main Skills and Talent Development Lab
B6.2 Main STEAME Communication Lab

BASEMENT
1:2000 @ A4

Figure 6.2: A design proposed by the STEAME project for a future school: Basement top-down section



Satelite Labs
G1.1 Robotics – Computing –Multimedia S-Lab
G2.2 Construction- Environmental S-Lab
G3.1 Biology-Chemistry S-Lab
G4.1 Physics-Mathematics S-Lab

GROUND FLOOR
1:2000 @ A4

Figure 6.3: A design proposed by the STEAME project for a future school: Ground floor section

Figure 6.4: A design proposed by the STEAME project for a future school: First Floor top-down section

Figure 6.5: A design proposed by the STEAME project for a future school: Roof top-down section

6.4 A SET OF ANIMATED PHOTOS OF INTERNAL SPACES

Figure 6.6: Photo of Basement (STEAME school)

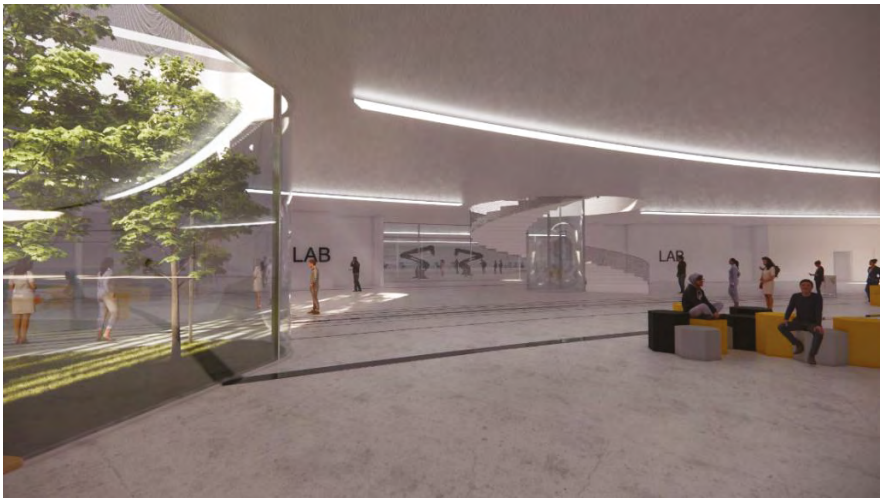


Figure 6.7: Photo of basement laboratories area (STEAME school)

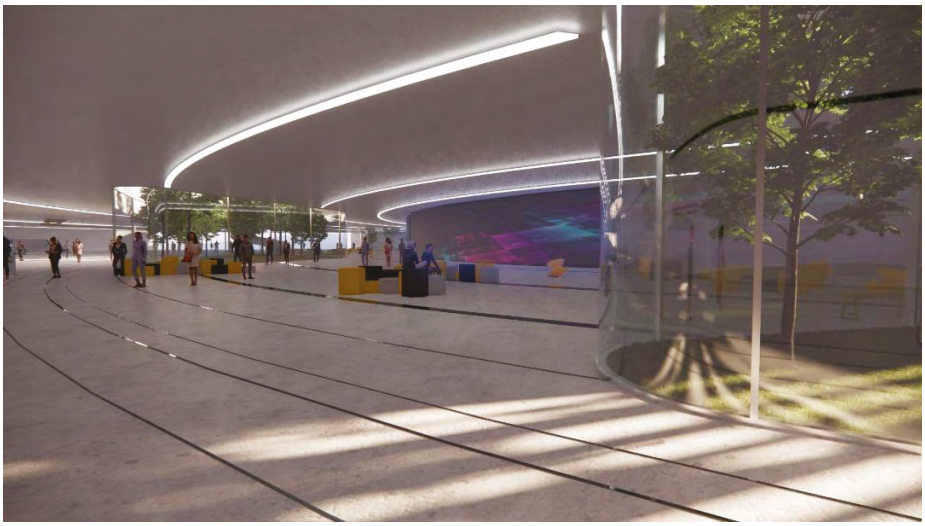


Figure 6.8: Photo of basement VR area (STEAME school)

Figure 6.9: Photo of ground floor (STEAME school)

Figure 6.10: Photo of Ground Floor Learning Stations (STEAME school)

Figure 6.11: Photo of Ground Floor Learning Rooms (STEAME school)

Figure 6.12: Photo of First Floor (STEAME school)

Figure 6.13: Photo of First Floor connecting to the roof (STEAME school)

Figure 6.14: Photo of First floor and train wagon with open top (STEAME school)

Figure 6.16: Photo of First floor and training closed type wagon (STEAME school)

Figure 6.15: Photo of First floor learning rooms area (STEAME school)

Figure 6.17: Photo of first floor Learning stations (STEAME school)

Figure 6.18: Photo of First floor top-down view (STEAME school)

6.5 COLOR OF STEAME SCHOOL CHANGES EVERY DAY

As one of the innovative features for future schools, this project proposes the use of new technologies so school walls can change colors almost every day. Some of these technologies are shown here below in photos:

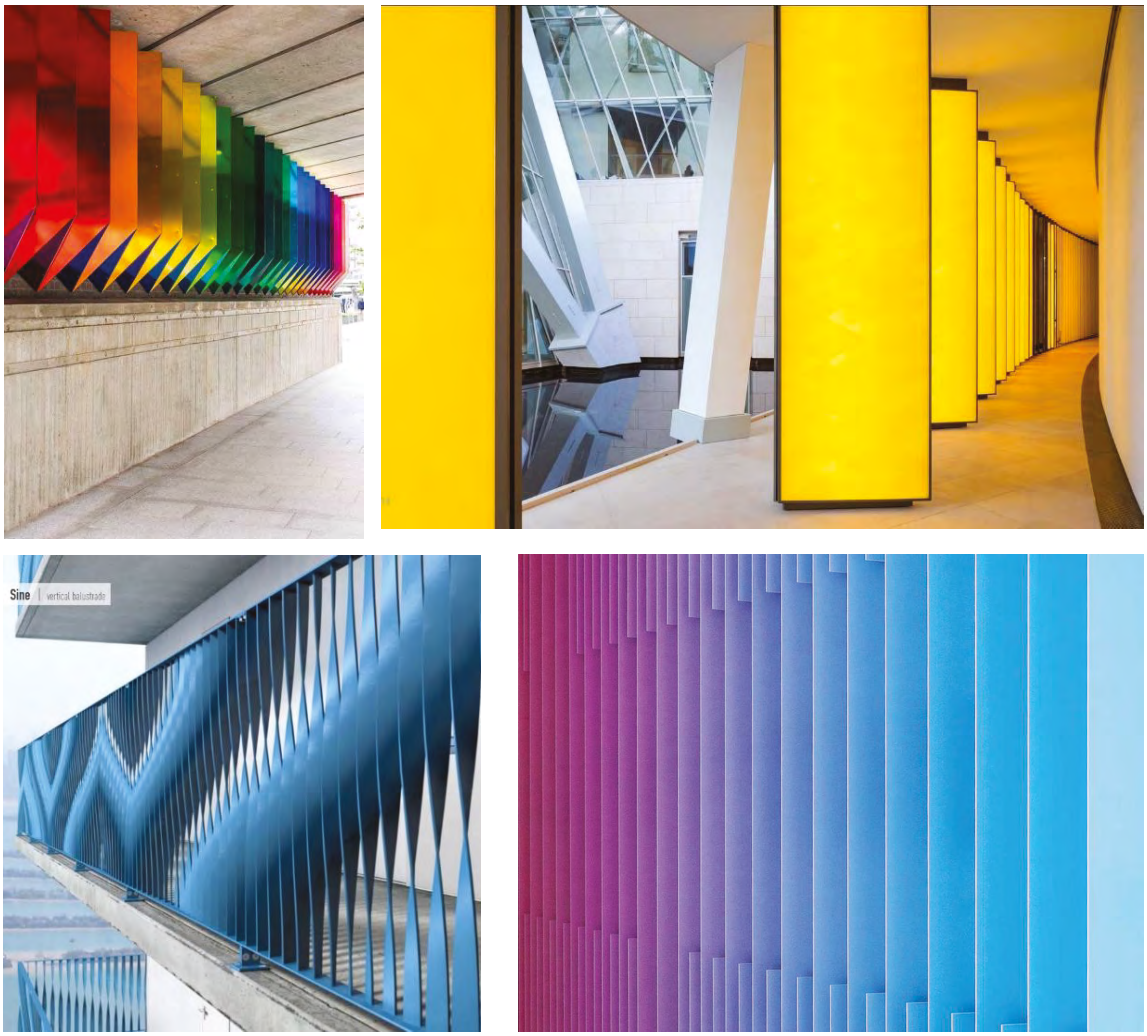


Figure 6.19: Technologies of color changing walls

6.6 OTHER TECHNOLOGY FEATURES – NEW GENERATION CLOSED MULTI-SPORTS TECHNOLOGIES

The project proposes the use of LED based multi-sports fields for flexible sport gaming. Some captures are shown here below. A related video can be found in the STEAME Observatory.

