Co-funded by the European Union

Guidelines for facilitating the learning of STEAME
Reference Number: 101102619

Module and Workshop Learning Plan

Module Number and Area/Topic: SUSTAINING AND IMPROVING THE STEAME PROCESS.
Module/workshop 13. Area 4: Sustainability of PBL in STEAME
Module leader: IDEA (ROMANIA)

Sustaining and Improving the STEAME Process: Fostering Sustainable Project-Based Learning for Students and Serving Teachers

Draft structure

1. Introduction

In the ever-evolving education landscape, Project-Based Learning (PBL) has emerged as a dynamic pedagogical approach that immerses students in real-world challenges, encouraging critical thinking, collaboration, and problem-solving skills. Sustaining and improving the STEAME process, which integrates Science, Technology, Engineering, Arts, Mathematics, and Entrepreneurship, is crucial for nurturing the next generation of innovative thinkers. This initiative not only focuses on the educational outcomes for students but also aims to support and empower serving teachers, recognizing their pivotal role in delivering effective STEAME education.

The STEAME process represents a holistic approach to education that transcends disciplinary boundaries, fostering creativity and interdisciplinary connections. As we navigate the 21st century, the need for a skilled workforce proficient in STEAME disciplines becomes increasingly apparent. Therefore, the goal of sustaining and improving the STEAME process is twofold:

Concerning the Student Empowerment:

- *Hands-on Learning*: Provide students with authentic, hands-on experiences that mirror real-world challenges, bridging the gap between theory and practice.
- *Critical Thinking*: Cultivate critical thinking skills by encouraging students to analyse, synthesize, and evaluate information within the context of STEAME projects.
- *Innovation and Entrepreneurship*: Foster an entrepreneurial mindset by integrating creativity and innovation into STEAME projects, preparing students for the demands of a rapidly changing global economy.

Concerning the Support for Serving Teachers:

- *Professional Development*: Offer ongoing professional development opportunities to equip teachers with the necessary skills and resources for effective STEAME implementation.
- *Collaborative* Learning *Communities*: Facilitate collaboration among teachers, enabling the sharing of best practices, resources, and experiences in STEAME education.
- *Mentorship Programs*: Establish mentorship programs to pair experienced STEAME educators with those seeking guidance, creating a supportive network for continuous improvement.

By focusing on sustaining and improving the STEAME process, we aim to create an educational environment that not only prepares students for the challenges of the future but also empowers teachers to excel in delivering impactful and engaging STEAME education. This initiative recognizes the symbiotic relationship between student success and teacher proficiency, ultimately contributing to a more sustainable and innovative educational ecosystem.

2. The learning outcomes to be achieved by teachers within the context of Sustaining and Improving the STEAME Process

Within the context of Sustaining and Improving the STEAME Process, teachers must become aware of the Mastery of Interdisciplinary Pedagogy (Interdisciplinary Didactics). Teachers should acquire a deep understanding of interdisciplinary pedagogy, enabling them to seamlessly integrate Science, Technology, Engineering, Arts, Mathematics, and Entrepreneurship into their lesson plans and activities.

To ensure sustainability, educators should develop the ability to design and implement effective STEAME projects, aligning them with curriculum standards while ensuring they are engaging, relevant, and reflective of real-world challenges. They also should be able to facilitate critical Thinking and Problem-Solving skills in students. Teachers should cultivate strategies for fostering critical thinking and problem-solving skills in students through STEAME projects, guiding learners to analyse, synthesize, and apply knowledge in innovative ways. Teachers need to develop their capacity to adapt to Evolving Technologies. Continuous professional development will equip teachers with the skills to stay abreast of emerging technologies, ensuring they can incorporate the latest tools and resources into their STEAME teaching methodologies.

Of paramount relevance is the Promotion of Entrepreneurial Mindset. Educators should learn to infuse an entrepreneurial mindset into their teaching, encouraging students to think creatively, take risks, and develop a sense of initiative in their pursuit of STEAME-related projects.

