Competence development of STE(A)M educators through online tools and communities

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Abstract: This deliverable provides the training plan and a handbook of the STEAMonEdu training programme. The originating point, the concept, the goals and the contents of the MOOC and the blended courses are described so to provide potential tutors with all the necessary information to support the programme.
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Abstract

This deliverable provides the plan and a handbook of the STEAMonEdu training programme that was designed in the context of Work Package 4 (WP4) of the project. Its main purpose is to facilitate and drive potential tutors to deliver the programme successfully. In this context, the originating point, the scope, the goals and the contents of the MOOC (massive open online course) and the blended course are described, in order to provide potential tutors with an overall view of the course. These aspects, together with the detailed description of the training material and the training material itself, uploaded on the corresponding platforms, will allow the tutors to support the programme effectively.

The introductory chapter provides the origins and the basic concepts behind the training programme design and development. Starting with a brief description of the educator's competence framework that has been developed in the context of the STEAMonEdu project, the rationale behind the training programme design and contents is explained. A short description of the methodology and the toolset that were used by the consortium in the development of the training programme is also provided.

The second chapter provides a description of the MOOC. A brief introduction of the basic information regarding the MOOC (participants, learning goals, structure, etc.) is given first. Next, a detailed description of the modules included in each week of the MOOC is provided. The learning objectives, the main topics discussed and the delivery methods are briefly presented.

The third chapter provides a description of the blended course. A brief introduction of the basic information regarding the course (participants, learning goals, structure, etc.) is given, followed by the modules designed to be delivered through the course is provided.

The Training Handbook concludes with a consistent guide for the tutors of the MOOC and the instructors of the blended learning course. The basic characteristics of each role and the major tasks that have to be undertaken during each course are summarized, to build a friendly, creative and effective learning environment.

1 Introduction

This chapter provides a brief description of the educator's competence framework that has been developed in the context of the STEAMonEdu project and its connection with the training programme designed to be delivered in the context of the project. Next, it gives a short description of the methodology and the toolset that were used by the consortium in the development of the training programme.

1.1 The educators' competence framework and the training programme

1.1.1 STE(A)MComp Edu: The educators' competence framework for STE(A)M education

Following desk and field research, along with intra-consortium analysis, the first version of STE(A)MComp Edu framework provides a complete set of competences that accommodates all the roles that STE(A)M educators undertake in their everyday, in and out of classroom, life. Teaching, creating content, managing class, empowering students, participating in communities, professional self-developing, as well as several other competences have been integrated and properly grouped in a common framework.

The proposed competence framework highlights the multi-dimensional role of the educator and may be used to compose the profile of future educators in different levels and setups of any educational context. Overall, the framework aims to [1]:

- Be usable by educators for self-evaluation purposes as a self-assessment tool in order to educators evaluate themselves and find specific competences that they need to improve.
- Allow support of professional development of STE(A)M educators, both as a guide for the formulation of the learning outcomes of specific training programs and as an assessment tool for the evaluation of the training program.

The framework, organized in a top-down approach, begins at the top with **five perspectives** that cover the most important aspects of the educator's roles, as follows:

- Educator as teacher-trainer-tutor, implementing the educational procedure
- Educator as designer and creator, designing and producing outputs
- Educator as orchestrator and manager, coordinating procedures and outputs
- Educator as community member, interacting with the environment
- Educator as professional, developing and applying competences.

Each perspective comprises a set of **dimensions** (competences) which are combined in **areas**, i.e., coherent groups of competences.

Figure 1 illustrates graphically the perspectives and areas of the framework while, Table 1 provides, in addition, the set of independent competences that have been included in the courses from each area (see the legend at the end for an explanation of the colour code used). A detailed description of STE(A)MComp Edu, is provided in the corresponding deliverable of the STEAMonEDU project [2].

1.1.2 The SteamOnEdu training programme

The brief description of STE(A)MComp Edu accents the necessity of multifaceted update, continuous education and active participation of future educators; a professional life of abiding learning of what and how to teach while teaching collaboratively using a holistic approach and constantly progressing methods.

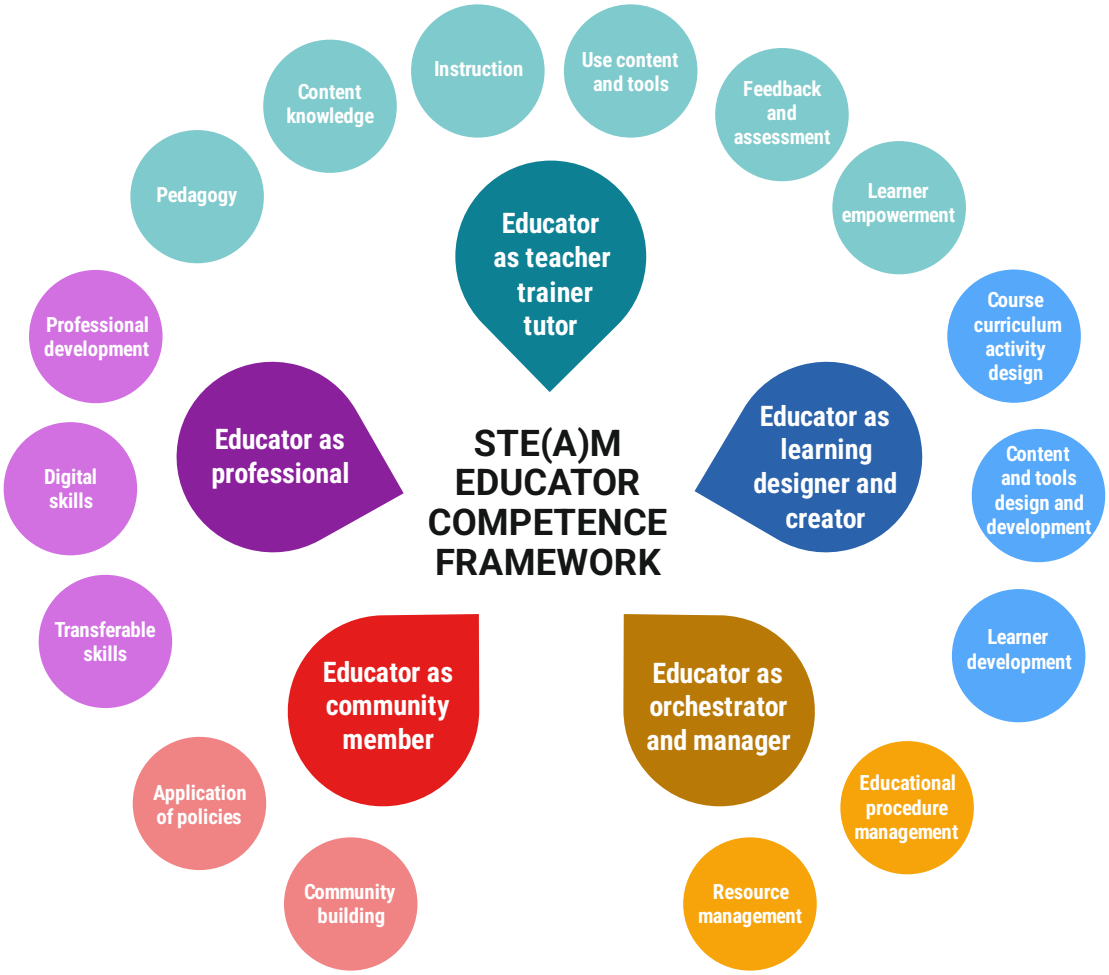

Figure 1. The perspectives and competence areas of STE(A)MComp Edu

Perspective (based on educator roles)	Area (coherent group of competences)	Competence (dimension)
Educator as teacher-trainer-tutor / implementing the educational procedure	Pedagogy	Understand and use teaching and learning techniques that promote STE(A)M education
		Apply collaborative learning methods in STE(A)M education activities
		Promote self-regulated learning in STE(A)M education activities
	Content knowledge	Understand what STE(A)M education represents and means
		Has the content knowledge of STE(A)M-related topics

Perspective (based on educator roles)	Area (coherent group of competences)	Competence (dimension)
	Instruction	Provide guidance in STE(A)M education activities
		Act as a facilitator in STE(A)M education activities
		Act as a mentor in STE(A)M education activities
	Use content and tools	Select and use appropriate content and tools for STE(A)M education
		Organize and share appropriate content and tools for STE(A)M education
	Feedback and assessment	Use assessment strategies for STE(A)M education
		Use feedback techniques for STE(A)M education
	Learner empowerment	Ensure accessibility and inclusion in STE(A)M education
		Ensure active engagement of learners in STE(A)M education
		Ensure differentiation and personalization in STE(A)M education
Educator as learning designer and creator / designing and producing outputs	Course / curriculum / activity design	Understand and develop STE(A)M education curriculum
		Design STE(A)M education courses
		Design STE(A)M education activities
	Content and tools design and development	Create and modify appropriate content for STE(A)M education
		Design and Develop software and apps for STE(A)M education
	Learner development	Facilitate learners' STE(A)M competences
		Provide guidance for STE(A)M related career opportunities
Educator as orchestrator and manager / coordinating procedures and outputs	Educational procedure management	Apply teaching organization methods in STE(A)M education
		Apply classroom management methods in STE(A)M education
	Resource management	Apply educational resources management methods in STE(A)M education
		Apply laboratory management methods in STE(A)M education
		Apply human resource management methods in STE(A)M education
Educator as community member / interacting with the environment	Community building	Engage in communities of STE(A)M educators
		Engage in institutional-based communities about STE(A)M education
		Engage in research and business communities about STE(A)M education
	Application of policies	Apply policies that promote STE(A)M education
		Develop policies that promote STE(A)M education