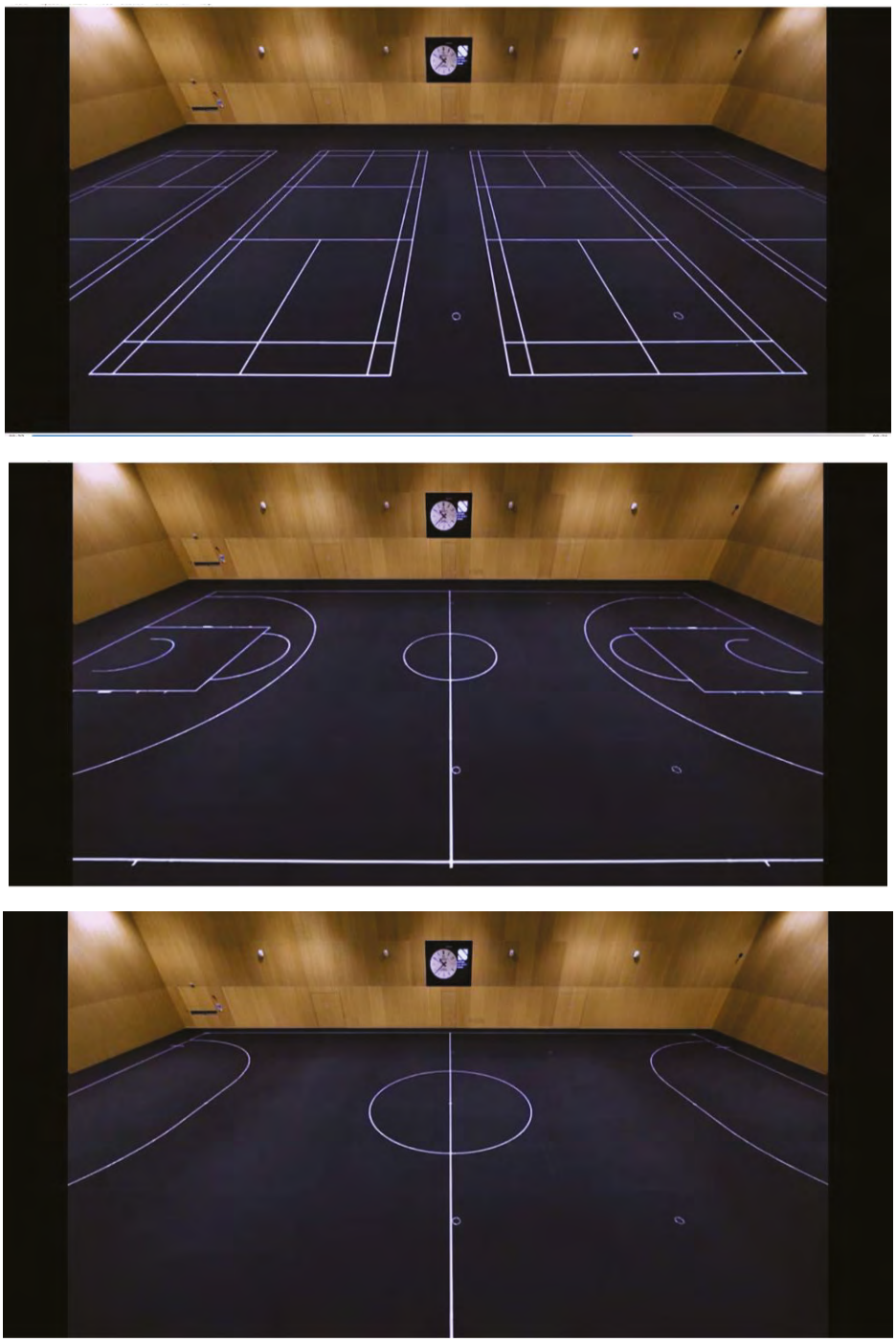


Figure 6.20: LED based multi-sports fields

What is a Learning Station or Center:

- Learning Station: a computer station with headphones so a student could watch a learning video or search the internet. Learning videos could be of three different speeds, 15 min, 30 min and 45 min, so students based on their ability can choose the speed of learning.
- Learning Center/Room: a room with a nice modern seating area of up to 10 students with a large screen TV through which students will be watching a learning video and learning as a group. The purpose is to allow interaction between students and between students and teachers.

Sports Center in STEAME School

- A Gym and internal Swimming pool (Athletic Center). On the roof there is a round running field. The idea of the GYM is that during the school day it will be used by the students and in the evening, it will run as gym center for the parents and community so this Gym center has to have two receptions, one internal open during the school day and one external for visitors/parents, which will be operating when school closed for the students. The Multifunction play fields mentioned above is part of this.

Exhibition Space

- Arts: An Arts Center will be in the hexagon adjacent to the Entrance Administration and Reception Hexagon to serve as a walk-through Gallery/Exhibition area. Theater stage, Music Center, Culture Lab, Gallery, VR, Holograms Communicator, Communication center, Digital information screens, etc. will be part of the latest technologies added.

CHAPTER 7. POLICY RECOMMENDATIONS

7.1 EXECUTIVE SUMMARY

The project STEAME - “STEAME: Guidelines for Developing and Implementing STEAME Schools” was developed and implemented by seven European partners between November 2019 and December 2021:

- Cyprus Mathematical Society – Cyprus (Coordinating organization)
- Cyprus Pedagogical Institute – Cyprus
- Pedagogical University of Krakow – Poland
- Prof. Ivan Apostolov Private English Language School – Bulgaria
- Institute of Accelerating Systems and Applications (IASA) – Greece
- Douka Ekpaideftiria AE-Palladion Lykeion-Doukas School – Greece
- ITC Pacle Morante Limbiate - Italy

The produced results and the achieved outcomes aimed at contributing to the transformation of the European educational system and the transition from Education 2.0 to Education 4.0.

The underlying concept is the STEM educational model – Science, Technology, Engineering, Mathematics. It was further elaborated and expanded to include Arts and Entrepreneurship. Thus, it provides guidelines for development of STEAME schools, as schools of the future, aim to transform knowledge into competences and skills through new structures, infrastructures and learning activities through "project-based learning" that meet the contemporary requirements of Education 3.0 and 4.0 and the needs of Industry 4.0 and employers.

According to publications of the Organization for Economic Cooperation and Development, (Future of Education and Skills) the following challenges can be identified:

1. Today's schools and universities are “overloaded” in their content and curriculum. As a result, students are often deprived of sufficient time to acquire and develop key concepts, abilities and skills. It is time to shift the focus of our students from "more hours of learning to quality time of learning and application of knowledge"

2. The content of learning and activities shall be of high quality if we want students to gain a deeper understanding of knowledge.

3. Curricula shall ensure equality and innovation. All students should benefit from social, economic and technological changes and developments.

4. Careful planning, continuous adaptation and modernization are essential to the effective implementation of reforms and changes.

The STEAME project results (www.steame.eu), provide solutions to these challenges through the creation of a model of school structure plan with proposed dynamic learning actions and learning programs, learning and creativity plans, as well as developing a teacher-centered curriculum support on how to work effectively and productively in a STEAME school.

The STEAME project has developed the following outputs:

- O1. Guidelines for dynamic and adaptive STEAME curricula
- O2. Guidelines for STEAME Activities in Schools for two age groups
- O3. Guidelines for STEAME School Organizational Structure.

Throughout the project, relevant target groups of teachers, school authorities, management/heads, administration staff, students, parents and other stakeholders were involved where their needs and expectations were taken into consideration with their inputs, suggestions and ideas – leveraged. Some of the identified key success factors for the transition and transformation are related to:

- Commitment by the school management/authorities/heads.
- Collaboration between teachers.
- Student-centered approach.
- Interdisciplinary approach.
- Application of new methodologies – project-based learning, inquiry-based learning, hybrid approach, flipped classroom, etc.
- New role of the teacher as a mentor, facilitator, coach, co-creator.
- Re-organization and re-arrangement of the classrooms and study spaces – towards open spaces, laboratories (Labs), learning and creativity spaces, teamwork.
- Use of digital tools and technology-enabled processes and spaces.
- Old Lesson plans become Learning and Creativity plans.
- Co-creation and innovation at its core.
- Development of personalized teaching and learning.
- Collaboration of schools, teachers and students with industry and researchers.

The above-mentioned recommendations could contribute to the following steps towards a successful STEAME school of the future model developed for newly established schools as well as for existing schools.

What was needed and what is delivered by the STEAME project:

- Model of STEAME Schools
- Guidelines for STEAME Activities in Schools
- Guidelines for cooperation between teachers of different disciplines
- New organizational structures for STEAME schools
- Training of Teachers to help them adapt
- Dynamic Change in Curricula, Tools, Methods

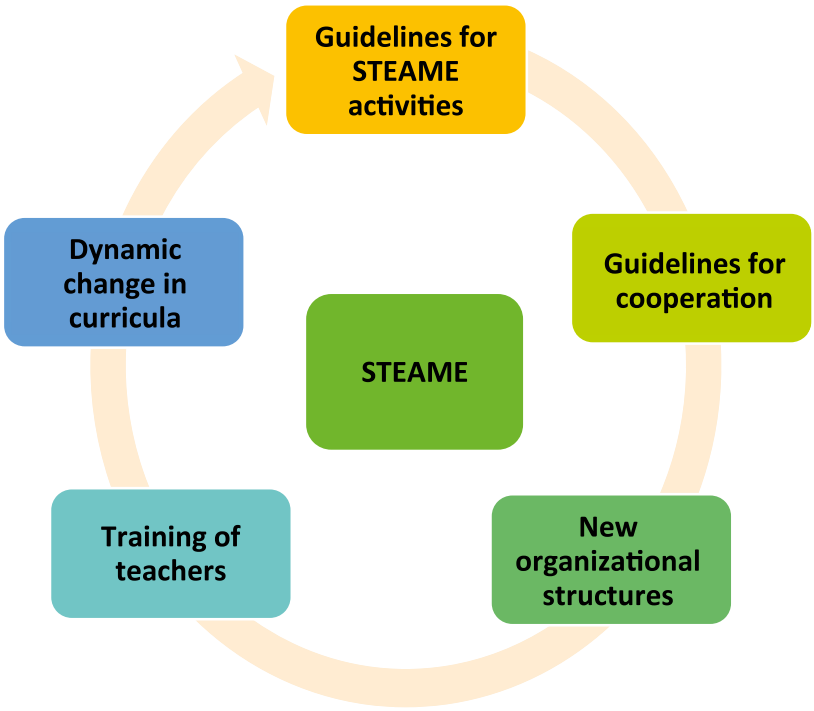


Figure 7. 1: STEAME project Deliverables

7.2 THE PARADIGM SHIFT OF SCHOOL LEARNING ENVIRONMENTS

What are the basic steps for changing current learning structures in schools into future STEAME project-based learning structures?

3 Steps to change from Education 2.0 to Education 4.0

- **Step 1.** Knowledge and Learning by School students: Secure digital learning through learning videos created by teachers. These learning videos can be created at three different speeds of learning. They should be available to school students for initial learning, for recalling knowledge and for accessing it at any time and any place.
- **Step 2.** Teacher Competences and Skills: Train teachers how to cooperate between different disciplines and how to develop(co-create) STEAME Learning & Creativity plans. Train teachers how to cooperate with academic and industry people and how to do STEAME related activities in hybrid environments. Help teachers to develop competences on becoming adaptable cloud education leaders. Give them freedom to create.
- **Step 3.** Create open spaces in current schools or build the new schools with more open spaces for project based cooperative work between school students. Plan or adapt dynamic curricula adaptable to change and adaptable to the student's competences and needs.

www.steame.eu

Annex I

Policy Recommendations in other languages

(GR, IT, PL, BG, ES, FR, DE)

(GR) ΚΕΦΑΛΑΙΟ 7. ΣΥΣΤΑΣΕΙΣ ΠΟΛΙΤΙΚΗΣ

7.1 ΠΕΡΙΛΗΨΗ

Το πρόγραμμα STEAME - "STEAME: Οδηγός για την Ανάπτυξη και Εφαρμογή Σχολείων STEAME" αναπτύχθηκε και εφαρμόστηκε από επτά Ευρωπαίους εταίρους από το Νοέμβριο του 2019 μέχρι τον Δεκέμβριο του 2021:

- Κυπριακή Μαθηματική Εταιρία – Κύπρος (Συντονιστής)
- Παιδαγωγικό Ινστιτούτο Κύπρου – Κύπρος
- Παιδαγωγικό Πανεπιστήμιο της Κρακοβίας – Πολωνία
- Ιδιωτικό αγγλικό σχολείο Prof. Ivan Apostolov– Βουλγαρία
- Ινστιτούτο Επιταχυντικών Συστημάτων και Εφαρμογών (ΙΕΣΕ) – Ελλάδα
- Εκπαιδευτήρια Δούκα – Ελλάδα
- ITC Pacle Morante Limbiate - Ιταλία

Τα παραγόμενα αποτελέσματα καθώς και τα παραδοτέα που επετεύχθησαν είχαν ως στόχο τη συνεισφορά στο μετασχηματισμό του Ευρωπαϊκού εκπαιδευτικού συστήματος και τη μετάβαση από την Εκπαίδευση 2.0 στην Εκπαίδευση 4.0.