Collaboration and Communication Skills remain essential. Teachers should enhance their ability to foster collaborative learning environments, promoting effective communication and teamwork among students engaged in STEAME projects. STEAME also comes with the cultivation of inclusive and diverse classrooms. Educators should gain insights into creating inclusive and diverse classrooms within the STEAME context, ensuring that all students feel represented and valued in their learning experiences. Professional Collaboration and Networking can effectively contribute to this. Educators should engage in collaborative learning communities, both online and offline, to share insights, challenges, and successful practices, contributing to a network of support and continuous improvement in STEAME education.

2.1. The set of learning outcomes for student teachers

The learning outcomes for student teachers are based on the following assumptions:

- Focussed on understanding key concepts of STEAME PBL education
- Stress on design and planning of STEAME PBL experiences that can be easily modified to meet the needs of the context in which they will be applied, probably, in the future
- Allow for more creativity.

On this basis, the learning outcomes mentioned below have been defined for **Area 4:** Sustainability of PBL in STEAME. The student teachers will be able to:

1. List actions that can foster a culture of feedback in the practice of STEAME PBL between students, between teachers and students, between colleagues or across the typical levels of school hierarchy
2. Understand the need to become a co-learner and co-creator, incorporating creative insight, students' or other colleagues' vision in STEAME PBL activities during or after their implementation
3. Understand strategies to critically reflect on one's own role and feelings after a STEAME PBL activity is completed, involving all participants of the learning process
4. Analyse the opportunities and threats to STEAME PBL as an innovation in formal education
5. Explain how creativity and adaptability to change can help in the design and implementation of STEAME PBL activities
6. Gain awareness of own skills that can facilitate the delivery of STEAME PBL teaching

2.2. The set of learning outcomes for in-service teachers

The learning outcomes for student teachers are based on the following assumptions:

- Strongly based on classroom practice, in practical application
- Oriented to action
- Consider the teacher as a professional who works in an institution where STEAME PBL is to be applied
- More focussed on learning to understand students' needs and abilities to deliver STEAME PBL teaching in a more productive way.

On this basis, the learning outcomes mentioned below have been defined for **Area 4:** Sustainability of PBL in STEAME. The student teachers will be able to:

1. Make a plan to foster a culture of feedback in a specific school about the practice of STEAME PBL between students, between teachers and students, between colleagues or across members of the school hierarchy
2. Plan actions to become a co-learner and co-creator, incorporating creative insight, students' or other colleagues' vision in STEAME PBL activities during or after their implementation
3. Develop skills to critically reflect on one's own role and feelings after a STEAME PBL activity is completed, involving all participants of the learning process
4. Analyse the opportunities and threats to STEAME PBL when applied as an innovation in a specific educational context

5. Apply creativity and adaptability to change in the design and implementation of STEAME PBL activities
6. Gain awareness of own weaknesses to identify Professional Development opportunities for better delivery of STEAME PBL teaching.

3. STEAME Competence Framework for Pre-service and In-service Teachers: Teacher Competencies for Sustaining and Improving the STEAME Process

In the dynamic landscape of modern education, where Science, Technology, Engineering, Arts, Mathematics, and Entrepreneurship (STEAME) play pivotal roles, the demand for proficient and innovative teachers is more pressing than ever. Recognizing the transformative potential of STEAME education, a comprehensive Competence Framework has been developed to guide both pre-service and in-service teachers in their journey toward sustaining and improving the STEAME process. This framework serves as a roadmap, outlining the essential competencies required to nurture a generation of students equipped with the skills needed for success in a rapidly evolving world.

The overarching goal of the STEAME Competence Framework is to provide a structured guide for educators to develop and refine their abilities in sustaining and improving the STEAME process. Concerning sustaining and improving the STEAME process, the framework tries to cover the following objectives:

- Equip teachers with competencies that align with the demands of the 21st century, ensuring that students are prepared with the skills necessary for success in STEAME fields and beyond.
- Encourage a culture of continuous professional development among teachers, fostering a commitment to lifelong learning and adaptability in the face of evolving STEAME methodologies and technologies.
- Focus on competencies that directly contribute to improved student learning outcomes, emphasizing not only academic achievement but also the development of critical thinking, creativity, and collaboration skills.
- Foster competencies that promote inclusivity, diversity, and equity in STEAME education, ensuring that every student has access to and feels represented in the learning process.
- Provide teachers with the tools to design, implement, and assess effective STEAME projects, placing emphasis on hands-on, inquiry-based, and experiential learning methods.
- Encourage collaboration and networking among educators, both pre-service and in-service, to create a community of practice where insights, challenges, and successful practices in STEAME education can be shared.