Perspective (based on educator roles)	Area (coherent group of competences)	Competence (dimension)
Educator as professional / developing and applying competences	Transferable skills	Develop leadership skills
		Develop presentation and communication skills
		Develop critical thinking and problem-solving skills
		Apply ethic skills
		Develop team work skills
		Apply information management skills
		Develop entrepreneurship skills
	Digital skills	Develop digital literacy skills
		Manage and use digital tools for STE(A)M education
	Professional development	Adapt self-reflective practices for STE(A)M education
		Participate in lifelong learning experiences related to STE(A)M education
		Act as a researcher on STE(A)M education topics

MOOC	Blended learning	Both

Table 1. The perspectives, areas and individual competences of STE(A)MComp Edu

The STE(A)M approach, as described by the competence framework, may be considered as a lifelong process of attaining and enhancing new competences, gaining and exchanging experiences, cooperating with educators, experts and scientists. Therefore, it is not expected that a single training programme would offer expertise and competence in all aspects of the framework. In this context, the STEAMonEdu training programme that was built around the first version of STE(A)MComp Edu, aims at covering the most important competences while, in parallel, giving the participants concrete directions to further improve their potential as STE(A)M educators.

Based on the above, the STEAMonEdu training programme goes beyond the standard (for educators) theoretical and practical knowledge and any straightforward adaptations of educational practice towards the STE(A)M approach. These are mostly covered in the first perspective of the educator as teacher-trainer-tutor. Among them, the programme focuses on the STE(A)M approach understanding and awareness as well as the dimensions (competences) that bring this approach to the forefront of the educational practice. In addition, the perspectives of the educator as learning designer and creator, as orchestrator and manager and as community member are given special attention, since these differentiate substantially the STE(A)M educator from the "standard" educator.

The training programme consists of two parts: a MOOC and a blended learning course. The MOOC focuses on the abovementioned aspects and will take place up to the 18th month of the project. However, this academic period is a full-time working period for active educators with a lot of everyday obligations. Thus, in designing the MOOC, we took special care so that the additional workload required to attend the MOOC is not high and is spread adequately in time (six weeks with additional "blank" weeks allowing educators who will adopt a slower-

than-average learning pace to catch up). Taking into account the goals and the restrictions posed, the specific competences that were selected for the MOOC are marked with light green background in Table 1. It has to be noted that the competences in the areas of digital and transferable skills are not examined in depth, but rather frameworks and directions for further development of the educator competences in these aspects are provided.

The blended learning, on the other hand, delves deeper into two perspectives, the educator as learning designer and creator and the educator as community member. It enforces interaction and cooperation of educators that are already well informed on the STE(A)M approach, having completed the MOOC. The competence framework itself, as well as the educator profiles arising from it, will be placed, among others, in the center of discussions. So, this is an intensive programme that can be delivered to a short number of participants, preferably over a short period that is not overloaded for active educators. The competences selected for the blended learning part are marked with the dark green background in Table 1. Finally, some dimensions will be developed in both parts, providing the basics within the MOOC and going deeper during the blended learning part. A summary of each phase of the training programme is given in the following chapters.

1.2 The training programme development methodology

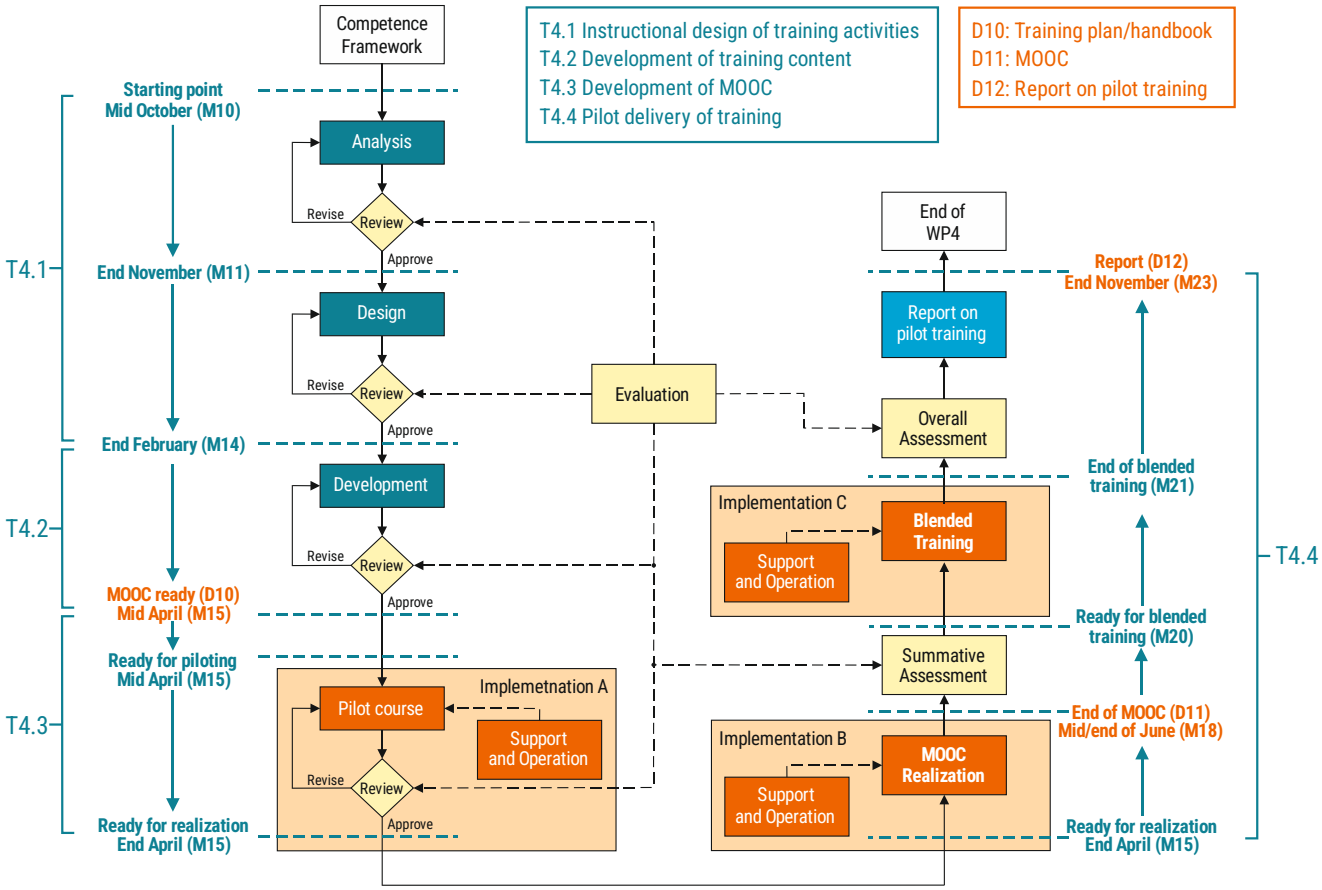

Figure 2. The ADDIE methodology and the schedule followed for the training programme development

The methodology adopted for the development of the training programme was based on the ADDIE model [3], i.e., Analysis, Design, Development, Implementation and Evaluation,

illustrating an iterative and self-corrected process since it provides continuous step-by-step assessment. In total, three implementation phases are considered; a first pilot implementation of the MOOC, the real MOOC realization and blended training implementation. The quality of the outcomes in each phase is assured by the employment of three roles: the author, the technical reviewer, and the scientific reviewer. The overall procedure and the schedule followed for the development of the training programme are given in Figure 2.

The effort of the design and development of the training programme was split to all project partners, except AD, based on the expertise of each partner, under management and monitoring by CTI. As such, the training programme was a collective work that necessitated common understanding, collaboration and strict coordination with a large number of meetings and bilateral discussions. Authoring and reviewing the learning modules was assigned to different partners so to allow a coherent design and development on one hand and consistent review on the other hand. CTI, being responsible for the online training environment, was responsible for the technical review of all the training material as well.

