WESTEM

Educational pedagogues for STEM and entrepreneurship – WeSTEM lessons learnt for a way toward

Paris, January 2024

About the project

The aim of the World of Entrepreneurship with STEM project is to equip teachers, pedagogues, educational experts, and employees with the entrepreneurial and digital skills that are supposed to help them introduce new teaching courses for pupils in schools.

The focus of the activities is on the Science, Technology, Engineering, and Math (STEM) approach, which is assumed as a basic model to be implemented in schools.

Four trainings have been performed starting from September 2022 and February 2024 with over 65 participants in total. These were school teachers, headmasters, coaches, and pedagogues. The topics of the courses were related to the connection between entrepreneurship and STEM in schools and approaches for teachers to integrate them better into their daily educational curricula.

During every course, there was a space for discussion and exchange of ideas, thoughts, challenges, and opportunities, which STEM might bring to schools and the new, rapidly changing labour market.

As a result of these talks and inspiring exchange of experiences, and ideas, WeSTEM project leader, Aksantys, has decided to prepare the educational pedagogues for head teachers and policy makers, where the main WeSTEM challenges and lessons learnt are presented. These materials are open-sourced, i.e. everyone can have access to it, and are aimed to be used by other primary schools in all EU countries. It is assumed to serve to help better integrate STEM, and entrepreneurial skills, as future competencies, into the school curricula.

We strongly believe that WeSTEM project, although based on training, brought tangible results in terms of the knowledge, ideas, and attitude helping transform the school educational system to a higher quality service, giving equal chances to all students regardless of the country of origin.

The consortium of four, consisting of partners from France, Italy, Turkey, and Macedonia, brought excellent diversity and complementarity allowing for comprehensive results and inspiring findings. We encourage all stakeholders related to the educational sector to go through the Guidelines and get inspirations.

What is a pedagogy for teaching?

"Pedagogy" refers to the way in which educators impart theory and practice to their students. Pedagogy, which explains the interactions between culture and different instructional modalities, is shaped by a teacher's teaching philosophy. STEM pedagogy is the study of teaching strategies, particularly STEM strategies, and how they impact students. An efficient and well-thought-out pedagogy is necessary for kids to study more successfully and to acquire STEM abilities. To ensure that kids can learn effectively, a strong pedagogy that incorporates math, physics, engineering, and the arts is required, which presents challenges and opportunities for teachers. This may mean understanding the many stages of a child's development and how they can affect learning, as well as using instructional strategies and materials appropriate for the kids' ages. This approach to learning is also highly beneficial for environmental learning, as digital and green skills are closely linked to the STEM methods that were previously employed.

Effective STEM education methodology should also consider the needs and preferred methods of learning of the students enrolled in the courses. One of the primary positive tenets of STEM is the implementation of customized learning plans and other tactics that enable kids to learn at their own pace and with their own skills. They may be more rapid artists but less proficient mathematicians, or they may possess stronger scientific knowledge that will enable them to complete math problems more quickly and free up more time for artistic endeavours. This is the added benefit of STEM pedagogy, and educators should be aware that children benefit from a multidisciplinary approach to learning, which gives them greater freedom, enjoyment, and the ability to pursue careers that fulfill them. The purpose of this paper is to examine the learning process and how evidence-based teaching practices might enhance it.

It is based on discussions and talks being performed between teachers from September 2022 to February 2024 within the WeSTEM project, their exchange of thoughts and experiences when it comes to the connection between STEM and entrepreneurship.

How does STEM pedagogy affect the learning process?

The best pedagogies combine a range of instructional strategies, such as guided learning, planned group projects for the entire class, a comprehensive teacher's manual, individual exercises, and assessment practice. All of these techniques are covered in the WeSTEM outputs. Our pedagogies employ discussion and questioning in a way that is suited to enhance STEM thinking and the development of digital skills.

Accordingly, we use readily available and reliable research when developing new teaching materials, in case other interested parties wish to go more into any of the subjects addressed. Our joint goal is to use the ease of access to digital content on the internet to enhance the learning opportunities for children. Our goal was to help children find trustworthy sources of knowledge. This means breaking down the learning process and creating effective teaching strategies that get pupils interested in learning.

The way that students learn has a big impact on the outcomes. With the aid of a well-crafted STEM pedagogical technique, students can enhance their critical thinking, problem-solving, and creative skills. Conversely, a subpar teaching approach could make students bored, uninterested, and unmotivated. Teachers need to be aware of how pedagogy influences the learning process and constantly refine their teaching techniques in order to ensure that their students meet effective learning outcomes.