Η έννοια που μελετήθηκε ήταν το εκπαιδευτικό μοντέλο STEM – Science (Φυσικές Επιστήμες), Technology (Τεχνολογία), Engineering (Μηχανική), Mathematics (Μαθηματικά). Το οποίο επεκτάθηκε και διευρύνθηκε συμπεριλαμβάνοντας τις Τέχνες (Arts) και την Επιχειρηματικότητα (Entrepreneurship). Συνεπώς, δίνει τις οδηγίες για την ανάπτυξη STEAME σχολείων, ως σχολεία του μέλλοντος, στοχεύοντας στη μετατροπή της γνώσης σε δεξιότητες και ικανότητες μέσω νέων δομών, υποδομών και μαθησιακών δραστηριοτήτων μέσω της 'μάθησης βάσει έργου' που πληρούν τις σύγχρονες απαιτήσεις της Εκπαίδευσης 3.0 και 4.0 καθώς και τις απατήσεις της Βιομηχανίας 4.0 και των εργαζομένων.

Σύμφωνα με τις εκδόσεις του Οργανισμού Οικονομικής Συνεργασίας και Ανάπτυξης, (για το μέλλον της εκπαίδευσης και των δεξιοτήτων), μπορούν να αναγνωριστούν οι παρακάτω προκλήσεις:

1. Τα σημερινά σχολεία και πανεπιστήμια έχουν 'υπερφορτωμένο' περιεχόμενο και πρόγραμμα σπουδών. Ως αποτέλεσμα, οι μαθητές, συχνά, στερούνται ικανοποιητικό χρόνο ώστε να μπορέσουν να αποκτήσουν και να αναπτύξουν βασικές απόψεις, ικανότητες και δεξιότητες. Ήρθε η στιγμή να μεταθέσουμε το επίκεντρο του ενδιαφέροντος των μαθητών μας από 'περισσότερες ώρες εκμάθησης σε ποιοτικό χρόνο εκμάθησης και εφαρμογής της γνώσης'.

2. Το περιεχόμενο της μάθησης και των δραστηριοτήτων θα πρέπει να είναι υψηλότερης ποιότητας εάν επιθυμούμε οι μαθητές μας να αποκτήσουν βαθύτερη κατανόηση της γνώσης.

3. Τα προγράμματα σπουδών πρέπει να διασφαλίζουν ισότητα και καινοτομία. Όλοι οι μαθητές θα πρέπει να επωφελούνται από τις κοινωνικές, οικονομικές και τεχνολογικές αλλαγές και εξελίξεις.

4. Ο προσεκτικός σχεδιασμός, η συνεχής προσαρμογή και ο εκμοντερνισμός είναι τα βασικά στοιχεία της αποτελεσματικής εφαρμογής των μεταρρυθμίσεων και των αλλαγών.

Τα αποτελέσματα του έργου STEAME (www.steame.eu), δίνουν λύσεις σε αυτές τις προκλήσεις μέσω του σχεδιασμού της δομής ενός πρότυπου σχολείου με τις προτεινόμενες δυναμικές μαθησιακές δράσεις και τα μαθησιακά προγράμματα, τα σχέδια μάθησης και δημιουργικότητας, καθώς και με την ανάπτυξη μίας δασκαλό-κεντρικής υποστήριξης στο πρόγραμμα σπουδών για το πως οι εκπαιδευτικοί θα δουλεύουν αποτελεσματικά και παραγωγικά σε ένα STEAME σχολείο.

Το έργο STEAME ανέπτυξε τα παρακάτω παραδοτέα:

- Ο1. Οδηγός για δυναμικά και ευπροσάρμοστα STEAME προγράμματα σπουδών
- Ο2. Οδηγός για STEAME Δραστηριότητες σε Σχολεία για δύο ηλικιακές ομάδες
- Ο3. Οδηγός για την Οργανωτική Δομή του STEAME Σχολείου.

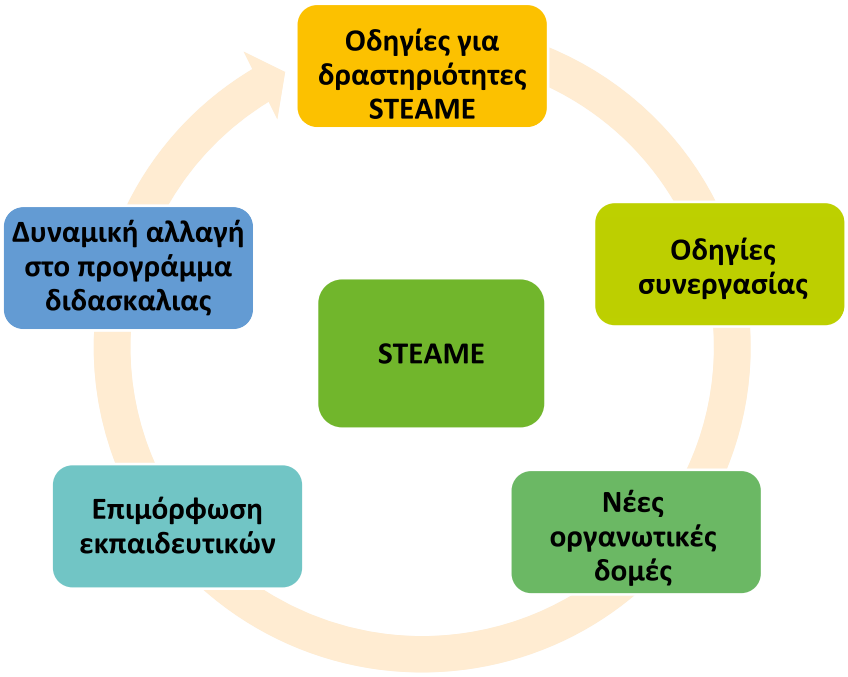
Κατά τη διάρκεια του έργου, συμμετείχαν συναφείς ομάδες-στόχοι όπως εκπαιδευτικοί, σχολικές αρχές, διαχείριση/επικεφαλής, προσωπικό, μαθητές και γονείς καθώς και άλλοι ενδιαφερόμενοι, καθώς λήφθηκαν υπόψιν οι ανάγκες και οι προσδοκίες τους μέσω των προτάσεων και των ιδεών τους. Ορισμένοι από τους βασικούς παράγοντες επιτυχίας για τη μετάβαση και το μετασχηματισμό σχετίζονται με:

- Δέσμευση από τη διαχείριση του σχολείου/ τις αρχές/ τους επικεφαλής.
- Συνεργασία μεταξύ εκπαιδευτικών.
- Μαθητό-κεντρική προσέγγιση.
- Διεπιστημονική προσέγγιση.
- Εφαρμογή νέων μεθόδων – μάθηση βάσει έργων, επαγωγική μάθηση, υβριδική προσέγγιση, ανεστραμμένη τάξη, κ.τ.λ.
- Νέος ρόλος του εκπαιδευτικού ως μέντορας, οργανωτής, καθοδηγητής, συνδημιουργός.
- Αναδιοργάνωση και αναδιάταξη των τάξεων και των χώρων μελέτης – προς μια κατεύθυνση ανοιχτών χώρων, εργαστηρίων, χώρων μάθησης και δημιουργικότητας, ομαδική εργασία.
- Χρήση ψηφιακών εργαλείων και διαδικασιών και χώρων που διευκολύνουν τη χρήση της τεχνολογίας.
- Τα σχέδια μαθήματος γίνονται σχέδια Μάθησης και Δημιουργικότητας.
- Η συν-δημιουργικότητα και η καινοτομία βρίσκονται στο επίκεντρο.
- Ανάπτυξη προσωποποιημένης διδασκαλίας και μάθησης.
- Συνεργασία σχολείων, εκπαιδευτικών και μαθητών με τη βιομηχανία και την έρευνα.

Οι προαναφερθείσες συστάσεις θα μπορούσαν να συμβάλουν στα παρακάτω βήματα προς ένα επιτυχημένο σχεδιασμό του STEAME σχολείου του μέλλοντος που δημιουργήθηκε για να εφαρμοστεί τόσο σε νεοσύστατα σχολεία καθώς και σε υπάρχοντα σχολεία.

Ποιες ήταν οι ανάγκες και τι επιτεύχθηκε από το έργο STEAME:

- Μοντέλο για τα STEAME Σχολεία
- Οδηγίες για STEAME Δραστηριότητες στα Σχολεία
- Οδηγίες για τη συνεργασία εκπαιδευτικών διαφορετικών ειδικοτήτων
- Νέες οργανωτικές δομές για τα STEAME σχολεία
- Κατάρτιση εκπαιδευτικών για να βοηθηθούν στην προσαρμογή
- Δυναμικές Αλλαγές στο Πρόγραμμα Σπουδών, τα Εργαλεία και τις Μεθοδολογίες



Εικόνα 7. 1: STEAME έργο Παραδοτέα

7.2 ΑΛΛΑΓΗ ΠΡΟΤΥΠΟΥ ΤΩΝ ΣΧΟΛΙΚΩΝ ΜΑΘΗΣΙΑΚΩΝ ΠΕΡΙΒΑΛΛΟΝΤΩΝ

Ποια είναι τα βασικά βήματα για την μετάβαση από τις τρέχουσες μαθησιακές δομές στα σχολεία σε μελλοντικές βάσει έργου μαθησιακές δομές STEAME;