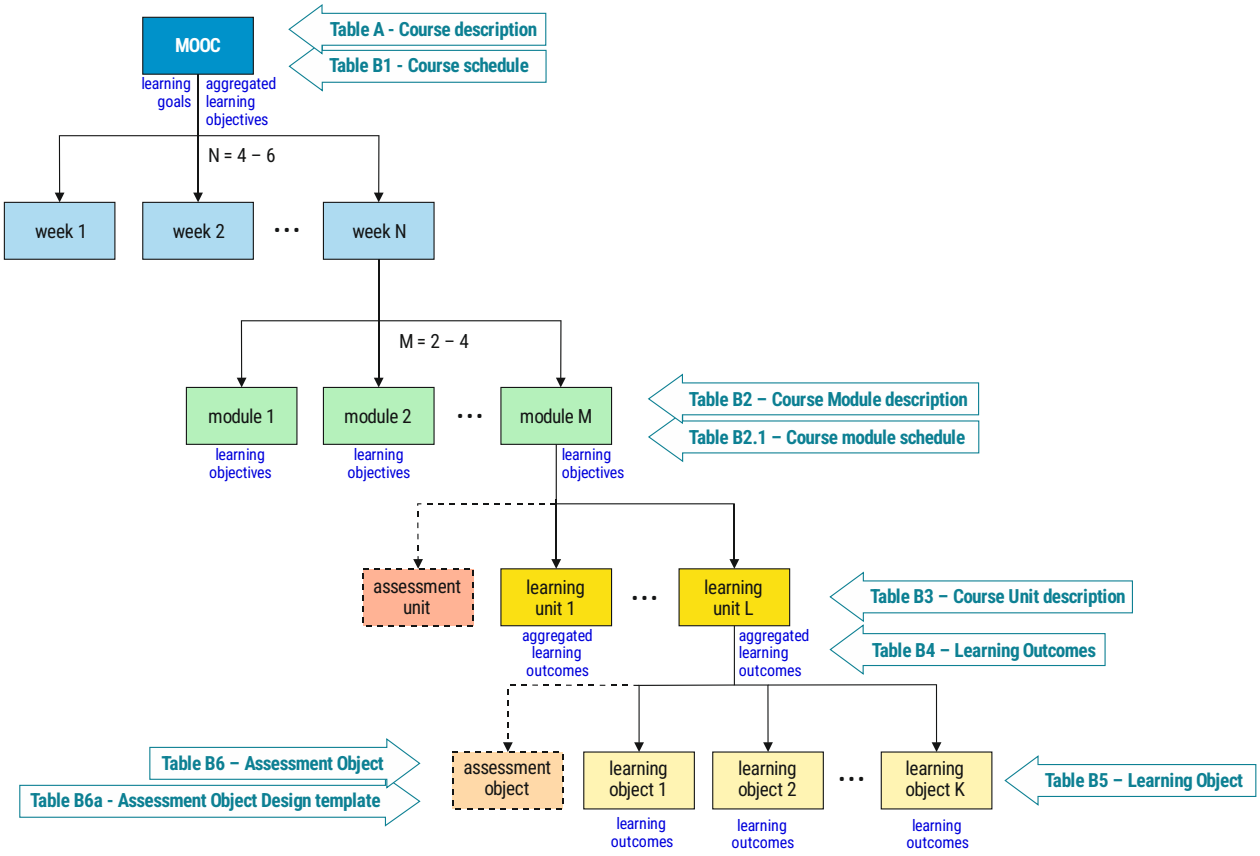

Figure 3. The structural model of the training programme components

The design of the training programme was based on the structural model shown in Figure 3. Each training week consists of two or more modules with each module representing one of the dimensions (competences) of Table 1. Each module consists of one or more learning units which, in turn, contain one or more learning objects. Following the educational design of e-courses, a set of tables was used for the description of all learning components of the training

programme, as noted on Figure 3 with all the necessary structural elements, such as educational activities, learning outcomes, learning objects, assessment objects. Each learning object description included all the necessary information including, functional, structural, educational and technical characteristics. The learning outcomes were written based on the Bloom's taxonomy [4][5][6][7], by using either the ABCD [8] or the SMART [9] methodology. Detailed guides, both for the MOOC development and the learning outcomes were provided by CTI and used by all the project partners participating in the training programme design and development.

Finally, a guide on content development, accompanied by a set of templates were provided to the project partners by CTI, so as to ensure uniformity and consistency in the format and the structure of the final learning objects.

2 The massive open online course (MOOC)

This chapter provides a description of the MOOC that was designed in the context of the training programme of STEAMonEdu project described in WP4. A brief introduction of the basic information regarding the MOOC (participants, learning goals, structure, etc.) is given first. Next, a detailed description of the modules included in each week of the MOOC is provided.

2.1 MOOC description

The MOOC supports the professional development of educators and managers/directors at all levels of education and guides them in becoming STE(A)M education tutors, designers and orchestrators. It addresses their need to understand, adapt, apply and create modern STE(A)M educational procedures and practices that enhance the effectiveness and acceptance of short and long term educational processes. The major knowledge domains of the course are:

- STE(A)M education
- Educational leadership
- Management
- Curriculum and instruction
- Educational technology
- Community practice

2.1.1 Potential participants

The course is addressed to all individuals who are interested in applying or finding out about STE(A)M education, such as:

- active educators at all levels and settings of formal and non-formal education of the relevant subject and related science field of the STE(A)M components (Mathematics, Science, Technology, Arts, Engineering),
- managers/directors at all levels of formal and non-formal education,
- students or graduates.

The learners must hold a degree (EQF 6 or higher) or be in the last year of their studies for one. Any working experience in the educational sector will be helpful but is not compulsory. Overall, the learners must present general knowledge of pedagogy, educational practice, information systems and computing.

2.1.2 Learning goals

The participants shall gain knowledge and develop competences in the following areas:

- Modern approaches of STE(A)M education
- Design and implementation of STE(A)M educational activities
- Content creation for STE(A)M education
- STE(A)M educational procedure and resource management
- Community building, participation and interaction
- Policies in the context of STE(A)M education
- Competence frameworks and lifelong learning opportunities.

2.1.3 MOOC structure

The MOOC spans six weeks and requires an allocation of five to six working hours per week. Each week focuses on one of the perspectives of the competence framework, introduced in the previous chapter, with the exception of weeks three and four that both focus on the same perspective. Each week offers training on two to four selected competences, delivering each competence via a separate module. Table 2 provides the distribution of the 18, in total, modules over the six weeks of the MOOC. Each module includes learning activities, which are further split into learning objects that provide the training content.

Week	Module Code	Module Title
1	**Introduction to STE(A)M education**	
	W1.0	Introduction to MOOC
	W1.1	The STE(A)M education approach
	W1.2	Teaching and learning techniques that promote STE(A)M education
	W1.3	Content and tools for STE(A)M education
2	**Educator as learning designer and creator**	
	W2.1	STE(A)M related educational activities design
	W2.2	STE(A)M related course design
	W2.3	Content creation for STE(A)M education
3	**Educator as orchestrator and manager (part A)**	
	W3.1	Teaching organization methods for STE(A)M education
	W3.2	Classroom management methods for STE(A)M education
4	**Educator as orchestrator and manager (part B)**	
	W4.1	Educational resource management methods for STE(A)M education
	W4.2	Lab management methods for STE(A)M education
	W4.3	Human resource management methods for STE(A)M education
5	**Educator as community member**	
	W5.1	STE(A)M communities of educators
	W5.2	Research and business communities for STE(A)M education
	W5.3	Policies that promote STE(A)M education approach
6	**Educator as professional**	
	W6.1	Research activities in STE(A)M education
	W6.2	Lifelong learning and professional development of STE(A)M educators
	W6.3	Digital skills, frameworks and tools for STE(A)M educators
	W6.4	Transferable skills for STE(A)M educators

Table 2. MOOC structure

2.1.4 MOOC delivery format

The MOOC has been developed on the CTI Moodle-based MOOC platform[1]. All the learning objects are delivered digitally in various forms (presentations, videos, study documents, interviews, activities etc.) and are available online. In addition, participants are able to join a community of peers by participating in open discussions and active interaction through a forum. As such, the educational environment of the MOOC is accessible through a personal

[1] https://mooc.cti.gr/steamonedu.html

computer, a tablet or a smartphone, connected to the internet, equipped with standard audio and visual peripherals (microphone, speakers, web camera).

2.2 Introductory module

This module introduces learners to the course and the platform. The learners will be able to explore the eLearning environment, its tools, and features. In addition, they will be informed about the course objectives, its structure, and learning goals. Finally, they will introduce themselves and will be informed and the tutors of this course.

Learning objectives

Upon completion of this module, the learners will:

- Become familiar with STEAMonEdu project.
- Be informed about the course concept, structure and learning goals of the MOOC.
- Become familiar with the learning environment.
- Interact with other learners in the e-learning community.
- Identify the tutors of the course.

Module contents

The module includes five parts, as follows:

"STE(A)M education for educators: Design, orchestration and implementation of STE(A)M education", a self-running presentation with an introduction to STE(A)MonEdu MOOC. It starts with the background and concept of the MOOC in the context of the STEAMonEdu Comp framework, the learning goals, requirements and structure of the MOOC as well as a brief description of its modules.

"Project STEAMonEdu: Competence development of STE(A)M educators through online tools and communities", a self-running presentation introducing the learners to the project and its approach, the partners in the consortium as well as a its main outcomes.

Platform guide: A user guide/manual for all learners, providing a brief navigation through the STEAMonEdu online course environment and describing the steps that the learner needs to follow in order to successfully log into the course platform. Furthermore, the learner will be familiar with the course structure, interactivity and basic functionalities of the platform.

"Introduce yourself!": A forum activity so that participants get to know each other and build a constructive relationship by exchanging their views on "STE(A)M educators, their goals and expectations in the course, etc.

"Meet the tutors": A page where all MOOC tutors are presented (photos and short bios are included).

2.3 Week 1: Introduction to STE(A)M education

2.3.1 W1.1: The STE(A)M education approach

This module provides an overview of STE(A)M education approach – differences between STEM and STE(A)M, according to literature. The module covers the development of STE(A)M as a concept and how its components come together. It also offers an overview and

classification of STE(A)M education with pointers to selected literature. A comparison between traditional education and innovative approaches is also given.

Learning objectives

Upon completion of this module, the learners will:

- Become familiar with the concept of STEM & STE(A)M education.
- Know how STE(A)M education was developed, in response to the needs of educational systems and of the labour market.
- Recognize STE(A)M education as an integrated approach to teaching STEM subjects in combination with Arts (e.g., visual arts, lyrics).
- Recognize that STE(A)M education approach aims to prepare active and functioning citizens in a scientifically and technologically society.

