STEAM APPROACH IN FORMAL AND NON-FORMAL EDUCATION

2025

Guidebook for educators

Co-funded by
the European Union

STEAM approach in formal and non-formal education
Guidebookforeducators

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Introduction

Eanradsmus+project "EnterSTEAM-Promoting and strengthening Inclusion, Diversity, entrepreneurship through STEAM approach as Innovation in Vocational and non-formal education" is being developed by 6 partner countries - Latvia (coordinator), Hungary, Italy, Turkey, Austria and Romania. EnterSTEAM combines STEAM (stands for *Science, Technology, Engineering, Arts, Mathematics*) approach with entrepreneurship, creativity and inclusion that are beneficial in building personal capacity for each individual.

This project's main objectives are:

1) Building capacity of VET providers to strengthen cooperation between private and public stakeholders in the field of VET and non-formal education for demand-oriented and opportunity-driven interventions;
2) Improve the quality and responsiveness of VET to socio-economic opportunities and social developments to enhance the labor market relevance of skills provision;

With these objectives, we intend to contribute to boosting gender equality in science and life-long learning opportunities.

As for the results with this project we intend to:

1) Reduce the generation and gender gap and demonstrate the importance of innovative STEAM subjects, as well as collect existing good practices to encourage educators;
2) Improve accessibility, and information exchange and make the learning process more appealing to youth as well as the use of devices more meaningful;
3) STEAM-based Workshops to create more interest;
4) Improved key competencies and entrepreneurship skills within the STEAM framework.

During the project period we are implementing the following outcomes:

1) Research and guidebook
2) Digital STEAM toolkit for savvy tech use
3) STEAM-based Workshops for all ages
4) It also includes one teacher training in Romania and two student trainings - one in Hungary, the other in Turkey.

This guidebook is divided in **3 main sections**:

1) What is STEAM - key ideas, benefits, methods for formal and non-formal education and good practices from partner countries.
2) Repository of existing ready-to-use resources in partner countries provides quality resources mostly in local languages for different ages and aims.
3) Integration of Inclusion, Creativity and Entrepreneurship (ICE) into STEAM approach will provide different aspects of how basic skills that are necessary for personal development and interest in life-long learning can be combined with STEAM approach with practical ideas and suggestions. This section is also available in video format.
4) At the end you can learn more about our findings from EnterSTEAM research where in total 137 respondents shared their opinion about the value of the integration of Inclusion, Creativity and Entrepreneurship (ICE) into exact sciences as well as their experience.

Section I: STEAM approach for promoting and strengthening Inclusion, Diversity, and entrepreneurship

What is STEAM?

STEAM stands for**Science, Technology, Engineering, Arts, and Mathematics**. It is a modern way of teaching that connects these subjects to help students understand how they work together in real life. Instead of learning each subject separately, STEAM combines them through creative and practical projects.

The STEAM approach is based on **problem-solving, critical thinking, creativity, and teamwork**. Students learn by doing—building things, experimenting, designing, and exploring real-world questions. This helps them develop important skills for the future, such as how to think independently, communicate ideas, and work with others.

One special part of STEAM is the **"A" for Arts**. This includes not only visual arts and music, but also design, storytelling, and creative thinking. The arts help students express their ideas, look at problems in new ways, and make learning more meaningful. When students use both technical and creative skills, they become more flexible and ready for different types of challenges.

STEAM is used in **both formal education (schools)** and **non-formal education (clubs, workshops, adult learning, and community programs)**. It can be adapted for all age groups—from young children to adults—and for learners with different backgrounds and abilities. This makes STEAM an inclusive method that supports diversity and encourages everyone to take part and succeed.

In today's fast-changing world, students need more than just facts. They need to know how to solve problems, think creatively, and use what they learn in real life. STEAM education helps students prepare for modern jobs, become active citizens, and build a better future.

This guidebook will show you how to use STEAM in different learning environments, share good practices from across Europe, and explain how STEAM supports **inclusion, creativity,** . It is designed to inspire educators to bring more innovation,

and entrepreneurship teamwork, and imagination into their teaching. **Key Ideas in STEAM**

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1. CombiningS ubjects:

STEAM connects science, technology, engineering, art, and math. It shows how these areas are linked and how they can be used together to solve problems.

2. Learning Through Projects:

Students often work in groups on projects that are based on real problems. This helps them practice teamwork, planning, and applying what they have learned.