3 Βήματα για τη μετάβαση από την Εκπαίδευση 2.0 στην Εκπαίδευση 4.0

- **Βήμα 1.** Γνώση και Μάθηση από τους μαθητές του σχολείου: Διασφάλιση της ψηφιακής μάθησης μέσω εκπαιδευτικών βίντεο που θα έχουν δημιουργηθεί από εκπαιδευτικούς. Αυτά τα εκπαιδευτικά βίντεο μπορούν να δημιουργηθούν σε τρεις διαφορετικές ταχύτητες μάθησης. Μπορούν να είναι διαθέσιμα στους μαθητές του σχολείου για το αρχικό στάδιο της μάθησης, για τη δυνατότητα ανάκλησης προϋπάρχουσας γνώσης καθώς και για να έχουν οι μαθητές τη δυνατότητα πρόσβασης σε αυτή οποιαδήποτε στιγμή και από οποιοδήποτε μέρος.
- **Βήμα 2.** Δεξιότητες και Ικανότητες του Εκπαιδευτικού: Εκπαίδευση των εκπαιδευτικών για τον τρόπο με τον οποίο θα συνεργάζονται μεταξύ διαφορετικών ειδικοτήτων και το πως θα αναπτύξουν (συν-δημιουργήσουν) σχέδια Μάθησης και Δημιουργικότητας. Κατάρτιση των εκπαιδευτικών για το πως θα συνεργάζονται με ακαδημαϊκούς και ανθρώπους της βιομηχανίας και το πως θα κάνουν STEAME δραστηριότητες σε υβριδικά περιβάλλοντα. Βοήθεια στους εκπαιδευτικούς για να αναπτύξουν δεξιότητες ώστε να γίνουν ευπροσάρμοστοι ηγέτες στην εκπαίδευση σε cloud περιβάλλοντα. Να τους δίνεται ελευθερία να δημιουργήσουν.
- **Βήμα 3.** Δημιουργία ανοιχτών χώρων στα υπάρχοντα σχολεία ή ανέγερση νέων σχολείων με περισσότερους ανοιχτούς χώρους για συνεργατική μάθηση μεταξύ των μαθητών μέσω projects. Σχεδίαση ή προσαρμογή δυναμικών ευπροσάρμοστων προγραμμάτων σπουδών ανάλογα με τις ικανότητες και τις ανάγκες των μαθητών.

www.steame.eu

(IT) CAPITOLO 7. RACCOMANDAZIONE POLITICHE

7.1 SOMMARIO

Il progetto STEAME - “STEAME: Guidelines for Developing and Implementing STEAME Schools” è stato sviluppato e implementato da sette partner europei tra novembre 2019 e dicembre 2021:

- Cyprus Mathematical Society – Cipro (organizzazione coordinatrice)
- Istituto pedagogico di Cipro – Cipro
- Università Pedagogica di Cracovia – Polonia
- Scuola privata di lingua inglese Prof. Ivan Apostolov – Bulgaria
- Institute of Accelerating Systems and Applications (IASA) – Grecia
- Scuola Douka Ekpaideftiria AE-Palladion Lykeion-Doukas – Grecia
- ITC Pacle Morante Limbiate - Italia

I risultati prodotti e gli esiti conseguiti mirano a contribuire alla trasformazione del sistema educativo europeo e al passaggio da Educazione 2.0 a Educazione 4.0.

Il concetto alla base è il modello educativo STEM – Scienza, Tecnologia, Ingegneria, Matematica. Questo é stato ulteriormente elaborato e ampliato per includere le arti e l'imprenditorialità. Pertanto, fornisce linee guida per lo sviluppo delle scuole STEAME, come scuole del futuro, che mirano a trasformare la conoscenza in competenze e abilità attraverso nuove strutture, infrastrutture e attività di apprendimento, per mezzo dell’ "apprendimento basato su progetti" al fine di soddisfare le esigenze contemporanee dell'Educazione 3.0 e 4.0 e le esigenze di Industria 4.0 e dei datori di lavoro.

Secondo i lavori pubblicati dall'Organizzazione per la Cooperazione e lo Sviluppo Economico (Future of Education and Skills) si possono identificare le seguenti sfide:

1. Le scuole e le università di oggi sono “sovraccariche” nei loro contenuti e programmi. Di conseguenza, gli studenti sono spesso privati del tempo sufficiente per acquisire e sviluppare concetti, competenze e abilità chiave. È tempo di spostare l'attenzione dei nostri studenti da "più ore di apprendimento a tempo di qualità per l'apprendimento e all'applicazione della conoscenza"

2. Il contenuto dell'apprendimento e delle attività deve essere di alta qualità se vogliamo che gli studenti acquisiscano una comprensione più profonda della conoscenza.

3. I curricula devono garantire equità e innovazione. Tutti gli studenti dovrebbero beneficiare dei cambiamenti e degli sviluppi sociali, economici e tecnologici.

4. Un'attenta pianificazione, il continuo adattamento e la modernizzazione sono essenziali per l'effettiva attuazione delle riforme e dei cambiamenti.

I risultati del progetto STEAME (www.steame.eu), forniscono soluzioni a queste sfide attraverso la creazione di un modello di struttura scolastica, con proposte di azioni di apprendimento dinamico e programmi di apprendimento, learning and creativity plans (piani di apprendimento e creatività), nonché lo sviluppo di un curriculum che si avvalga del supporto dell’insegnante e mostri come lavorare in modo efficace e produttivo in una scuola STEAME.

Il progetto STEAME ha sviluppato i seguenti output:

- O1. Linee guida per curricula STEAME dinamici e adattivi
- O2. Linee guida per le attività STEAME nelle scuole per due fasce d'età
- O3. Linee guida per la struttura organizzativa della scuola STEAME.

Durante il progetto, sono stati coinvolti importanti gruppi target di insegnanti, autorità scolastiche, dirigenti, personale amministrativo, studenti, genitori e altri attori che sono stati interpellati laddove le loro esigenze e aspettative sono state prese in considerazione grazie ai loro input, suggerimenti e idee. Alcuni dei fattori chiave di successo identificati per la transizione e la trasformazione sono legati a:

- Impegno da parte della direzione/autorità/dirigenti scolastici.
- Collaborazione tra docenti.
- Approccio centrato sullo studente.
- Approccio interdisciplinare.
- Applicazione di nuove metodologie: apprendimento basato su progetti, apprendimento basato sull'indagine, approccio ibrido, classe capovolta, ecc.
- Nuovo ruolo dell'insegnante come mentore, facilitatore, coach, co-creatore.
- Riorganizzazione e riordino delle aule e degli spazi di studio – verso spazi aperti, laboratori (Labs), spazi di apprendimento e creatività, lavoro di squadra.
- Utilizzo di strumenti digitali e processi e spazi abilitati dalla tecnologia.
- I vecchi piani di lezione diventano piani di apprendimento e creatività.
- Co-creazione e innovazione al centro.
- Sviluppo di insegnamento e apprendimento personalizzati.
- Collaborazione di scuole, insegnanti e studenti con l'industria e i ricercatori.

Le suddette raccomandazioni potrebbero contribuire ai seguenti passaggi volti alla realizzazione di una scuola STEAME di successo, basata sul futuro modello sviluppato sia per le scuole di nuova costituzione, sia per le scuole già esistenti.

Cosa richiedeva e cosa offre il progetto STEAME:

- Modello delle Scuole STEAME
- Linee guida per le attività STEAME nelle scuole
- Linee guida per la cooperazione tra docenti di diverse discipline
- Nuove strutture organizzative per le scuole STEAME
- Formazione degli insegnanti per aiutarli ad adattarsi
- Cambiamento dinamico di curricula, strumenti, metodi

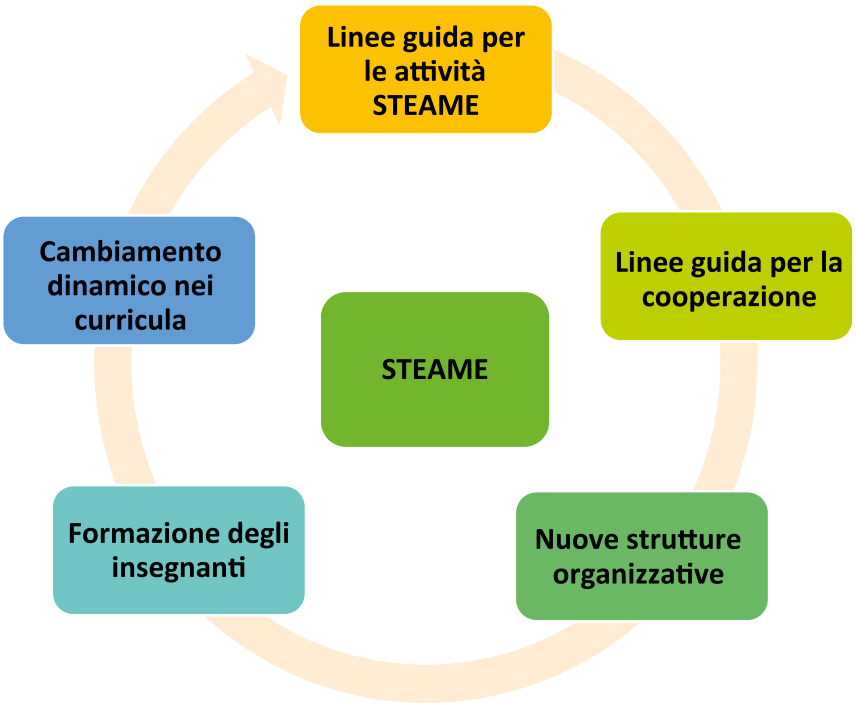


Figure 7. 1: STEAME project Deliverables

7.2 IL CAMBIO DI PARADIGMA DEGLI AMBIENTI DI APPRENDIMENTO SCOLASTICO

Quali sono i passaggi fondamentali per trasformare le attuali strutture di apprendimento nelle scuole in future strutture di apprendimento basate sul progetto STEAME?

3 passaggi per passare da Education 2.0 a Education 4.0

- **Passaggio 1.** Conoscenza e apprendimento degli studenti della scuola: proteggere l'apprendimento digitale attraverso video didattici creati dagli insegnanti. Questi video didattici possono essere creati a tre diverse velocità di apprendimento. Essi dovrebbero essere a disposizione degli studenti delle scuole per l'apprendimento iniziale, per ricordare le conoscenze e per accedervi in qualsiasi momento e luogo.
- **Passaggio 2.** Competenze e abilità dell'insegnante: formare gli insegnanti su come cooperare tra diverse discipline e su come sviluppare (co-creare) piani di apprendimento e creatività STEAME. Formare gli insegnanti su come collaborare con persone accademiche e del settore e su come svolgere attività relative a STEAME in ambienti ibridi. Aiutare gli insegnanti a sviluppare competenze per diventare leader adattabili dell'istruzione cloud. Dare loro la libertà di creare.
- **Passaggio 3.** Creare spazi aperti nelle scuole attuali o costruire le nuove scuole con più spazi aperti per il lavoro cooperativo basato su progetti tra gli studenti delle scuole. Pianificare o adattare curricula dinamici adattabili al cambiamento e adattabili alle competenze e alle esigenze dello studente.

www.steame.eu

(PL) ROZDZIAŁ 7. ZALECENIA DOTYCZĄCE POLITYKI OŚWIATOWEJ

7.1 STRESZCZENIE WYKONAWCZE

Projekt STEAME – „STEAME: Guidelines for Developing and Implementing STEAME Schools" został opracowany i wdrożony przez siedmiu europejskich partnerów w okresie od listopada 2019 do grudnia 2021:

- Cypryjskie Towarzystwo Matematyczne – Cypr (organizacja koordynująca)
- Cypryjski Instytut Pedagogiczny – Cypr
- Uniwersytet Pedagogiczny w Krakowie – Polska
- Prywatna Szkoła Anglojęzyczna im. prof. Ivana Apostolova – Bułgaria
- Instytut Systemów Przyspieszania i Aplikacji (IASA) – Grecja
- Szkoła Douka Ekpaideftiria AE-Palladion Lykeion-Doukas – Grecja
- ITC Pacle Morante Limbiate – Włochy

Opracowane wyniki i osiągnięte rezultaty miały na celu przyczynienie się do transformacji europejskiego systemu kształcenia i wdrożenia transformacji od Edukacji 2.0 do Edukacji 4.0.