Module contents

The module includes two main learning units, as follows:

W1.1.1 **Overview of the development of STE(A)M education as a concept**: An introduction to the development and evolution of the STE(A)M approach is provided with emphasis on the aims and objectives, followed by the differences between STEM and STE(A)M education.

W1.1.2 **The importance of STE(A)M education**: The benefits of the STE(A)M approach in the educational process are presented and the impact on the economic, social growth and the involvement of girls and unprivileged.

The module includes four self-running presentations and two study documents and concludes with the assessment in the form of a quiz with multiple choice questions.

2.3.2 W1.2: Teaching and learning techniques that promote STE(A)M education

This module aims at supporting learners to understand that STE(A)M education can be promoted by using innovative teaching/learning techniques which create a positive classroom climate and increase students' interest and engagement in STE(A)M content.

Learning objectives

Upon completion of this module, the learners will be able to:

- Recognize that STE(A)M education is a learning approach that uses Science, Technology, Engineering, the Arts and Mathematics as access points for developing student's competency and securing their future personal and professional success.
- Adapt themselves to different teaching/learning goals and needs related to STE(A)M content.
- Decide which teaching/learning technique is more suitable for STE(A)M educational purposes.
- Practice, reflect and share with their colleagues and feedback about STE(A)M teaching/learning techniques.

Module contents

The module includes two main learning units, as follows:

W1.2.1 **Introduction to STE(A)M education approach**: Competences and important skills to teach in schools are discussed and a summary of learning and teaching techniques that foster critical thinking and creativity in a STE(A)M classroom are presented.

W1.2.2 **Steps to create a STE(A)M-centered classroom**: Analysis and application methods of six basic steps to create a STE(A)M classroom are discussed.

The module includes five self-running presentation and a forum activity for the participants to exchange experiences on innovative teaching and learning techniques. A quiz with multiple choice, true/false and matching type questions concludes the module.

2.3.3 W1.3: Content and tools for STE(A)M education

This module aims at supporting learners to select and use suitable educational content based on their specific curriculum and related to real life as well as tools, software and apps in order to enhance STE(A)M teaching and learning. Furthermore, facilitates them to promote concepts and educational content or tools from non-STEM fields such as art, language etc. in STE(A)M education, focusing on understanding and creation of students' participating incentives.

Learning objectives

Upon completion of this module, the learners will be able to:

- Select and use suitable educational curriculum-oriented content related to real life and students' needs, prior knowledge or interests.
- Select and use concepts and educational content from non-STEM fields such as art, language etc.
- Select and use appropriate software and apps for STE(A)M content.
- Point out appropriate use of various software, apps, techniques or tools in STE(A)M education.

Module schedule

The module includes two main learning units, as follows:

W1.3.1 **Select and use suitable educational content**: Basic principles and examples of appropriate content selection, suitable for STE(A)M education are provided.

W1.3.2 **Select and use of appropriate software and apps**: Techniques, tools, applications for STE(A)M education and selected examples of them are presented.

The module includes four self-running presentations and a forum activity for knowledge and experience exchange. A set of multiple-choice questions are given in the end for assessment purposes.

2.4 Week 2: Educator as learning designer and creator

2.4.1 W2.1: STE(A)M related educational activities design

This module guides the participants to design and creation of STE(A)M related educational activities. Starting with the benefits of STE(A)M design and the target group needs, it provides

the principles of designing a STE(A)M activity as well as the process and the steps to be followed, focusing on opportunities that may arise, quality aspects, potential risks identification and assessment techniques. The module concludes with the review of selected STE(A)M activities, available in public repositories.

Learning objectives

Upon completion of this module, the learners will be able to:

- Know how to start the design an educational STE(A)M related activity that is useful for the target group and takes advantage of the contextual opportunities.
- Have a proficiency level about the process of creation of an educational STE(A)M related activity.
- Know the principles of the design of multimedia and STE(A)M related activities.
- Review some STE(A)M related activities in order to evaluate them.
- Collect information about some public repositories.

Module contents

The module includes the following four learning units:

W2.1.1 **Design of an educational STE(A)M related activity**: Benefits of acquiring STE(A)M competences, target group needs and strategies to identify and take advantage of opportunities in the context of STE(A)M activities design.

W2.1.2 **Principles of the design of multimedia and STE(A)M related activities**: Multimedia design and STE(A)M activities design principles and contextualization.

W2.1.3 **Creation of an educational STE(A)M related activity**: Needs, opportunities, solutions, quality and risk aspects, assessment techniques involved in STE(A)M activities creation.

W2.1.4 **Examples of STE(A)M related activities and public repositories**.

The module includes a set of short but targeted self-running presentations, supported by a forum discussion. It ends with an assessment unit.

2.4.2 W2.2: STE(A)M related course design

This module guides the participants to design and creation of STE(A)M related educational activities. Starting with the benefits of STE(A)M course design and the target group needs, it provides the principles of designing a STE(A)M course as well as the process and the steps to be followed, focusing on opportunities that may arise, innovative methodologies, quality aspects, potential risks identification and assessment techniques. The module concludes with examples of some publicly available STE(A)M courses.

Learning objectives

Upon completion of this module, the learners will be able to:

- Know how to start the design an educational STE(A)M course that is useful for the target group and takes advantages of the contextual opportunities.
- Have a proficiency level about the process of creation of an educational STE(A)M course.

- Review some STE(A)M related courses in order to developed some criteria to evaluate them and to be applied to our own course design.

Module contents

The module includes three main learning units, as follows:

W2.2.1 **Design of an educational STE(A)M related course**: Purpose and benefits of designing a STE(A)M related course. Target group needs and their relation with the design.

W2.2.2 **Principles of the design of a course**: General principles of course design and their application.

W2.2.3 **Creation of an educational STE(A)M related course**: Needs, opportunities, methodologies, quality aspects, risks identification and assessment techniques to synthesize STE(A)M courses.

The module comprises eight self-running presentations and three forum discussion activities. It concludes with an assessment unit.

2.4.3 W2.3: Content creation for STE(A)M education

This module guides the trainee to create and modify its own content for STE(A)M education. It introduces the STE(A)MonEdu platform of best practices.

Learning objectives

Upon completion of this module, the learners will be able to:

- Know how to analyze educational content and instruments for own needs and adaption for learners.
- Know the STE(A)MonEdu platform and its best practices.
- Know how to analyze digital tools for own needs and adaption for learners.
- Adapt check list for appropriate learning content and tools.
- Know about current topics of STE(A)M.
- Create own appropriate STE(A)M learning activity.

Module contents

The module includes three main learning units, as follows:

W2.3.1 **Identify appropriate tools for STE(A)M activities**: Introduction to digital STE(A)M tools. STEAMonEdu platform best practice guide presentation.

W2.3.2 **Modify and create a STE(A)M learning activity**: TurtleCoder, Scratch and Minecraft tools for STE(A)M activities creation.

The module includes two video presentations and three video demonstrations followed by an assessment quiz on the topics discussed.

2.5 Week 3: Educator as orchestrator and manager (part A)

2.5.1 W3.1: Teaching organization methods for STE(A)M education

This module facilitates attendants to address the design and the structure of lesson plans with a specific focus on inquiry-based teaching strategies and STE(A)M educational activities. The trainee will be able to:

- Consider the possible and applicable organizational strategies and tools.
- Develop inquiry-based teaching strategies.
- Organize lesson plans.

Learning objectives

Upon the completion of the module, the learner will become proficient in:

- Using simple organizational tools.
- Using GTD time management methodology.
- Using Agile time management tools.
- Develop inquiry-based teaching strategies.
- Develop lesson plans.

Module contents

The module includes the following learning units:

W3.1.1 **Simple tools for time management**: Key principles and main tools of time management.

W3.1.2 **Getting things done with GTD methodology**: Getting Things Done (GTD) principles, workflow and examples.

W3.1.3 **Inquiry-based teaching strategies**: Introduction to inquiry-based learning key principles and benefits and strategies for inquiry-based STE(A)M activities.

W3.1.4 **Lesson planning**: Basic elements of a lesson plan, methods for effective lesson plan realization and examples.

The module includes seven self-running presentations accompanied four study documents. It concludes with a multiple-choice quiz.

2.5.2 W3.2: Classroom management methods for STE(A)M education

This module facilitates attendants to organize and prepare classrooms and labs for STE(A)M educational activities. The trainee will be able to:

- Manage class effectively.
- Create a positive learning environment.
- Maintain a physically organized set-up.

Learning objectives

Upon the completion of the module, the learner will become proficient in:

- Managing class effectively.
- Creating a positive learning environment.
- Setting-up classrooms and labs effectively.

Module schedule

The module includes three learning units, as follows:

W3.2.1 **Managing classroom effectively**: Managing classroom techniques.

W3.2.2 **Creating a positive learning environment**: Classroom emotional setting and techniques towards a student-oriented classroom in the context of STE(A)M education.

W3.2.3 **Maintaining a physically-organized set-up**: The set-up of a STE(A)M oriented classroom and a mixed-reality lab. Teacher's workspace organization.

The module is developed through four self-running presentations and two study documents. An assessment quiz is provided in the end.