Maybe there are times when we find it challenging to implement the best teaching practices due to the circumstances surrounding the classroom. Time is of the essence in schools; busy schedules necessitate well-organized classrooms that cannot constantly act impulsively or deviate from the plan. We create instructional resources that promote active learning in the classroom.
By breaking down learning tasks using the universal thought framework, teachers can carefully design instructional strategies that scaffold difficult classroom tasks. An instructional approach like this gets to the heart of students' thinking.

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profound learning is the result of profound thought. If a student is not mentally engaged in the lesson, it is likely that they will not be able to understand it. Because STEM programs revolve around the same topic but present it from several aspects in science, engineering, art, and math, they aid kids in maintaining focus and catching up on some reading and studying deficiencies.

A pedagogical approach to education emphasizes the need of creating a warm and engaging learning environment that fosters student success. The STEM approach is one of the best instances of this, as our WeSTEM initiative has demonstrated.

How do we advance the pedagogy of STEM teaching?

This question was asked after every training to the WeSTEM participants. The conclusions were strongly related to the robust integration of differentiated solutions, helping out-of-the-box thinking and deciding.

Advancing the pedagogy of STEM teaching involves continuously improving teaching practices, curriculum development, and instructional strategies to effectively integrate STEM disciplines and promote deeper learning and engagement among students. Here are some key approaches to advancing the pedagogy of STEM teaching:

- Interdisciplinary curriculum design: Develop an interdisciplinary curriculum that integrates concepts and practices from multiple STEM disciplines. Design projects and activities that encourage students to make connections between different subject areas and apply their knowledge in real-world contexts.
- Project-Based Learning (PBL): Implement project-based learning approaches that emphasize hands-on, inquiry-based activities and collaborative problem-solving. Design projects that allow students to explore complex problems, propose solutions, and create tangible artefacts or products using STEM principles.
- Experiential Learning: Provide opportunities for experiential learning through field trips, laboratory experiments, maker spaces, and hands-on activities. Allow students to engage in authentic, meaningful experiences

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that connect theory to practice and promote a deeper understanding of STEM concepts

- Inquiry-Based Learning: Foster curiosity, exploration, and discovery through inquiry-based learning experiences. Encourage students to ask questions, investigate phenomena, and develop hypotheses, using scientific inquiry processes and methods across STEM subjects.

- Technology Integration: Integrate technology tools and resources into STEM teaching to enhance learning outcomes and facilitate student engagement. Use digital simulations, modelling software, coding platforms, and other technology tools to support inquiry, experimentation, and creative expression in STEM subjects.

- Arts integration: Incorporate arts and creative expression into STEM teaching to foster innovation, imagination, and aesthetic appreciation. Encourage students to explore the intersection of art, design, and technology through activities such as visual arts, music composition, digital media production, and performance arts

- Differentiated Instructions: Adopt differentiated instructional strategies to meet the diverse learning needs and interests of students. Provide multiple pathways for learning, allowing students to pursue individual interests, strengths, and goals within the context of STEM education.

- Assessment for Learning: Implement formative assessment practices that provide ongoing feedback and support student learning in STEM subjects. Use authentic assessment methods, such as project portfolios, presentations, and performance assessments, to evaluate students' mastery of STEM concepts and skills.

- Professional Development: Provide professional development opportunities for educators to enhance their knowledge, skills, and pedagogical practices in STEM teaching. Offer workshops, training sessions, and collaborative learning communities to support teachers in implementing effective STEM instruction.

- Collaborative Partnerships: Foster partnerships and collaborations with industry partners, research institutions, cultural organizations, and community stakeholders to enrich STEM teaching and learning experiences. Engage external experts and resources to provide authentic,

real-world connections and opportunities for students to explore STEM careers and pathways.

How can the pedagogy help connect STEM and entrepreneurial teaching?

Teachers highlighted several measures the pedagogues could use to merge these both topics. They can be summarised into the following points:

1) Curriculum Development: Design an innovative and interdisciplinary curriculum that combines STEM subjects with entrepreneurship principles and practices. Develop project-based learning activities, case studies, and real-world projects that engage students in hands-on learning experiences and encourage creativity, critical thinking, and problem-solving.

2) Instructional Design: Create engaging learning materials, resources, and activities that cater to diverse learning styles and abilities. Use a variety of teaching methods, technologies, and resources to facilitate active learning and foster entrepreneurial mindset and skills among pupils.

3) Facilitation and Coaching: facilitate classroom discussions, group activities, and experiential learning opportunities that promote collaboration, teamwork, and communication skills. Provide coaching and mentorship to students as they explore their interests, develop ideas, and launch entrepreneurial ventures.

4) Collaboration and networking: Collaborate with other educators, industry partners, and community stakeholders to enrich STEM and entrepreneurship education initiatives. Build partnerships with local businesses, startups, incubators, and organizations to provide students with authentic learning experiences, mentorship opportunities, and access to resources.