As we embark on this journey of sustaining and improving the STEAME process, the STEAME Competence Framework stands as a guiding beacon for teachers, fostering a sense of purpose and direction in their mission to cultivate the next generation of innovative thinkers and problem solvers. The competencies taken into account in this area are listed below, together with their levels of achievement.

STEAME COMPETENCES (Area 4)

	Area 4: Sustainability of PBL applied to STEAME		
Competence	**10. Reflection on performance as a STEAME project facilitator** (To critically reflect of your own performance as a facilitator of STEAME projects based on empirical evidence, with the ultimate intention to deliver better PBL experiences across STEAME subjects.)	**11. Apply creativity and innovation in STEAME projects** (To adapt to quick changes that affect the teacher task in the design, the implementation or the evaluation of STEAME projects.)	**12. Keep learning about STEAME projects and share knowledge** (To stay informed, updating one's skills, and expanding expertise in the fields of Science, Technology, Engineering, Arts, Mathematics, and Entrepreneurship and actively sharing this acquired knowledge and expertise with others, including colleagues, students, parents, and the community.)
	Knowledge ● Reflect on the teaching role to guide education for employability and the scientific-technological strengthening in different countries. ● Acquire theoretical knowledge and reference frameworks of the STEAME and ABP educational trends. ● **Skills** ● Connect with the environment, orient the action to the service and the institutional organization to respond to the needs of the context. ● Be able to assume the role of facilitator to ensure that learners have an active role that they play in the community. ● Be able to reinterpret the STEAME subjects from a pedagogical view of the context, especially in terms of accompanying the identification of the project's objectives, structuring its sequence, and evaluating it. ● Be able to collaborate with other teachers to deal with complexities and challenges. **Attitudes** ● Be critical of the reference frameworks and personal or	**Knowledge** ● Breaking down the barriers of an instrumental subject to give space to creativity. ● Ability to transfer knowledge to new and unforeseen situations, located in the context of implementation. **Skills** ● Ability to bounce back from setbacks, learn from failures, and use challenges as opportunities for growth ● Adaptability to change ● Explore programs, applications, and devices to develop STEAME application environments **Attitudes** ● Commitment to staying updated with the latest trends, research, and best practices in STEAME education. ● Willingness to explore unconventional ideas, technologies, and teaching methods	**Knowledge** ● Awareness of relevant professional organizations and associations as well as conferences, workshops, and seminars related to STEAME education. **Skills** ● Involve experts in the areas of knowledge, facilitating initiatives such as co-teaching or joint work with experts outside the classroom ● Promote the sharing and open access of knowledge, publishing materials or resources in open access spaces. **Attitudes** ● Be open to participating in organizations, associations, or exchange spaces. ● Be aware of the importance of continuous training and

	institutional interests related to the implementation of the STEAME approaches. ● Willingness to connect practice and discourse in the creation of pedagogical knowledge around PBL.	● Being open to world scenarios outside the classroom, also as a teacher.	constant improvement ● Recognize the importance of establishing relationships with other teachers as a source of learning.
Level 1	● Demonstrates a superficial reflection on the teaching role in STEAME + PBL projects. ● Comes up with well-designed projects but doesn't take context into account. ● Proposes well-designed projects but does not incorporate the active role and decision-making of students. ● Knows frames of reference but does not show a critical perspective.	● Shows a limited openness to incorporate changes and modifications in the design, implementation, or evaluation of STEAME PBL activities. ● Makes limited use of innovative tools, resources, or methods. ● Shows some resistance to change, error or changing scenarios outside the classroom.	● Master the specific knowledge received in initial training. ● Shares the teaching role with another teaching colleague. ● Recognizes the importance of being part of communities but does not actively participate.
Level 2	● Can reflect on the teaching role in STEAME PBL projects. ● Links project design to the needs of the context based on a pre-defined framework. ● Creates spaces for joint teacher-student construction during the implementation of the STEAME PBL activity.	● Partially incorporates changes in the design, implementation, or evaluation of activities. ● Is open to using new tools, resources, or methods. ● Consider mistakes and changes as part of the learning process.	● Has a moderate interest in participating in teaching training spaces. ● Generates interdisciplinary work teams. ● Occasionally participates in exchange spaces.
Level 3	● Reflects on the teaching role from his own experience and involves the other participants in the learning process. ● Plans the design of scenarios and projects considering the	● Systematically reviews and incorporates changes and innovations in both the design and implementation and evaluation of STEAME projects. ● Explore and implement the use of tools, resources, and methodologies for the	● Shows a commitment to continuing training and participates in training spaces. ● Promotes co-working experiences of people inside and outside the format setting, with colleagues, experts, etc. ● Engages and promotes spaces for