2.6 Week 4: Educator as orchestrator and manager (part B)

2.6.1 W4.1: Educational resource management methods for STE(A)M education

This module facilitates the attendants to identify the educational resources that are/can be available for his/her use during a STE(A)M activity or course and to review some best practices in using these resources. Attendees will be asked to identify and classify different kinds of educational resources (human, technical, infrastructural, educational objects, training sequences etc.) and will acquire criteria in order to be able to manage the use, according to their trainees needs. Sensitive content criteria, privacy and copyright rules will be analyzed.

Learning objectives

After the module, the trainees will be able to:

- Identify potential educational resources in a local, regional, national or international level, which could be used during a STE(A)M activity or course.
- Apply privacy rules and select resources that can be used effectively.
- Apply copyright rules and detect sources that can be used effectively.
- Identify best practices and used them as a source of inspiration.

Module contents

The module includes three learning units, as follows:

W4.1.1 **The educational resources**: Definition, classification and different types of educational resources.

W4.1.2 **The available educational resources: the criteria to be applied**. Sensitive content identification, European and international privacy and copyright rules. Availability of educational resources.

W4.1.3 **Best practices on educational resources.**

The module includes six self-running presentations and a forum activity. It concludes with an assessment unit.

2.6.2 W4.2: Lab management methods for STE(A)M education

This module facilitates the attendants understanding of the STE(A)M activities and trainings as a potential generator of Lab-spaces. It provides a review of the definition of a Lab-Space and compares with the space where an educational STE(A)M related activity takes places. It

also gets into the strategies of a Lap Space that can be applied during the STE(A)M educational activities.

Learning objectives

After the module, the trainees will be able to:

- Manage the educational STE(A)M "space" as a Lab space.
- Apply the Lab culture to their own educational activities.
- Generate a peer-to-peer support system.
- Handle unexpected technical problems.
- Identify problem-solving strategies.

Module contents

The module includes the following learning units:

W4.2.1 **STE(A)M spaces and Lab spaces: a shared culture.** STE(A)M space as a lab, lab spaces culture and Makers Manifesto.

W4.2.2 **We have an unexpected problem!** Peer-to-peer support methodology. Learning by doing, problem-solving strategies and benefits of being part of a STE(A)M community.

The module comprises six self-running presentations, followed by a multiple-choice type quiz.

2.6.3 W4.3: Human resource management methods for STE(A)M education

Within this module trainees learn about team communication and collaboration methods which enable them to develop multidisciplinary activities with the support of their colleagues. The module serves to provide methods of group management to coordinate a group of educators. Further, it presents group work arrangements and scenarios which can be conducted with students and which work well for STE(A)M education. Trainees will be enabled to manage group-based activities.

Learning objectives

Within this module trainees will learn how to:

- Identify adequate group work arrangements.
- Plan group work tasks.
- Conduct group work.
- Identify multidisciplinary intersections within educator teams.

Module contents

The module includes three main learning units, as follows:

W4.3.1 **Introduction to human resource management**: The relevance of human resource management with the education sector.

W4.3.2 **Team communication method: Working out loud**. Communication formats, introduction to the WOL method and initiation of a WOL circle.

W4.3.3 **Team collaboration method: Scrum**.

The module includes four video presentations, two interviews, and a forum discussion activity. It concludes with an assessment unit with multiple-choice questions.

2.7 Week 5: Educator as community member

2.7.1 W5.1: STE(A)M communities of educators

This module facilitates attendants to engage in STE(A)M communities of educators. The trainee will be able to:

- Understand what a community of practice is.
- Understand how to engage in communities.
- Learn about relevant communities of STE(A)M educators.

Learning objectives

Upon the completion of the module, the learner will become proficient in:

- Finding suitable communities of practice of STE(A)M educators.
- Being a well-accepted member in communities of practice of STE(A)M educators.
- Exchanging valuable content, ideas and insights with other members in communities of practice of STE(A)M educators.

Module contents

The module includes four learning units, as follows:

W5.1.1 **Communities of practice**: Introduction to Communities of Practice (CoPs), their benefits and impact for educators and the critical factors for their success.

W5.1.2 **Netiquette**: What is "Netiquette" and what are the main rules it involves.

W5.1.3 **Basics of Psychology of the Digital Age**: Online identity management and online behavioral issues involved in the Digital Age.

W5.1.4 **Examples of STE(A)M educator communities of practice**: Presentation of a set of selected STE(A)M educator CoPs.

This module includes four self-running presentations accompanied by three study documents. It concludes with a quiz on the topics discussed.

2.7.2 W5.2: Research and business communities for STE(A)M education

This module introduces learners to the concept, goals and techniques of citizen science. In addition, learners explore how they can participate in online research and business communities, and how they can learn from peers.

Learning objectives

Upon completion of the course, the learner will:

- Become familiar with the concept, goals and main techniques of citizen science.
- Explore and engage in online research and business communities.

Module contents

The module includes the following learning units:

W5.2.1 **Introduction to citizen science**: Citizen science, what is it, its evolution and goals, how can one be involved, techniques and current application domains.

W5.2.2 **STE(A)M research and business communities**: Goals of research and business communities, benefits for educators involved with them. The role of business and research communities in STE(A)M education.

The module includes two self-running presentations supported by web activities and forum discussions of the participants. It concludes with a set of multiple choice and true/false quiz.

2.7.3 W5.3: Policies that promote STE(A)M education approach

The module offers information and critical reflection tools regarding what is educational policy and how practitioners can contribute to its development and implementation. The learners will reflect on the factors shaping STE(A)M education policy and how they can translate policy provisions into their day-to-day practice.

Learning objectives

Upon completion of the course, the learner will:

- Understand what educational policy is and how it is developed.
- Know the main EU level policies for promoting STE(A)M education.
- Reflect on the role of stakeholders and drivers of STE(A)M policy.
- Know what the main policy making tools are.
- Understand the policy formulation process at local and regional levels
- Be able to design a clear and effective message advocating for STE(A)M education
- Identify and analyze the practical implications of STE(A)M policy for their work.

Module contents

The module includes two main learning units:

W5.3.1 **How STE(A)M policy is developed**: Introduction to educational policy and the policy cycle. STE(A)M policy overview, the drivers and the educators' needs.

W5.3.2 **Connecting policy and practice**: Policy making tools, STE(A)M policy in your regional context. Getting messages across and advocating for STE(A)M, pointers for creating effective advocacy messages.

The module includes of eight self-running presentations followed by an assessment unit on the topics presented.

2.8 Week 6: Educator as professional

2.8.1 W6.1: Research activities in STE(A)M education

In this module, learners become familiar with the basics of science epistemology and research skills. They will learn how to set up a research process and how to engage with researchers.

Learning objectives

Upon completion of the course, the learner will:

- Understand how knowledge is created through a scientific process.
- Scientific data literacy (i.e., collecting, processing and sharing data, open data and data repositories, the role of cloud)
- Become familiar with quantitative and qualitative research methodology in education.

- Understand the ethical aspects of educational research.
- Be able to present and disseminate the results.
- Be able to engage with researchers and to support a research process.

Module contents

The module includes two main learning units, as follows:

W6.1.1 **How scientific knowledge is created**: What is scientific knowledge and how it is created. How scientific knowledge can be used in practice.

W6.1.2 **Quantitative and qualitative research methodology**: The basics of qualitative and quantitative research methods. Writing and disseminating a research report, participation and support in research programmes.

The module includes six presentations, followed by an assessment quiz.

2.8.2 W6.2: Lifelong learning and professional development of STE(A)M educators.

In this module, the learners acquaint themselves with the concept and values of lifelong learning and how they are applied in STE(A)M education. They will consider their own needs for continuous professional development (CPD), while mapping local training opportunities.

Learning objectives

Upon completion of the course, the learner will:

- Understand how the principles of lifelong learning were developed and how they apply to teacher training.
- Know what competence frameworks are and how they can be used.
- Reflect on one's training needs regarding STE(A)M education.
- Map local stakeholders and CPD providers.

Module contents

The module includes two main learning units, as follows:

W6.2.1 **Lifelong learning and CPD in STE(A)M education**: Professional development in STE(A)M education, why and how. Analyzing own training needs.

W6.2.2 **Mapping stakeholders and opportunities**: STE(A)M training and a map of stakeholders and opportunities. Contribution to the development of training opportunities.

The module includes four self-running presentations, followed by an assessment quiz.

2.8.3 W6.3: Digital skills, frameworks and tools for the STE(A)M educator.

This module introduces learners to European frameworks and tools for digital skills, such as Digital Competence framework for Educators (DigCompEdu) and SELFIE tool.

Learning objectives

Upon completion of the course, the learner will:

- Become familiar with European frameworks and tools for digital skills
- Recognize the different uses of these frameworks and tools.

Module contents

The module includes five main learning units and an assessment unit, as follows:

W6.3.1 **Competence frameworks for digital skills**: Existing digital competence frameworks, their scope, structure and uses.

W6.3.2 **The DigComp framework**: Scope, structure, uses, contents and professional levels of DigComp framework.

W6.3.3 **The DigCompEdu framework**: Scope, structure, uses and contents of DigCompEdu framework.

W6.3.4 **The SELFIE tool**: The scope and a general overview of the SELFIE tool structure.

W6.3.5 **European policies**: Overview of European policies related to STE(A)M education. European Skills Agenda, the Pact for Skills and the Digital Education Action Plan.

The module includes five self-running presentations and an activity forum. A quiz with true/false and multiple-choice questions concludes the module.