3. Creativity and Innovation:
Addingthe artsto STEMhelps students be more creative. They learn to think differently and come up with new ideas and solutions.

4. Inclusion and Participation:

STEAM allows different types of learners to take part. It supports students from different backgroundsand withdifferent learningstyles, making education moreinclusive.

Benefits of Using the STEAM Approach in Formal and Non-Formal Education

Benefits for Students

1. Improves Learning in All Subjects

Because STEAM mixes different subjects, it helps students understand each one better. For example, a student might use math in an art project or science in a technology task. This makes learning more complete and helps students remember what they learn.

2. Develops Creativity and Thinking Skills

STEAM helps students become better thinkers. They learn how to ask questions, find answers, and work in teams. This helps them become more confident and ready for the future. They learn to solve problems, make decisions, and try different ideas. These skills are very important in school and in life.

3. Encourages an Entrepreneurial Attitude

STEAM teaches students to take action, try new things, and not be afraid to fail. This helps them build confidence and prepares them to start their own projects or even businesses in the future.

4. Supports Teamwork and Understanding Others

Students often work in groups. They learn to listen, share ideas, and respect different opinions. This helps them work better with others and become more open-minded. All students can take part in STEAM. It supports different learning styles and makes everyone feel included. Students who may not do well in normal classes often do better with hands-on projects. They feel proud when they finish a STEAM project and see what they can do.

5. Prepares Students for the Future

Many jobs today need skills in science, technology, and creativity. STEAM helps students get ready for these jobs by teaching them how to work with technology, solve problems, and think creatively.

6. Connects School with Real Life

STEAM projects are often based on real situations. Students work on projects that solve real problems, like building something or creating a design. For example, students might design a green building or create an app to help their community. This shows them how school subjects are useful in real life and what they learn in school can be used to make the world better. Students enjoy STEAM because it makes learning fun and real.

Benefits for Teachers 1. Enhancing Teaching Through Creativity and Integration

STEAM helps teachers use creative and modern ways to teach. It gives them the chance to combine different subjects like science and art. This makes teaching more interesting and helps teachers connect better with students. Many teachers say that using STEAM helps them enjoy teaching more.

2. Supporting Professional Growth and Flexibility Teachers gain new skills through STEAM. They use technology more often, plan team projects, and focus on real-world problems. This helps them grow in their jobs. In less formal environments like clubs or workshops, teachers can also be more flexible. They can choose fun activities that match students' interests and learning styles. **3. Making Learning Engaging and Practical for Students** Students benefit from STEAM because it makes learning more fun and meaningful. They work on hands-on projects that solve real-life problems, which helps them see the value of what they learn. They also develop important skills like critical thinking, creativity, and teamwork. These skills are useful in school, future jobs, and everyday life.

4. Promoting Inclusion and Building Confidence STEAM supports different types of learners. Whether students learn best by doing, seeing, or working in groups, STEAM gives everyone a chance to succeed. It also helps students feel more confident. When they complete a project, they see what they can do, which builds their self-esteem and encourages them to keep learning.

Conclusion

STEAM is a powerful and modern way of teaching. It helps students learn important knowledge and skills by combining science, technology, engineering, arts, and math. Students become more creative, confident, and ready for future jobs. They learn to work with others, solve problems, and use what they learn to make a difference.

At the same time, teachers need support to use the STEAM method successfully. They need training, tools, and time to plan good lessons. If schools and educational systems invest in STEAM, they can help create a better future for both teachers and students.

Methods for STEAM based approach in formal and non-formal education

Good practices adaptable to different age groups

Best Practicesfor Promoting the STEAM Approach in Austria

For Families:

Austria offersvarious opportunitiest o integrateSTEAM topicsintoeveryday family life. Someof themost notablescience and technologycenters include:

- **Ars Electronica Center (Linz)** – Aworld-renownedinnovationhub forart, technology, and society,offering interactiveSTEAMexperiencesfocusedon artificial intelligence, robotics,and future technologies.
- **ZOOM Children's Museum (Vienna)** –Hands-onSTEAMexperiencesfor children, includingworkshopsonscience, technology,andcreativeexperiments.
- **Technisches Museum Wien (Vienna Technical Museum)** –Amuseumthat blends historicaldiscoverieswithinteractiveSTEAMexhibitionstointroducechildrenand youngpeople to technical innovations.