	needs of the context. • Contemplates and integrates a pedagogical, organizational, and educational policy perspective. • Incorporates co-creation by all the agents involved in the activity, even by people outside the classroom.	constant improvement of the learning process. • Shows a proactive attitude in search of innovations and interest in adapting and incorporating new ideas, proposals, resources, or tools.	relationships with other teachers, communities of practice, etc.

4. Content and Resources (providing information on the various constituents/ dimensions of the topic under consideration), including presenter's notes for guidelines of the workshops organisation

Teacher facilitators competence framework: https://steame-academy.eu/wp-content/uploads/2024/03/D2.4-STEAME-Teacher-Facilitators-Competence-Framework.pdf

STEAME Teacher facilitators learning outcomes set: https://steame-academy.eu/wp-content/uploads/2024/01/D2.2-STEAME-Teacher-Facilitators-Learning-Outcomes-set.pdf

Survey tool: https://onlife.uken.krakow.pl/test/

5. Methodology and approaches for the module training presentation and guidelines for workshops organisation

Self reflection

Panel discussion

Methodology:

A step-by-step approach based on assessment of current knowledge and skills, introduction of new concepts and practices, independent and collaborative activities, and applying support strategies.

Approaches:

Active, interactive and collaborative learning, group work, practical activities, presentation of results for sharing.

6. Instruments/Tools/Supporting Materials/Resources to be used

Teacher facilitators competence framework: https://steame-academy.eu/wp-content/uploads/2024/03/D2.4-STEAME-Teacher-Facilitators-Competence-Framework.pdf

STEAME Teacher facilitators learning outcomes set: https://steame-academy.eu/wp-content/uploads/2024/01/D2.2-STEAME-Teacher-Facilitators-Learning-Outcomes-set.pdf

Survey tool: https://onlife.uken.krakow.pl/test/

White posters for each team, markers.

PART 1	**Introductory Activities (creation of interest, reference to real-world issues, relation to background and experiences, etc.)**
Learning Objectives	Upon completion of Part 1, participants will:

	• Understand the characteristics of STEAME PBL implementation in a given country • Outline current challenges in STEAME PBL as an innovation in formal education
Learning Outcomes	1. Understand strategies to critically reflect on one's own role and feelings after a STEAME PBL activity is completed, involving all participants of the learning process 2. Analyse the opportunities and threats to STEAME PBL as an innovation in formal education • Understand the characteristics of STEAME PBL implementation in a given country • Outline current challenges in STEAME PBL
Competences	***Keep learning about STEAME projects and share knowledge*** *(To stay informed, updating one's skills, and expanding expertise in the fields of Science, Technology, Engineering, Arts, Mathematics, and Entrepreneurship and actively sharing this acquired knowledge and expertise with others, including colleagues, students, parents, and the community.)* • *Describe the way STEAME PBL is implemented in a certain country* • *Identify current challenges in STEAME PBL*
Content, Resources and Tools	At this stage, the facilitator does not provide any information, because the participants' experience is called upon, but these sources can be accessed: https://blog.kidsparkeducation.org/blog/10-stem-education-myths-busted https://www.linkedin.com/pulse/understanding-gap-stem-education-starlighteducation-pu4ac/ https://www.theaccessgroup.com/en-gb/blog/edu-equity-in-stem-education/
Activities	**A)** Each group member will present himself and tell others about how STEAME PBL is being implemented in their country, what successes have been achieved, and what they would change about how STEAME PBL is implemented in their country. **B) Group work** Current challenges in STEAME PBL: *Group A.* Identifying barriers and obstacles; *Group B.* Discussing common misconceptions; *Group C.* Addressing the gender gap in STEAME Fields.
Estimated Time	30 minutes