2.8.4 W6.4: Transferable skills for STE(A)M educators

This module provides an overview about transferable skills. It presents the definition of skills which are needed for personal development within the 21st century. According to the European Framework for Personal, Social and Learning to Learn Key Competences (LifeComp) and the 21st Century Competences the module outlines needed skills when it comes to STE(A)M-education. The following transferable skills will be presented while exploring the module:

- Leadership skills.
- Presentation and communication skills.
- Critical thinking and problem-solving skills.
- Ethics skills.
- Teamwork skills.
- Information management skills.
- Entrepreneurship skills.

The module focuses on the presentation of concrete examples and best practices. It concentrates on what the meaning and definition of each transferable skill and underlines the understanding by illustrating them.

Learning objectives

Within this module trainees will learn how to:

- Identify concepts of transferable skills.
- Identify transferable skills e.g., critical thinking and problem-solving skills, teamwork skills.
- Identify how skills are related to the professional development of STE(A)M educators.

Module contents

The module includes two main learning units and an assessment unit, as follows:

W6.4.1 **Introduction to transferable skills**: Introduction to transferable skills and their frameworks. 21st Century Skills, LifeComp and the UNICEF Global Framework on Transferable Skills.

W6.4.2 **Examples of transferable skills**: Communication, collaboration, openness for change (creativity), critical thinking and problem-solving skills as well as other transferable skills.

The module includes two video presentations and a study document, followed by an assessment quiz.

2.9 MOOC platform views

This section includes screenshots of the MOOC platform environment. In specific, Figure 4 provides a view of the first week's page, Figures Figure 5, Figure 6, and Figure 7 show views of a module's page, Figures Figure 8 and Figure 9 show views of a learning unit's page and Figure 10 shows a view of a learning object's page.