Wyjściową koncepcją jest model edukacyjny STEM – Nauka, Technologia, Inżynieria, Matematyka. Został on dalej opracowany i rozszerzony o Sztukę i Przedsiębiorczość. Wobec tego wyniki projektu zawierają wytyczne dotyczące rozwoju szkół STEAME, jako szkół przyszłości, których celem jest zastąpienie wiedzy przez kompetencje i umiejętności poprzez nowe struktury nauczania, infrastrukturę szkoły i działania edukacyjne oparte na nauczaniu projektowym, które spełniają współczesne wymagania Edukacji 3.0 i 4.0 oraz odpowiadają potrzebom Przemysłu 4.0 i pracodawców.

Według publikacji Organizacji Współpracy Gospodarczej i Rozwoju (Przyszłość Edukacji i Umiejętności) można zidentyfikować następujące wyzwania:

1. Dzisiejsze szkoły i uniwersytety są „przeciążone" treścią i programem nauczania. W rezultacie uczniowie są często pozbawieni wystarczającej ilości czasu na przyswajanie i rozwijanie kluczowych pojęć, zdolności i umiejętności. Nadszedł czas na przeniesienie uwagę naszych uczniów z systemu „więcej godzin nauki" do systemu opartego na „jakości wykorzystania czasu uczenia się i zastosowania wiedzy".

2. Nauczane treści i czynności edukacyjne powinny być wysokiej jakości, jeśli chcemy, aby uczniowie pogłębili swoje zrozumienie dla znaczenia wiedzy.

3. Programy nauczania powinny zapewniać równość dostępu i innowacyjność. Wszyscy uczniowie powinni czerpać korzyści ze zmian i osiągnięć społecznych, gospodarczych i technologicznych.

4. Staranne planowanie, ciągła adaptacja i modernizacja są niezbędne do skutecznego wdrażania reform i zmian.

Wyniki projektu STEAME (https://steame.eu/) dostarczają rozwiązań dla tych wyzwań poprzez stworzenie modelu planu struktury szkoły z proponowanymi dynamicznymi działaniami i programami nauczani, planami uczenia się i kreatywności, a także opracowanie skupionego na nauczycielach programu wsparcia w zakresie efektywnej i produktywnej pracy w szkole STEAME.

W ramach projektu STEAM opracowano następujące wyniki::

- O1. Wytyczne dotyczące dynamicznych i adaptacyjnych programów STEAME.
- O2. Wytyczne dotyczące zajęć STEAME w szkołach dla dwóch grup wiekowych.
- O3. Wytyczne dotyczące struktury organizacyjnej szkół STEAME.

W całym projekcie zaangażowane były odpowiednie grupy docelowe nauczycieli, władz szkolnych, kierownictwa/dyrektorów, personelu administracyjnego, uczniów, rodziców i innych interesariuszy. Zgłoszone przez nich potrzeby i oczekiwania zostały wzięte pod uwagę podobnie jak ich wykorzystano ich opinie, sugestie i pomysły. Niektóre ze zidentyfikowanych kluczowych czynników sukcesu reformy i transformacji to:

- Zaangażowanie dyrekcji/władz/dyrektorów szkoły.
- Współpraca między nauczycielami.
- Podejście skoncentrowane na uczniu.
- Podejście interdyscyplinarne.
- Zastosowanie nowych metodologii – uczenie oparte na projektach, uczenie oparte na dociekaniu, podejście hybrydowe, odwrócona klasa itp.
- Określenie nowej roli nauczyciela jako mentora, facylitatora, coacha, współtwórcy.
- Reorganizacja i przearanżowanie sal lekcyjnych i przestrzeni do nauki – w kierunku otwartych przestrzeni, laboratoriów (Labs), przestrzeni do uczenia się, kreatywności i pracy zespołowej.
- Wykorzystanie narzędzi cyfrowych oraz procesów i przestrzeni wykorzystujących technologię.
- Odejście od tradycyjnych planów lekcji do planów uczenia się i kreatywności.
- Uznanie współtworzenia i innowacyjności podstawa nowego nauczania.
- Rozwijanie spersonalizowanego nauczania i uczenia się.
- Nawiązywanie współpracy szkół, nauczycieli i studentów z przemysłem i naukowcami.

Uwzględnienie wyżej wymienionych zaleceń może przyczynić się do stworzenia udanego modelu szkół STEAME tak w zakresie adaptacji obecnych szkół do tego modelu nauczania, jak i w odniesieniu do szkół nowopowstających.

Jakie były potrzeby i jak odpowiada na nie projekt STEAME:

- Opis modelów szkół STEAME;
- Wytyczne dotyczące zajęć STEAME w szkołach;
- Wytyczne dotyczące współpracy między nauczycielami różnych dyscyplin;
- Propozycja nowych struktur organizacyjnych dla szkół STEAME;
- Szkolenie dla nauczycieli pomagające w przystosowaniu się do transformacji;
- □ Dynamiczna zmiana w programach nauczania, narzędziach, metodach.

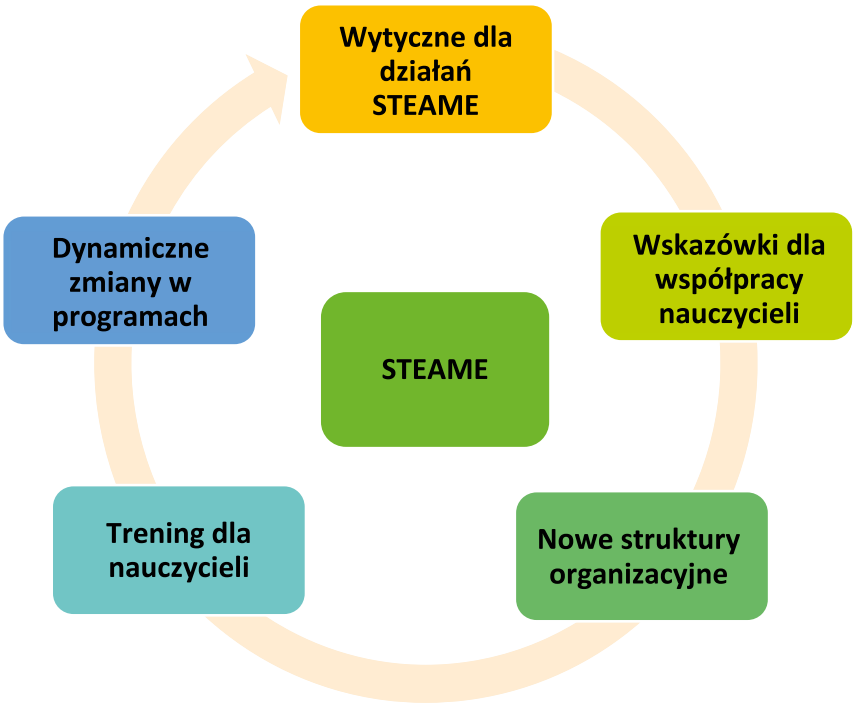


Figure 7. 1: Elementy projektu STEAME

7.2 ZMIANA PARADYGMANTU DOTYCZĄCEGO ŚRODOWISKA PRACY W SZKOLE

Jakie są podstawowe kroki w celu zmiany obecnych struktur uczenia się w szkołach na przyszłe struktury uczenia się oparte na projektach STEAME?

3 kroki do przejścia z edukacji 2.0 na edukację 4.0

- **Krok 1.** Wiedza i uczenie się uczniów: Bezpieczna nauka cyfrowa dzięki filmom edukacyjnym stworzonym przez nauczycieli. Te filmy szkoleniowe można tworzyć w trzech różnych szybkościach uczenia się. Powinny być dostępne dla uczniów w celu początkowego uczenia się, przywoływania wiedzy i uzyskiwania do niej dostępu w dowolnym czasie i miejscu.
- **Krok 2.** Kompetencje i umiejętności nauczycieli: Szkolenie nauczycieli, jak współpracować między różnymi dyscyplinami i jak opracowywać (współtworzyć) plany uczenia się i kreatywności STEAME. Szkolenia dla nauczycieli, jak współpracować ze środowiskami akademickimi i przemysłowymi oraz jak wykonywać działania związane ze STEAME w środowiskach hybrydowych. Pomoc dla nauczycieli w rozwoju kompetencji niezbędnych dla stania się elastycznymi liderami edukacji w chmurze. Swoboda tworzenia.
- **Krok 3.** Tworzenie otwartych przestrzeni w obecnych szkołach lub budowanie nowych szkół z większą ilością przestrzeni otwartych dla współpracy uczniów nad projektami. Planowanie lub adaptacja dynamicznych programów nauczania, które można dostosować do zmian zachodzących w otaczającym nas świecie i dostosowywać do kompetencji i potrzeb ucznia.

www.steame.eu

(BG) ГЛАВА 7. ПРЕПОРЪКИ ЗА СТРАТЕГИЯ

7.1 Резюме на изпълнението

Проектът STEAME - "STEAME: Насоки за развитие и прилагане на STEAME училища" е разработен и изпълнен от седем европейски партньори между ноември 2019 г. и декември 2021 г.:

- Кипърско математически общество – Кипър (Координираща организация)
- Кипърски педагогически институт – Кипър
- Педагогически университет Краков – Полша
- Частна английска езикова гимназия „Проф. Иван Апостолов“– България
- Институт за ускорителни системи и приложения (IASA) – Гърция
- Училище Дука Екпаидефтирия АЕ-Паладион Ликион-Дукас – Гърция
- ITC Пакле Моранте Лимбиат - Италия

Постигнатите резултати и изработените продукти имаха за цел да допринесат за трансформацията на европейската образователна система и прехода от Образование 2.0 към Образование 4.0.