PART 2	**Development Activities**
Learning Objectives	Upon completion of Part 2, participants will: • Examine the list of the competences

	• Understand the fourth area of the Competence framework
Learning Outcomes	• Analyse the fourth area of the Competence framework • Demonstrate the understanding of the above mentioned area of the Competence framework
Competences	***Keep learning about STEAME projects and share knowledge*** *(To stay informed, updating one's skills, and expanding expertise in the fields of Science, Technology, Engineering, Arts, Mathematics, and Entrepreneurship and actively sharing this acquired knowledge and expertise with others, including colleagues, students, parents, and the community.)*
Content, Resources and Tools	**https://steame-academy.eu/wp-content/uploads/2024/03/D2.4-STEAME-Teacher-Facilitators-Competence-Framework.pdf**
Activities	Presentation of the fourth area of the Competence framework that was developed during the STEAME Teacher Facilitators Academy - there will be 3 groups that will analyse the information and will present it to the other groups. Group work: *Group A.* Analyse, present, and provide examples of activities for developing competence 10: Reflection on performance as a STEAME project facilitator; *Group B.* Analyse, present, and provide examples of activities for developing competence 11: Apply creativity and innovation in STEAME Projects; *Group C.* Analyse, present, and provide examples of activities for developing competence 12: Keep learning about STEAME projects and share knowledge.
Estimated Time	40 minutes

PART 3	**Practical Activities (hands-on activity) in the case of a workshop mode**
Learning Objectives	Upon completion of Part 3, participants will reflect on the teaching role in STEAME projects with a sense of purpose, in a systematic way.
Learning Outcomes	Gain awareness of own skills that can facilitate the delivery of STEAME PBL teaching. Evaluate the efficiency of the presented tool.
Competences	***Reflection on performance as a STEAME project facilitator*** *(To critically reflect on your own performance as a facilitator of STEAME projects based on empirical evidence, with the ultimate intention to deliver better PBL experiences across STEAME subjects.)*
Content, Resources and Tools	**Survey tool: https://onlife.uken.krakow.pl/test/**
Activities	1. The participants will be asked if they know examples of tools that can be used to assess one's performance in the delivery of STEAME PBL. Then they will be presented with the self-assessment tool

	created by the project "ONLIFE SELF TEST", which aims to deliver a report after the user provides answers to all queries. That report indicates the modules of the ONLIFE Learning Environment that are considered the best to attend in order to improve one's performance. 2. The participants will pass the test and share their impressions on the efficiency of such a tool.
	Discussion about similar tools.
Estimated Time	**30 min**

(add more Activity sections as needed)

PART 4	**Evaluation of Learning Outcomes**
Learning Objectives	Upon completion of Part 4, participants will: 1. Understand the need to become a co-learner and co-creator, incorporating creative insight, students' or other colleagues' vision in STEAME PBL activities during or after their implementation
Learning Outcomes	Understand the need to become a co-learner and co-creator, incorporating creative insight, students' or other colleagues' vision in STEAME PBL activities during or after their implementation
Competences	***Keep learning about STEAME projects and share knowledge*** *(To stay informed, updating one's skills, and expanding expertise in the fields of Science, Technology, Engineering, Arts, Mathematics, and Entrepreneurship and actively sharing this acquired knowledge and expertise with others, including colleagues, students, parents, and the community.)*
Content, Resources and Tools	**https://www.researchgate.net/publication/357226794_Chapter_11_Looking_at_STEM_education_in_different_countries** (this info can be resumed if participants do not know anything about this subject)
Activities	What are the strategies for sustaining STEAME Education? (Possible answers: A. Integrating STEAME into the Curriculum (examples of countries that succeed in doing so, case studies; B. Project-Based Learning Approaches; C. Collaboration and Cross-disciplinary Teaching; D. Professional Development for Educators) **Panel discussion**
Estimated Time	**15 min**

(add more Activity sections as needed)

7. Reflection and Closure activity

Each participant will mention one thing that he/she learned/will remember because of this workshop.