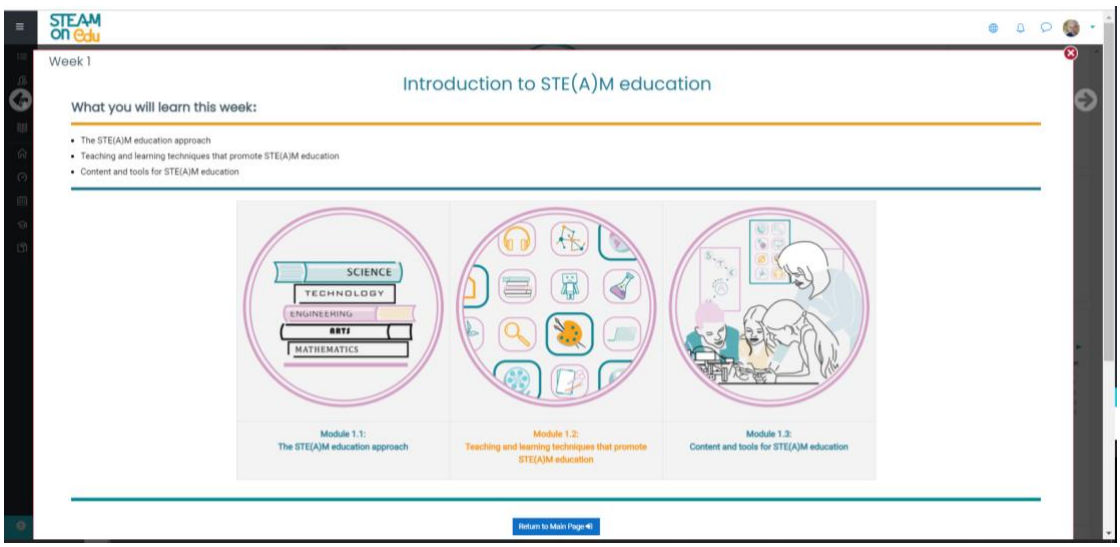

Figure 4. A view of first week's page on the MOOC's platform

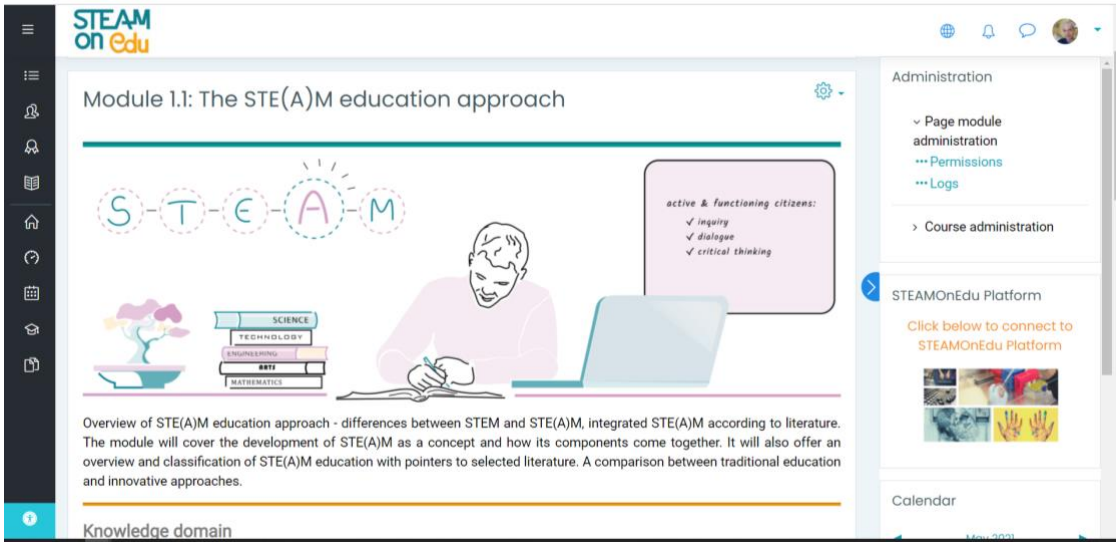

Figure 5. A view of a module's page on the platform

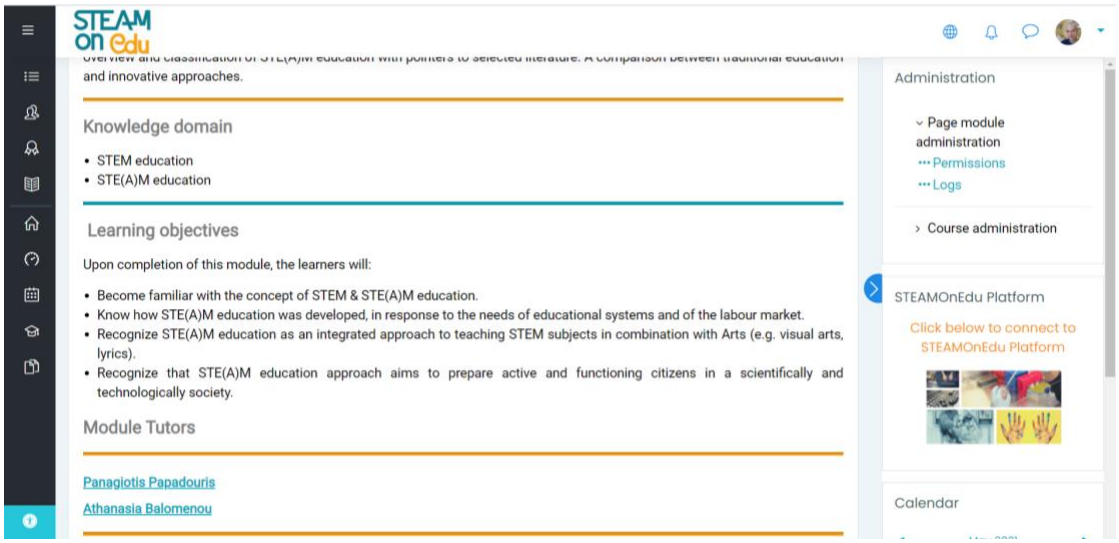

Figure 6. A view of a module's page on the platform

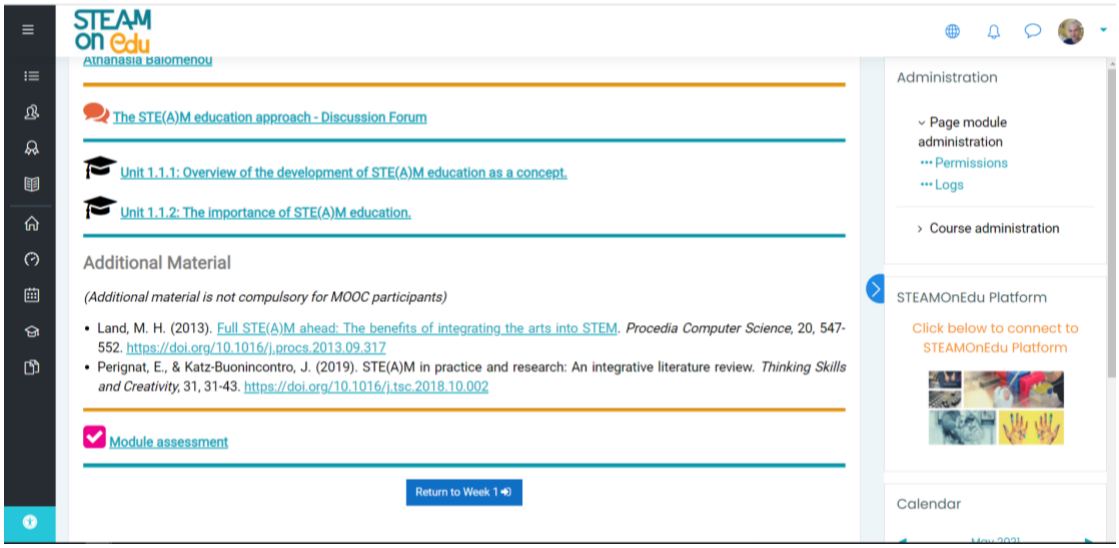

Figure 7. A view of a module's page on the platform

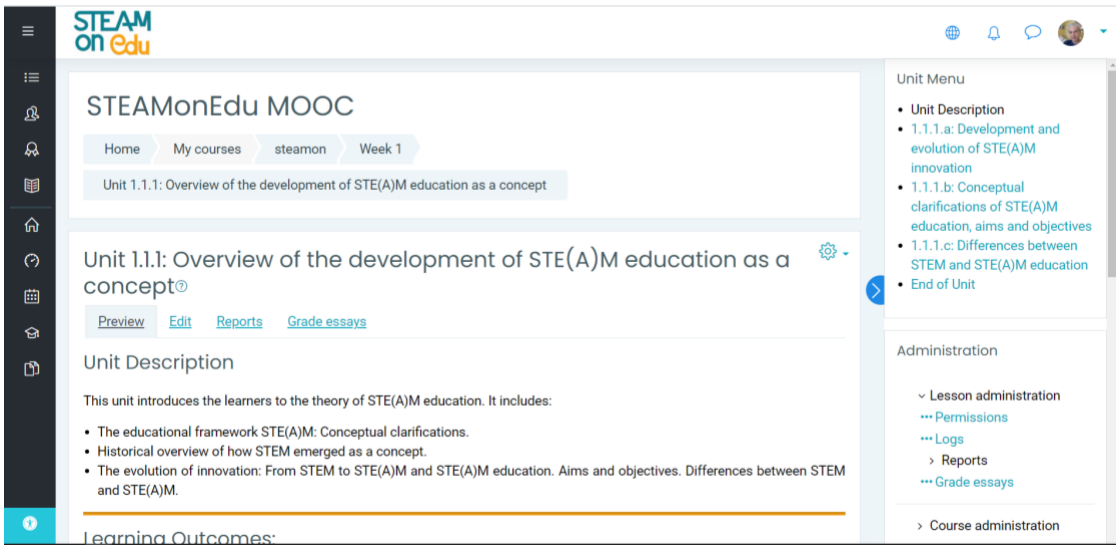

Figure 8. A view of a unit's page on the platform

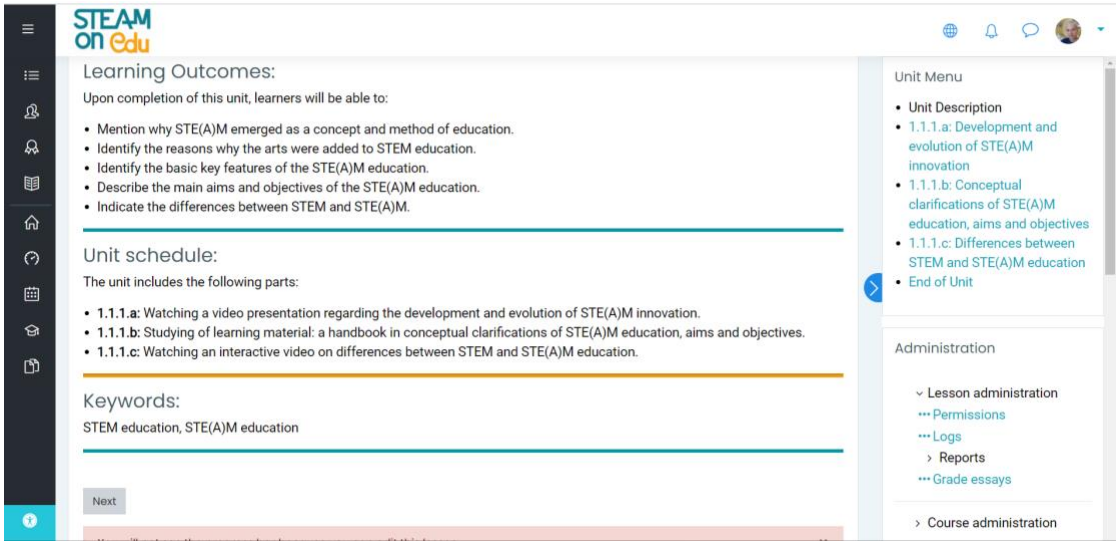

Figure 9. A view of a unit's page on the platform

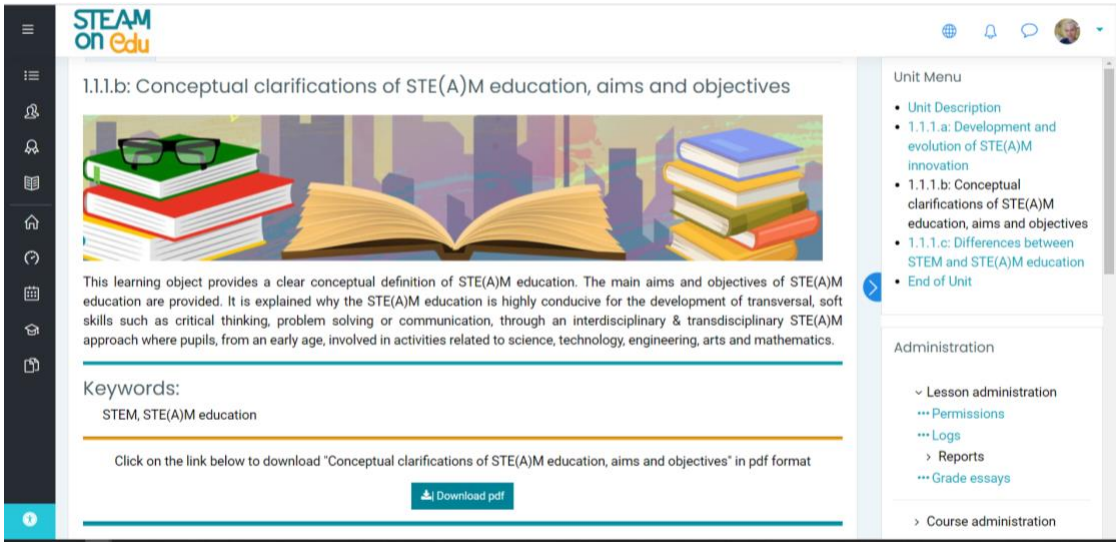

Figure 10. A view of a learning object's page on the platform

3 The blended course

This chapter provides a description of the blended course that was designed in the context of the training programme of STEAMonEdu project described in WP4. A brief introduction of the basic information regarding the course (participants, learning goals, structure, etc.) is given first. Next, a description of the modules designed to be delivered through the course is provided.

3.1 Blended course description

The blended course analyses more specific perspectives of the STE(A)MComp competence framework, that is, the educator as learning designer and creator (designing and producing outputs) and the educator as community member (interacting with the environment). The major knowledge domains of the course are:

- Curriculum and instruction
- Community practice

3.1.1 Participants

The course is addressed to the participants that have successfully concluded the MOOC. However, since the number of the participants of the blended course should be restricted, in order to attain the expected outcomes, a selection process will take place. The selection criteria under consideration include MOOC performance, background, professional/academic profile etc. The goal is to create an active group of participants representing all, if possible, categories of stakeholders of STE(A)M education, which will also be diverse in orientation and age. This will allow exchange of experiences, views and knowledge that will boost a multi-dimensional understanding and synthesis of different viewpoints during the cooperative tasks and activities.

3.1.2 Learning goals

The blended course offers:

- Knowledge and experience exchange in the context of the STE(A)MonEdu community.
- Delving into STE(A)M curricula design and development.
- Cooperative activities towards the design of STE(A)M activity templates.
- Understanding the STE(A)M competence framework and educator profiles and use of them towards the promotion of new educational policies.

3.1.3 Structure

The blended course will take place during a two-week period. It will consist of five main modules focusing on specific topics that cover the learning goals, as illustrated in Table 1Table 3.

Module Code	Module Title
B1.0	Introduction to the blended course
B1.1	Learning activity template design
B1.2	STE(A)M curricula design
B1.3	Learner development techniques
B1.4	STE(A)M competence framework and educator profiles

B1.5	STE(A)M policies promotion

Table 3. The structure of the blended course

It has to be noted that the abovementioned modules are provisional. This is due to the fact the MOOC implementation and its evaluation (both by participants and project partners) will provide a better understanding of the educator needs and will probably pose new requirements for the blended course.

3.1.4 Delivery format

The blended course will use the CTI Moodle-based platform. Some learning objects will be delivered digitally in various forms (presentations, videos, study documents, interviews, activities, etc.) and will be available online, while others will be delivered by synchronous online tutoring sessions and activities[2]. The participants will have to join the STE(A)MonEDU community[3] and participate in open discussions and active interaction using its services. As such, the educational environment will be accessible through a personal computer, tablet or smartphone, connected to the internet, equipped with standard audio and visual peripherals (microphone, speakers, web camera).

3.2 Blended course modules

3.2.1 B1.1: Learning activity templates design

Following the knowledge gained on STE(A)M activity design through the MOOC module *W2.1: STE(A)M related educational activities design*, this module goes one step forward towards the design of learning activity templates.