Основната концепция е образователният модел STEM – Наука, Технология, Инженерство, Математика. Тя беше допълнително развита и разширена, за да включи изкуства и предприемачество. По този начин концепцията предоставя насоки за развитие на STEAME училища, като училища на бъдещето, които имат за цел да трансформират знанията в компетентности и умения чрез нови структури, инфраструктури, учебни дейности, и проекто-базирано обучение, които отговарят на съвременните изисквания на Образование 3.0 и 4.0 и нуждите на индустрия 4.0 и работодателите.

Според публикации на Организацията за икономическо сътрудничество и развитие, (Бъдеще на образованието и уменията) съществуват следните предизвикателства:

1. Учебното съдържание и учебната програма на съвременните училища и университети са "претоварени". В резултат на това учениците често са лишени от достатъчно време, за да усвоят ключови концепции, и да придобият и развият способности и умения. Време е да изместим фокуса на нашите ученици от „повече часове учене към качествено време на учене и прилагане на знанията"

2. Учебното съдържание и дейностите трябва да бъдат с високо качество, ако искаме учениците да придобият по-задълбочени познания

3. Учебните програми трябва да осигуряват равенство и иновации. Всички студенти трябва да се възползват от социални, икономически и технологични промени и развитие.

4. Внимателното планиране, непрекъснатата адаптация и модернизацията са от съществено значение за ефективното осъществяване на реформите и промените.

Резултатите от проекта STEAME (www.steame.eu), предоставят решения на тези предизвикателства чрез създаването на модел на училищна структура с предложени динамични учебни действия и учебни програми, планове за учене и творчество, както и разработване на ориентирана към учителя подкрепа за това как да работите ефективно и продуктивно в STEAME училище.

Проектът STEAME разработи следните крайни продукти:

- O1. Насоки за динамични и адаптивни учебни програми за STEAME
- O2. Насоки за дейностите по STEAME в училища за две възрастови групи
- O3. Насоки за организационна структура на STEAME училище.

По време на целия проект бяха включени съответните целеви групи учители, училищни органи, мениджмънт/ръководители, служители на администрацията, ученици, родители и други заинтересовани страни, където техните нужди и очаквания, бяха взети под внимание, а техните принос, предложения и идеи бяха използвани като средства за разработване на продуктите.. Установените бяха следните ключови условия за успех на прехода и трансформацията:

- Ангажимент от страна на ръководството на училището/органите/ръководителите.
- Сътрудничество между учителите.
- Подход, съсредоточен върху учениците.
- Интердисциплинарен подход.
- Прилагане на нови методологии – проектобазирано обучение, изследване, хибриден подход, обърната класна стая и др.
- Нова роля на учителя като ментор, фасилитатор, треньор, съсъздател.
- Реорганизация и преподреждане на класните стаи и учебните пространства – към открити пространства, лаборатории, учебни и творчески пространства, пространства за работа в екип.
- Използване на дигитални инструменти и технологично-оборудвани процеси и пространства.
- Урочните планове да се превърнат в планове за учене и творчество.
- Колективното творчество и иновациите са от ключово значение.
- Развитие на персонализираното преподаване и учене.
- Сътрудничество на училища, учители и ученици с индустрията и изследователите.

Горепосочените препоръки биха могли да допринесат за следните стъпки към успешно създаване на модел на STEAME училище на бъдещето, разработен за новосъздадени, както и за съществуващите училища.

Какво е необходимо и беше ли то осигурено от проекта STEAME:

- Модел на STEAME училища
- Насоки за STEAME дейностите в училищата
- Насоки за сътрудничество между учители от различни дисциплини
- Нови организационни структури за STEAME училища
- Адаптиращо обучение за учителите
- Динамична промяна в учебните програми, инструменти, методи

Фигура 7. 1: Продукти на aSTEAME проект

7.2 ПРОМЯНАТА НА ПАРАДИГМАТА НА УЧЕБНИТЕ СРЕДИ В УЧИЛИЩАТА

Кои са основните стъпки за промяна на настоящите учебни структури в училищата в бъдещи структури за проекто-базирано STEAME обучение?

3 Стъпки за промяна от Образование 2.0 на Образование 4.0

- **Стъпка 1.** Знания и учене от ученици в училище: Сигурно цифрово обучение чрез учебни видеоклипове, създадени от учители. Тези учебни видеоклипове могат да бъдат създадени за три различни интензивности на обучение. Те следва да бъдат на разположение на учениците в училищата за първоначално научаване, за припомняне на знанията и за достъп до тях по всяко време и всяко място.
- **Стъпка 2. Компетентности и умения на** учителите: Обучаване на учителите по различните дисциплини как да си сътрудничат и как да създават съвместно STEAME планове за учене и творчество. Обучаване на учителите как да си сътрудничат с хората от академичните среди и промишлеността, и как да провеждат STEAME дейности в хибридни среди. Подпомагане на учителите да развият компетентности за превръщането им в адаптивни ръководители на образование. Осигуряване на свобода за творчество на учителите.
- **Стъпка 3.** Създаване на открити пространства в настоящите училища или изграждане на новите училища с повече отворени пространства за проекто- базирана кооперативна работа между учениците в училище. Планиране или адаптиране на динамични учебни програми, приспособими към промените и приспособими към компетентностите и нуждите на ученика.

www.steame.eu

(ES) CAPÍTULO 7. RECOMENDACIONES DE POLÍTICA

7.1 Resumen del proceso de ejecución

El proyecto STEAME - "STEAME: Reglas generales para desarrollo e implementación de las escuelas STEAME" fue desarrollado e implementado por siete socios europeos entre noviembre de 2019 y diciembre de 2021:

- Sociedad Matemática de Chipre – Chipre (Organización coordinadora)
- Instituto Pedagógico de Chipre – Chipre
- Universidad Pedagógica de Cracovia - Polonia
- Escuela privada de inglés Prof. Ivan Apostolov - Bulgaria
- Instituto de Aplicaciones y Sistemas de Aceleración (IASA) - Grecia
- Escuelas de Douk SA-Escuela Palladion Lyceum-Doukas - Grecia
- ITC Pacle Morante Limbiate - Italia

Los resultados obtenidos y los productos elaborados tenían por objetivo contribuir a la transformación del Sistema educativo europeo y a la transición de la Educación 2.0 a la Educación 4.0.

El concepto subyacente es el modelo educativo STEM: Ciencia, Tecnología, Ingeniería y Matemáticas, que ha sido elaborado y ampliado aún más con el fin de incluir las Artes y el Emprendimiento, proporcionando de esta manera reglas generales para el desarrollo de las escuelas STEAME como escuelas del futuro cuyo objetivo es transformar el conocimiento en competencias y habilidades a través de nuevas estructuras, infraestructuras y actividades de aprendizaje mediante el "aprendizaje basado en proyectos" que cumplan con los requisitos contemporáneos de la Educación 3.0 y 4.0. y las necesidades de la Industria 4.0 y de los empleadores.

Según publicaciones de la Organización para la Cooperación y el Desarrollo económicos (Futuro para la Educación y las Competencias) se pueden identificar los siguientes desafíos:

1. Las escuelas y universidades de hoy están "sobrecargadas" en cuanto a su contenido y currículos. Como resultado los estudiantes resultan privados de tiempo suficiente para adquirir y desarrollar conceptos, habilidades y destrezas clave. Ya es hora de cambiar el enfoque de nuestros estudiantes de "más horas dedicadas al aprendizaje a tiempo de calidad del aprendizaje y aplicación de los conocimientos".

2. El contenido del aprendizaje y las actividades deberían ser de alta calidad si queremos que los estudiantes adquieran una comprensión más profunda del conocimiento.

3. Los currículos deberían garantizar la igualdad y la innovación de modo que todos los estudiantes se puedan beneficiar de los cambios y desarrollos sociales, económicos y tecnológicos.

4. La planificación cuidadosa, la adaptación continua y la modernización son esenciales para la implementación efectiva de reformas y cambios.

Los resultados del proyecto STEAME (www.steame.eu) proporcionan soluciones a estos desafíos a través de la creación de un modelo de plan de estructura escolar con propuestas de acciones de aprendizaje dinámico y programas de aprendizaje, planes de aprendizaje y creatividad, así como el desarrollo de un currículo centrado en el docente sirviéndole de apoyo en su trabajo de modo eficaz y productivo en una escuela STEAME.

El proyecto STEAME ha desarrollado los siguientes productos finales:

- O1. Reglas generales para el currículo STEAME dinámico y adaptable
- O2. Reglas generales para las actividades STEAME en las escuelas para dos diferentes grupos de edad
- O3. Reglas generales para la estructura organizativa de las escuelas STEAME

A lo largo del proyecto, se involucraron grupos destinatarios relevantes de profesores, autoridades escolares, gerentes / directores, personal administrativo, estudiantes, padres y otras partes interesadas, cuyas necesidades y expectativas se tomaron en consideración aprovechando sus aportes, sugerencias e ideas. Algunos de los factores clave de éxito identificados para la transición y transformación están relacionados con:

- Compromiso por parte de la gerencia/las autoridades/los encargados del centro.
- Colaboración entre los profesores.
- Aprendizaje centrado en el estudiante.
- Enfoque interdisciplinario.
- Aplicación de nuevas metodologías – aprendizaje basado en proyectos, enseñanza reflexiva, enfoque híbrido, el aula invertida, etc.
- Nuevo rol del docente como mentor, facilitador, instructor, cocreador.
- Reorganización y reordenación de las aulas y espacios de estudio en espacios abiertos, laboratorios (Labs), espacios de aprendizaje y creatividad, trabajo en equipo.
- Uso de herramientas digitales, al igual que procesos y espacios habilitados por la tecnología.
- Los planes de las clases previamente usados se convierten en planes de aprendizaje y creatividad.
- La creación en colaboración y la innovación tienen un papel clave.
- Desarrollo de enseñanza y aprendizaje personalizados.
- Colaboración entre escuelas, profesores y estudiantes con la industria y los investigadores.

Las recomendaciones arriba mencionadas podrían contribuir a los siguientes pasos hacia una creación exitosa de un modelo de la escuela STEAME del futuro, desarrollado tanto para escuelas recién creadas como para escuelas ya existentes.