5) Advocacy and outreach: Advocate for the importance of STEM and entrepreneurship education in preparing students for future careers and equipping them with the skills and mindset needed to succeed in a rapidly changing world. Engage with policymakers, educational leaders, and community members to promote the integration of STEM and entrepreneurship into educational policies and programs.

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6) Professional development: Stay updated on the latest developments and best practices in STEM education, entrepreneurship education, and pedagogy. Attend professional development workshops, conferences, and training sessions to enhance teaching skills, content knowledge, and instructional strategies.

7) Assessment and evaluation: Develop assessment methods and criteria to measure student learning outcomes and progress in both STEM and entrepreneurship. Use formative and summative assessment strategies to evaluate students' knowledge, skills, and competencies and provide feedback for improvement.

Demagogy for the Modern Classroom on Entrepreneurship Based on STEM

The aim of STEM pedagogy in the modern classroom ought to be to cultivate an environment that is secure, engaging, and productive for every student. This could entail using cooperative learning strategies and instructional activities, such as group projects and team-based assignments, to encourage students to collaborate and support one another's academic development. Using creative learning, which flips conventional teaching strategies so that students learn foundational information outside of the classroom before applying STEM methodologies, is another crucial aspect of pedagogy in the contemporary classroom. This tactic can help make education more interesting and relevant to students' everyday lives.

Furthermore, the goal of STEM pedagogy in the modern classroom is to promote deep learning, in which students fully understand significant concepts and ideas, as opposed to only having them memorize facts and information. In addition to practical, hands-on learning activities that foster introspection and critical thinking, this can be accomplished through discussion and questioning.

One of the examples being discussed during the courses was the concept of social pedagogy, which is very much perceived as a future of the forthcoming pedagogical curricula.

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A comprehensive strategy for working with children and their families in a way that supports their growth, well-being, and education is provided by social pedagogy. This is an additional method of systemically integrating STEM into the curriculum in an efficient way. Social pedagogy holds that education is crucial to students' growth and welfare. These kinds of pedagogical practices are seen as forms of practice in the broadest sense since they facilitate social learning and development in an individual's life. Students are social creatures by nature. While integrating STEM into this way of thinking may initially seem difficult, a thorough examination of the school curriculum reveals that project-based learning is really quite helpful for social learning. Students' social skills are improved through group classes, shared tasks, games, and contests centred around a single subject, which supports the efficacy of social pedagogy.

They also need to have received the education required for effective communication. Different cultural and social settings can influence how public education is provided in various countries, which is also very important in today's globalized world. Social pedagogy is generally used by educators to highlight the value of traits like empathy and compassion through social education. The knowledge of practitioners is critical to using the right resources for children to explore at the right stage of development. Through the use of art, STEM may also greatly aid with that.

Another example of the pedagogies being pointed out as helpful in developing entrepreneurship in educational curricula is culture-responsive education.

Cultural contexts are taken into consideration in culture-responsive education. When implementing culturally responsive education, educators modify their teaching methods based on observations of students to better suit the requirements of students from different cultural backgrounds. The school occasionally makes changes to its procedures and rules in an effort to promote more community involvement.

Students' diverse racial, religious, and ethnic backgrounds are encouraged and taken into consideration by educators using a culturally responsive teaching approach. Giving students access to video pedagogy that educates them about the many cultural cuisines being studied would be one way to show how culturally

responsive cooking instruction is. Culturally sensitive political studies examine and explore a broad spectrum of political issues across multiple cultural contexts. This means that in the legal domain, different cultural and religious viewpoints must be taken into consideration, such as how different groups may interpret similar legal difficulties. Within this kind of instruction, STEM techniques ought to mesh quite nicely. Because STEM is centred on project-based learning, it can work well in the battle against discrimination, for equal rights, or for people from different backgrounds. Using art as a STEM component helps make students more aware of the marginalized groups.

Moving teacher's pedagogy forward

This innovative pedagogy guideline sought to clarify the connections between STEM education and other pedagogical philosophies. We attempted to determine which educational strategies should be established in order to encourage STEM and entrepreneurship on a more frequent and systemic basis by utilizing the WeSTEM experience. We attempted to demonstrate that while some educators are too traditional to accept such a cutting-edge method of working with children, others are able to readily adopt the STEM approach, spread it, and encourage its use.

Teachers attest that in the quickly evolving world of today, the shift to a greener and more digital economy, as well as the growing demand for social skills, empathy, and artistic expression, may expose students to issues that they will face in the real world. The WeSTEM project is evidence that problem-solving based on various multifaceted approaches is possible through project-based learning.