The participants will cooperate actively using the LAMS (Learning Activity Management System)[4] so to create STE(A)M activity templates that will facilitate STE(A)M educators in authoring learning activities. Based on initial designs provided by the project partners, the participants will have the opportunity and task to enrich, alter, differentiate or design from scratch, STE(A)M education activity templates for subjects that fit better their orientation. In addition, they will be asked to design STE(A)M education scenario, that will take into account the good practice guide. Their products will be evaluated and become part of the STE(A)M education framework. Moreover, they will be offered via the STE(A)MonEdU community platform open repository and will be used to enrich the MOOC content that is related with learning activity design and planning.

3.2.2 B1.2: STE(A)M curricula design

This module builds upon course and activity design modules introduced during the MOOC. With these in hand, the participants will go one step further to the next level of the design, i.e., curricula design. The following will be discussed among others:

- Curriculum definitions, dimensions and models.
- Processes, tools, diagnosis and analysis for curriculum design, planning and content.

[2] Blended learning originally includes face-to-face traditional classroom methods. These will be effectively replaced by online live sessions.
[3] https://steamonedu.eu/platform/
[4] https://www.lamsfoundation.org/

- Quality criteria of curricula.
- Curricula for STE(A)M education.
- Curricula and stakeholders.

3.2.3 B1.3: Learner development techniques

This module focuses on two major aspects: a) to facilitate learner STE(A)M competences and b) to provide learners with guidance for STE(A)M related career opportunities. In this context, the participants will follow lectures and then participate in open discussions on how to incorporate activities, assignments and assessments that facilitate learners to acquire cognitive skills, problem solving skills, scientific investigation skills, creativity and innovation skills, collaboration and communication skills etc. Furthermore, methods, techniques and basic knowledge on career possibilities related to STEM fields will be discussed.

3.2.4 B1.4: STE(A)M competence framework and educator profiles

As described in section 1.1.1, the STE(A)MComp Edu competence framework is a multi-perspective framework that comprises a complete set of dimensions which can be used to define the modern STE(A)M educator profiles. Involving the blended course participants deeper with the framework, serves two major goals: a) better understanding of the STE(A)M approach and the competences involved in the realization of STE(A)M education through study and reflection, and b) improving and refining the framework itself through interaction and experiences exchange among the participants, the tutors/educators of the course and the project partners. The first goal leads mainly to self-growth (professional and general) while the second will enhance the STEAMonEdu community and related activities.

Another significant aspect – both for the participants and the project – is the contribution to the creation, adaptation and fine tuning of STE(A)M educator profiles, so as to cover different professional requirements of educators in different contexts and setups that fit the participants' profiles.

3.2.5 B1.5: STE(A)M policies promotion

From the abovementioned training activities related to STE(A)MComp Edu and the corresponding educator profiles, it is clear that the participants of the blended course will eventually be expected to act rather as collaborators of the STEAMonEdu project than just students of the training programme. In this context, some or all of them are expected to blossom out into "STE(A)M ambassadors". It is of great importance to equip these participants with methods, tools and skills that will allow them to act accordingly. To do so, this module will build upon the basic knowledge offered in the module *W5.3: Policies that promote STE(A)M education approach* of the MOOC. It will emphasize on significant aspects of promoting the STE(A)M approach and then train the participants by assigning personal tasks and/or collaborative activities that will enhance their potential to deliver efficient and clear messages in different cases and contexts.

4 Tutoring and instruction

This chapter provides a compact guide for the tutors of the MOOC and the instructors of the blended learning course. The basic characteristics of each role and the major tasks that have to be undertaken during each course are summarized, so to build a friendly, creative and effective learning environment.

4.1 MOOC tutor

4.1.1 The role of the tutor

The major objective of the tutor is to ensure that a high percentage of participants achieves the MOOC learning objectives and completes the course successfully. This responsibility includes, among others:

- Establishing continuous and productive communication with the MOOC curator.
- Monitoring the progress of participants, identifying possible drop-out cases and encouraging them to stay in the course.
- Posting important announcements regarding the MOOC and in general.
- Using forums to communicate with participants, to help them present themselves and feel accepted by the community, to facilitate interaction and to assign learning tasks.
- Regularly monitoring the forums and providing timely responses to questions.
- While supervising forums, informing the MOOC curator of any incident or complaint that goes beyond the knowledge or responsibility of the tutor.
- Promoting the use of the STEAMonEdu community online platform, as a source of good practices and experience, as well as a tool to be used in carrying out learning activities.
- Resolving doubts about the operation of the platform, and ensuring the correct use of social tools and due respect of the usual netiquette of academic forums.
- Encouraging autonomous work and self-learning, by explaining the methodology and teaching tools available to participants.
- Detecting and transmitting possible course improvement proposals to the MOOC curator and the STEAMonEdu partnership.
- Informing of any events or important issues occurring in the course via announcements.
- Encouraging participants to complete the final assessment questionnaire for the course.

4.1.2 Tips for tutors

The tutors' role is very important for the success of the MOOC. Well-prepared and responsive tutors may convert a passive MOOC into a creative and satisfactory experience for the students. Student support and motivation will reduce drop out and ensure high MOOC completion rate. Some tips towards this end are the following:

- Become familiar with the training content **before** the start of the week. In case of doubt, ask the content authors.
- Be prepared. Be fair. Be encouraging. Be open. Be flexible. Be adaptive. Be quick. Be inclusive. Be positive. Be a facilitator.

- Don't intimidate. Don't discourage. Don't neglect. Don't forget. Don't disappear. Don't delay. Don't procrastinate. Don't teach.
- Update your Moodle profile. Then, consider what your students want to hear from you. Include at least your photo (recent and clear) and possibly a video message in your profile. This adds far more value than simple and basic content profile.
- Introduce yourself as a tutor at the **start** of your tutoring module, through the first module of the week and assure that trainees know what they are expected to do that week. Encourage the trainees to use the forums in order to introduce themselves, to express opinions and questions and to collaborate. Make the trainees feel included and empowered to express themselves. Remember: most of them are probably more expert and experienced than you on the topic; your role is not to teach but to facilitate learning.
- Some educational activities have the form of forum discussions on specific topics. These forums are including during weekly educational material. Try to moderate the discussion as well as to encourage trainees to express their opinion.
- Make sure you know the contact of the content authors of the unit you are tutoring (important in case any specific question arises).
- Always respond to the trainee requests quickly (< 24 hours). In case you receive message from any enquiring student, be helpful to them. Do the best you can to minimize dropout.
- Overview forum messages and inform the coordinator about technical issues reported or the content authors, if any scientific questions are placed.

4.2 The blended course instructor

The role of the blending learning course instructor (tutor) is much more involved and demanding than the MOOC tutor role. The instructors are not just tutors, they act as facilitators and moderators. They provide encouragement and guidance to the learners, they support them to develop themselves through a supportive, non-judgemental, accepting, environment. In this context the blended course instructors should, among others:

- Establish a good relationship with the learners based on mutual trust.
- Explain the learning objectives of each module in depth, communicate what is expected from the learners and what the learners should expect from the instructor.
- Take responsibility of the learning process while allowing learners to find their personal way towards the learning objectives.
- Enhance community building and facilitate interaction among the learners. Create a non-competitive, collaborative, open atmosphere that helps students feel comfortable, enjoy the learning process and participate actively.
- Make the learners part of the teaching process by facilitating knowledge and experience exchange while keeping the track of the course towards the predefined learning objectives.
- Move away from the traditional "teacher authority", be supportive and not dominating in learner group activities.

- Be flexible and respond to the learners needs by changing/adding material that help learners improve.
- Provide space for reflection, encourage learners' self-assessment, help learners to identify their strengths and weaknesses.
- Provide constructive feedback, acknowledge and value learners' contribution and make assessment a powerful tool to build learners self-confidence and take responsibility of their own-learning and behavior.
- Help them produce outcomes of high quality and value to the community.

Finally, it should be emphasized that the blended course learners have to be treated as collaborators that will (hopefully) be engaged with the STE(A)M approach and STEAMonEdu community, disseminate, reinforce and build upon the project outcomes.

References

[1] N. Spyropoulou and A. Kameas, “A Holistic Framework of STE(A)M Educators Competences”, ICERI2020 Proc., pp. 4445–4450, Nov. 2020.

[2] STEAMonEdu – 612911 KA3 EU project, *D8: STE(A)M educator competence framework and profile*, project deliverable.

[3] R. Branch. *Instructional design: the ADDIE approach*. Boston, MA: Springer US, 2010.

[4] B.S. Bloom, M.D. Engelhart, E.J. Furst, W.H. Hill and D.R. Krathwohl, *Taxonomy of educational objectives: The classification of educational goals. Handbook I: Cognitive domain*. New York: David McKay Company, 1956.

[5] B.S. Bloom, B.B. Masia and D.R. Krathwohl, *Taxonomy of Educational Objectives Volume II: The Affective Domain*. New York: McKay, 1964.

[6] E. Simpson, *The classification of educational objectives in the psychomotor domain: The psychomotor domain*. Vol. 3. Washington, DC: Gryphon House, 1972.

[7] D. Kennedy, *Writing and using learning outcomes: a practical guide*. Cork: University College Cork, 2007.

[8] S. Kurt, "Using Bloom’s Taxonomy to Write Effective Learning Objectives: The ABCD Approach," *Educational Technology*, April 24, 2019.

[9] L.W. Anderson et al., Eds., *A Taxonomy for Learning, Teaching, and Assessing: a revision of Bloom's taxonomy of educational objectives*. New York: Longman, 2001.