Lo que se necesitaba y lo que ya ha sido proporcionado por el proyecto STEAME:

- Un modelo de escuelas STEAME
- Reglas generales para las actividades de STEAME en las escuelas
- Reglas generales para la cooperación entre profesores de disciplinas diferentes
- Nuevas estructuras organizativas para las escuelas STEAME
- Formación de profesores para ayudarles a adaptarse
- Cambio dinámico de los currículos, las herramientas y los métodos

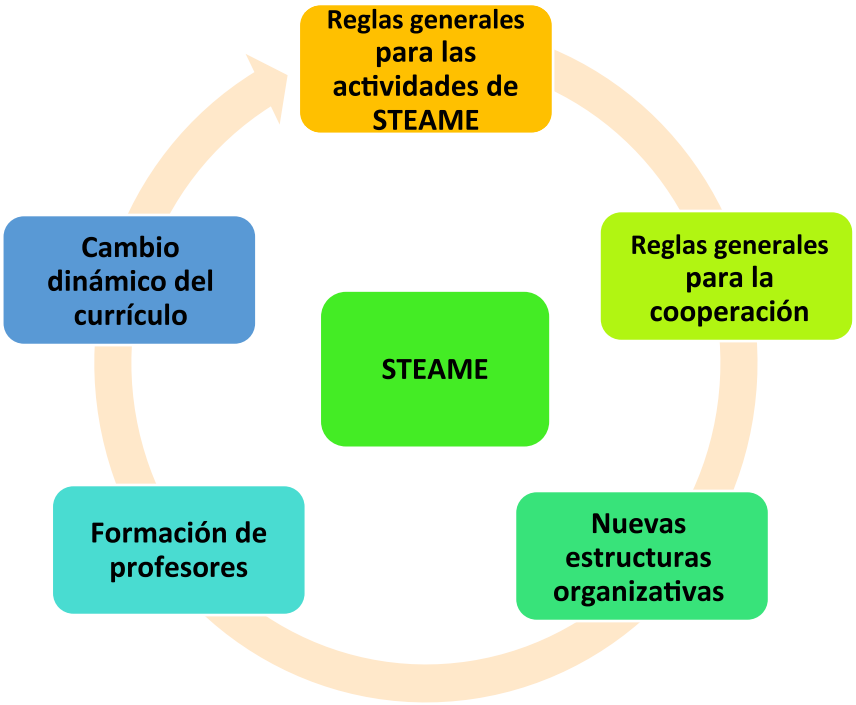


Figura 7. 2: Productos finales de un proyecto STEAME

7.2 EL CAMBIO DE PARADIGMA DE LOS ENTORNOS DE APRENDIZAJE ESCOLAR

¿Cuáles son los pasos a seguir para la transformación de las estructuras de aprendizaje actuales en las futuras estructuras de aprendizaje basado en proyectos?

3 pasos a seguir para el cambio de la Educación 2.0 a la Educación 4.0

- **Primer paso.** Conocimiento y aprendizaje por parte de los alumnos en la escuela: Aprendizaje digital asegurado a través de videos de aprendizaje creados por los profesores. Estos videos de aprendizaje se pueden crear para tres niveles diferentes de intensidad. Los videos deben estar a disposición de los alumnos en la escuela para aprendizaje inicial y para traer a la memoria conocimientos previos, asegurando acceso a los mismos a cualquier hora y en cualquier parte.

- **Segundo paso.** Competencias y habilidades de los profesores: Enseñar a los profesores cómo colaborar entre las diferentes disciplinas y cómo desarrollar (crear conjuntamente) planos de aprendizaje y creatividad STEAME. Enseñar a los profesores cómo cooperar con el personal académico y de la industria y cómo hacer actividades STEAME relacionadas en entornos híbridos. Suministrar ayuda a los profesores a desarrollar competencias para convertirse en líderes adaptables a la educación en la nube dándoles libertad de creación.

- **Tercer paso.** Crear espacios abiertos en las escuelas actuales o construir nuevas escuelas con más espacios abiertos para el trabajo cooperativo basado en proyectos entre los estudiantes de la escuela. Planificar o adaptar currículos dinámicos adaptables a los cambios y adaptables a las competencias y necesidades del alumno.

www.steame.eu

(FR) PARTIE 7. RECOMMANDATIONS DE POLITIQUE

7.1 Résumé de la réalisation

Le projet STEAME - "STEAME : Directions de développement et application des écoles STEAME " est développé et réalisé du novembre 2019 au décembre 2021par sept partenaires européens :

- La société des mathématiciens de Chypre / coordinateur du projet /
- L'Institut pédagogique du Chypre – Chypre
- Université pédagogique de Cracovie – Pologne
- Lycée privé bilingue de langue anglaise « prof. Ivan Apostolov » - Bulgarie
- Institut de systèmes d'accélération et d'applications (IASA) – Grèce
- Douka Ekpaideftiria AE-Palladion Lykeion-Doukas School – Grèce
- ITC Pacle Morante Limbiate – Italie

Les résultats acquis et les produits réalisés avaient comme but de contribuer à la transformation du système éducatif européen ainsi qu'à la transition de l'Éducation 2.0 à l'Éducation 4.0.

La conception principale c'est le modèle éducatif STEM – Science, Technologie, Ingénierie, Mathématiques. Elle a été complétée et élargie pour y inclure les arts et l'entreprenariat. De cette façon la conception propose des directions de développement des écoles STEAME en tant qu'écoles du futur ayant pour but la transformation des savoirs en compétences et savoir-faire par des nouvelles structures, infrastructures, activités éducatives et formation à la base d'un projet qui correspondent aux exigences contemporaines de l'Éducation 3.0 et 4.0 et aux besoins de l'industrie et des employeurs.

Selon des publications de l'Organisation de collaboration économique et développement (Avenir de l'éducation et des savoir-faire) il existe les défis suivants :

1. Le contenu scolaire ainsi que les programmes scolaires des écoles et des universités contemporaines sont « surchargés ». D'où le manque du temps pour les élèves à apprendre les conceptions clés et d'acquérir et de développer des compétences et des savoir-faire. Il est temps qu'on dévie le focus de nos élèves de « plus d'heures d'apprentissage vers un apprentissage effectif et une application des savoirs »

2. Le contenu scolaire et les activités doivent être de très bonne qualité si on veut que les élèves acquièrent des connaissances approfondies

3. Les programmes scolaires doivent assurer de l'égalité et des innovations. Tous les étudiants doivent pouvoir bénéficier des changements sociaux, économiques et technologiques et du développement.

4. La planification attentionnée, l'adaptation continue et la modernisation sont d'une importance significative pour la réalisation effective des réformes et des changements.

Les résultats du projet STEAME, (www.steame.eu), assurent des résolutions à ces défis par la création de modèle de structure éducative qui propose des démarches éducatives dynamiques et des programmes scolaires, des projets d'apprentissage et de création ainsi que le développement d'un support destiné aux professeurs pour les aider à travailler effectivement à l'école STEAME.

Le projet STEAME a développé les produits finals suivants :

- O1. Directions de programmes scolaires dynamiques et adaptifs pour STEAME
- O2. Directions des activités selon STEAME dans des écoles à deux groupes d'âge
- O3. Directions d'organisation de la structure d'une école STEAME.

Pendant la réalisation du projet ont été inclus les groupes cibles de professeurs, de structures scolaires, de management / directeurs, employés dans l'administration, élèves, parents et d'autres personnes concernées dont les besoins et les attentes ont été pris en considération et leurs contributions, propositions et idées ont été utilisées pour le développement des produits. On a constaté les conditions essentielles pour le succès de la transition et de la transformation suivantes :

- Engagement de la part de la direction de l'école.
- Collaboration entre les professeurs.
- Une approche focalisée sur les élèves.
- Une approche interdisciplinaire.
- Application de nouvelles méthodologies – éducation basée à des projets, recherche, approche hybride, une salle de classe inversée etc.
- Un nouveau rôle du professeur en tant que mentor, facilitateur, moniteur, co-créateur.
- Réorganisation et réaménagement des salles de classe et des espaces scolaires vers des espaces ouvertes, laboratoires, espaces éducatives et créatrices, espaces de travail en groupe.
- Utilisation d'outils numériques et de processus et des espaces technologiquement aménagés.
- Les plans des leçons doivent être transformés en plans d'apprentissage et de création.
- La création collective et les innovations sont d'une importance significative.
- Développement d'un enseignement et d'un apprentissage personnalisés.
- Coopération des écoles, professeurs et élèves avec le monde de l'industrie et des chercheurs.

Les recommandations ci-dessus pourraient contribuer à la création réussie du modèle d'école STEAME de l'avenir, conçu pour de nouvelles écoles ainsi que pour des écoles déjà existantes.

De quoi a-t-on besoin et a-t-il été assuré par le projet STEAME :

- Un modèle d'école STEAME
- Directions des activités aux écoles STEAME
- Directions de collaboration entre les enseignants des différentes disciplines.
- De nouvelles structures d'organisation d'écoles STEAME
- Une formation adaptée aux professeurs
- Un changement dynamique des programmes scolaires, outils, méthodes.

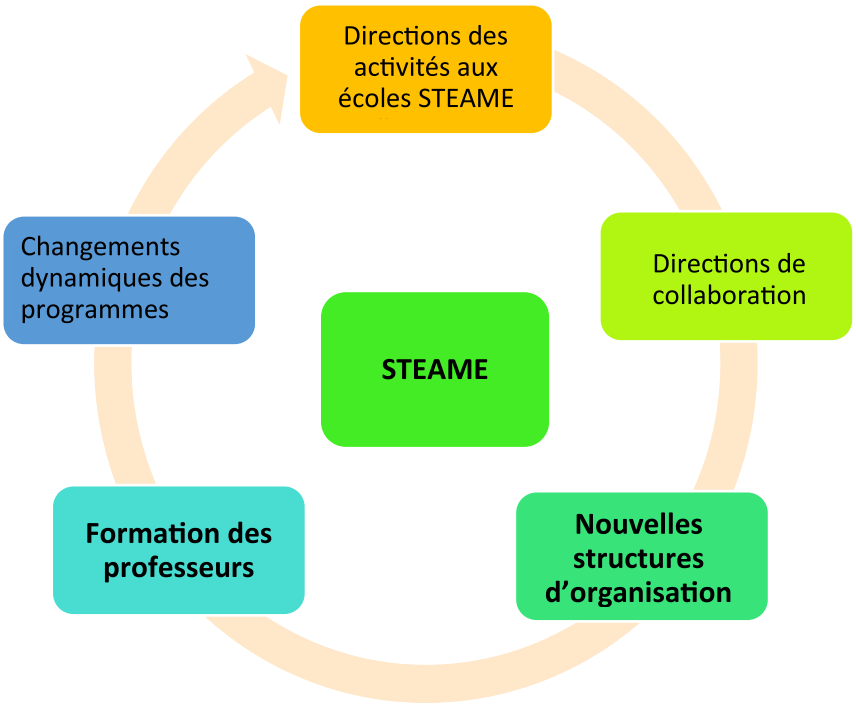


Figure 7. 1: Produits du projet STEAME

7.2 Le changement du paradigme de l'environnement scolaire aux écoles

Quelles sont les démarches principales pour le changement des structures scolaires actuelles en futures structures d'éducation STEAME basée sur des projets.

3 démarches pour un changement de l'Éducation 2.0 à l'Éducation 4.0

- **Démarche 1. Connaissances acquises par les élèves à l'école :** Enseignement numérique par des vidéo séquences créées par les professeurs. Celles-ci peuvent être créées pour trois niveaux différents d'éducation. Elles doivent être à la disposition des élèves à l'école pour une première approche, pour un rappel des connaissances et pour y avoir accès à tout moment et partout.
- **Démarche 2. Compétences et savoir-faire des professeurs :** Former les professeurs des différentes disciplines comment collaborer et comment créer des projets STEAME d'apprentissage et de création. Former les professeurs comment collaborer avec les spécialistes des milieux académiques et industriels et comment effectuer des activités STEAME dans un milieu hybride. Aider les professeurs à développer leurs compétences pour devenir des directeurs adaptifs d'éducation. Assurer aux professeurs de la liberté de création.
- **Démarche 3.** Aménagement d'espaces ouverts dans les écoles actuelles ou bien construire dans les nouveaux établissements plus d'espaces ouverts destinés au travail coopératif entre les élèves. Planification et adaptation des programmes scolaires dynamiques adaptables aux changements, aux compétences et aux besoins de l'élève.

www.steame.eu

(DE) KAPITEL 7. STRATEGIEEMPFEHLUNGEN

7.1 ZUSAMMENFASSUNG

Das Projekt STEAME – „STEAME: Leitlinien für die Entwicklung und Umsetzung von STEAME-Schulen“ wurde zwischen November 2019 und Dezember 2021 von sieben europäischen Partnern entwickelt und umgesetzt:

- Zypern Mathematische Gesellschaft – Zypern (Koordinierende Organisation)
- Zypern Pädagogisches Institut – Zypern
- Pädagogische Universität Krakau – Polen
- Institut für Beschleunigungssysteme und Anwendungen (IASA) – Griechenland
- Douka Ekpadeftiria AE-Palladion Lykeion-Doukas Schule – Griechenland
- ITC Pacle Morante Limbiate – Italien

Die erzielten Ergebnisse und die entwickelten Produkte zielten darauf ab, zur Transformation des europäischen Bildungssystems und zum Übergang von Bildung 2.0 zu Bildung 4.0 beizutragen.

Das zugrunde liegende Konzept ist das MINT-Bildungsmodell – Naturwissenschaften, Technik, Ingenieurwissenschaften, Mathematik. Es wurde weiter ausgearbeitet und um die Bereiche Arts and Entrepreneurship erweitert. Damit gibt sie Leitlinien für die Entwicklung von STEAME-Schulen vor, die darauf abzielen, Wissen in Kompetenzen und Fähigkeiten durch neue Strukturen, Infrastrukturen und Lernaktivitäten durch „projektbasiertes Lernen“ umzuwandeln, die den heutigen Anforderungen von Bildung 3.0 und 4.0 gerecht werden und die Bedürfnisse von Industrie 4.0 und Arbeitgebern.

Laut Veröffentlichungen der Organisation für wirtschaftliche Zusammenarbeit und Entwicklung, (Zukunft von Bildung und Kompetenzen) lassen sich folgende Herausforderungen identifizieren:

1. Schulen und Universitäten sind heute inhaltlich und lehrplanmäßig „überlastet“. Dadurch wird den Studierenden oft nicht genügend Zeit zum Erlernen und Entwickeln von Schlüsselkonzepten, Fähigkeiten und Fertigkeiten verwehrt. Es ist an der Zeit, den Fokus unserer Schüler von "mehr Stunden des Lernens auf eine hochwertige Zeit des Lernens und der Anwendung von Wissen" zu verlagern.

2. Die Lerninhalte und Aktivitäten müssen von hoher Qualität sein, wenn wir wollen, dass die Studierenden ein tieferes Verständnis des Wissens erlangen.

3. Die Lehrpläne gewährleisten Gleichstellung und Innovation. Alle Studierenden sollen von gesellschaftlichen, wirtschaftlichen und technologischen Veränderungen und Entwicklungen profitieren.

4. Sorgfältige Planung, kontinuierliche Anpassung und Modernisierung sind für die wirksame Umsetzung von Reformen und Veränderungen unabdingbar.

Die STEAME-Projektergebnisse (www.steame.eu) bieten Lösungen für diese Herausforderungen durch die Erstellung eines Modells für einen Schulstrukturplan mit vorgeschlagenen dynamischen Lernaktionen und Lernprogrammen, Lern- und Kreativitätsplänen sowie die Entwicklung eines lehrerzentrierten Lehrplans Unterstützung beim effektiven und produktiven Arbeiten in einer STEAME-Schule.

Das STEAME-Projekt hat die folgenden Produkte entwickelt:

- 1. Leitlinien für dynamische und adaptive STEAME-Lehrpläne
- 2. Richtlinien für STEAME-Aktivitäten in Schulen für zwei Altersgruppen
- 3. Richtlinien für die Organisationsstruktur der STEAME-Schule.

Während des gesamten Projekts wurden relevante Zielgruppen von Lehrern, Schulbehörden, Management/Leitungen, Verwaltungspersonal, Schülern, Eltern und anderen interessierten Gruppen eingebunden, wobei ihre Bedürfnisse und Erwartungen sowie ihre Beiträge, Vorschläge und Ideen berücksichtigt wurden. Einige der identifizierten Schlüsselerfolgsfaktoren für den Übergang und die Transformation beziehen sich auf:

• Engagement der Schulleitung/Behörden/Leiter.
• Zusammenarbeit zwischen Lehrern.
• Schülerzentrierter Ansatz.
• Interdisziplinärer Ansatz.
• Anwendung neuer Methoden – projektbasiertes Lernen, forschendes Lernen, hybrider Ansatz, umgedrehtes Klassenzimmer usw.
• Neue Rolle des Lehrers als Mentor, Moderator, Coach, Mitgestalter.
• Neuordnung und Neuordnung der Klassen- und Lernräume – hin zu Freiräumen, Laboren (Labs), Lern- und Kreativitätsräumen, Teamarbeit.
• Nutzung digitaler Tools und technologiegestützter Prozesse und Räume.
• Alte Unterrichtspläne werden zu Lern- und Kreativitätsplänen.
• Mitschöpfung und Innovation im Mittelpunkt.
• Entwicklung von personalisiertem Lehren und Lernen.
• Zusammenarbeit von Schulen, Lehrern und Schülern mit Industrie und Forschern.

Die oben genannten Empfehlungen könnten zu den folgenden Schritten zu einer erfolgreichen STEAME-Schule des Zukunftsmodells beitragen, das sowohl für neu gegründete Schulen als auch für bestehende Schulen entwickelt wurde.

Was wurde benötigt und was liefert das STEAME-Projekt:

- Modell der STEAME-Schulen
- Richtlinien für STEAME-Aktivitäten in Schulen
- Leitlinien für die Zusammenarbeit zwischen Lehrenden verschiedener Fachrichtungen
- Neue Organisationsstrukturen für STEAME-Schulen
- Ausbildung von Lehrern, um ihnen bei der Anpassung zu helfen
- Dynamischer Wandel von Curricula, Tools, Methoden

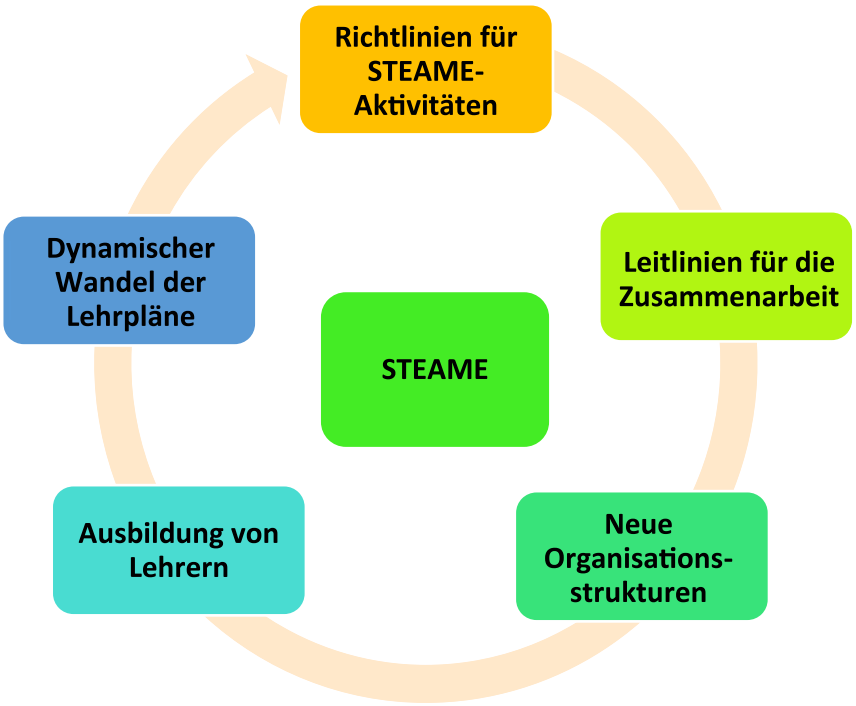


Abbildung 7. 1: Leistungen des STEAME-Projekts

7.2 DER PARADIGMENWECHSEL DER SCHULEN LERNUMGEBUNGEN

Was sind die grundlegenden Schritte, um aktuelle Lernstrukturen in Schulen in zukünftige projektbasierte STEAME-Lernstrukturen umzuwandeln?

3 Schritte zum Wechsel von Bildung 2.0 zu Bildung 4.0

- Schritt 1. Wissen und Lernen von Schülern: Sicheres digitales Lernen durch von Lehrern erstellte Lernvideos. Diese Lernvideos können in drei verschiedenen Lerngeschwindigkeiten erstellt werden. Sie sollen den Schülerinnen und Schülern zum Erstlernen und Wiederholung jederzeit und an jedem Ort zur Verfügung stehen.

- Schritt 2. Lehrerkompetenzen und -fähigkeiten: Ausbildung von den Lehrerkräften, zwischen verschiedenen Disziplinen zusammenzuarbeiten und STEAME-Lern- und Kreativitätspläne zu entwickeln (mitzugestalten). Ausbildung von Lehrerkräften, wie sie mit Hochschul- und Industrievertretern kooperieren und STEAME-bezogene Aktivitäten in hybriden Umgebungen durchführen können. Hilfe für die Lehrer, Kompetenzen zu entwickeln, um anpassungsfähige Cloud-Bildungsführer zu werden. Gestaltungsfreiheit sichern.

- Schritt 3. Schaffen von Freiräumen in bestehenden Schulen oder Bauen von neuen Schulen mit mehr Freiräumen für projektbezogenes kooperatives Arbeiten zwischen Schülern. Planen oder Entwickeln von dynamischen Lehrplänen, die an Veränderungen angepasst und an die Kompetenzen und Bedürfnisse der Studierenden angepasst werden können.

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STEAME
Guidelines for STEAME School Organizational Structure

STEAME

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