For Adults:

Digital Skills and Vocational Training

- **DigiSkills Austria** –Anationalplatformpromotingdigitalskillsinadulteducation, offering courses onITbasics,programming, and digital business models.
  → Link: https://www.digiskills.at
- **Training Programs by the Chamber of Labor & Adult Education Centers**
  In cooperationwiththe **Austrian Economic Chamber** andthe **Austrian Public Employment Service (AMS)**,numerous digitaltrainingopportunitiesareavailable, particularlyforwomenandindividuals transitioningtonewcareers.
  → Link: https://www.arbeiterkammer.at/bildung

Entrepreneurship & Technology for Adults

- **Female Founders** –Aprogramdedicated to supportingwomenin tech andstartups byprovidingtraining,mentoring,andnetworkingopportunitiesin the STEAM field.
  → Link: https://www.femalefounders.global
- **Talent Garden Vienna** – An innovation campusfor digitalcareers and entrepreneurship,focusing on programming, artificial intelligence, and future business models.
  → Link: https://vienna.talentgarden.org

National STEAM Promotion Initiatives

- **Fit4Internet** –AnAustriangovernmentinitiativepromotingdigitalliteracy for all age groups.Itoffersonlinecoursesandself-assessmenttestsfordigitalcompetencies.
  → Link: https://www.fit4internet.at

- **MINT-Girls Challenge** –Aprogramthatencouragesgirlstopursue STEM careers through mentoring,workshops, and networking events.
  → Link: https://www.mint-girls.at

European and International Programs with Austrian Participation

- **EPALE Austria (Electronic Platform for Adult Learning in Europe)** – A platform offering a wide range ofresourcesand onlinecoursesforprofessionaldevelopment, with a focus on digital skills and entrepreneurship.
  → Link: https://epale.ec.europa.eu/en

Best practices and inspiring examples on the promotion of STEAM among different age groups in Italy

F– **a**A**b**d**la**ig**b**i t**fa**o**l** **r**f a**K**br**id**ic**s**a **(**ti**T**o**un**r** l**ia**n**b**)**o ffering hands-onworkshopsin coding, robotics and3Dprintingfor children, fostering creativityand problem-solvingfrom anearly age.
Website: https://www.facebook.com/fablabforkids/

RomeCup (Rome) – An annual event combining robotics, AI and innovation, engaging students from primary to university levels in competitions, hackathons and mentorship with industry experts. The 2025 event will take place on 7, 8 and 9 May 2025 in Rome.
Website: https://romecup.org/
Email: romecup@mondodigitale.org

CoderDojo Italy (Nationwide) – A volunteer-led initiative organizing free programming clubs where kids and teens learn to code, build apps and experiment with digital creativity in an informal setting.
Website: https://coderdojo.com/

Museo della Scienza e della Tecnologia Leonardo da Vinci (Milan) – Italy's largest science museum, offering interactive STEAM workshops and educational paths for all ages, inspiring curiosity through experiential learning.
Website: https://www.museoscienza.org/

Best practices and inspiring examples on the promotion of STEAM among different age groups in Hungary Hungary has implemented several innovative initiatives to promote STEAM (Science, Technology, Engineering, Arts, and Mathematics) education across various age groups. Here are some notable examples:

KIKS Project (Kids Inspiring Kids in STEAM): This international educational project involves students from four European countries collaborating virtually to create projects in the STEAM fields. Supported by the Hungarian Digital Education Association, Hungarian students from six institutions participate by forming teams that design and implement projects integrating mathematics, at least one science subject, and the arts. The initiative emphasizes experiential learning, fostering creativity and problem-solving skills among students.

Smartiz Program: Aimed at high school girls, the Smartiz program develops digital skills and introduces participants to informatics and mathematics. Organized by Morgan Stanley Hungary and the Women in Science Association (NATE), the program offers free online workshops and face-to-face sessions. Participants engage in weekly online classes focusing on mathematics and information technology, utilizing experiential and discovery-based learning methods. The program also includes mentorship from experienced professionals, enhancing both technical and soft skills essential for future careers. Digital Skills and Jobs Platform

Abacusan Educational Studio: Based in Budapest, the Abacusan Educational Studio is a non-profit organization specializing in STEAM education through robotics and digital tools. They offer a range of programs, including summer camps, courses, and extracurricular activities for children aged 5 and above. Their approach emphasizes individualized learning paths, cooperation, creativity, and self-reflection. Abacusan also engages in international collaborations, coordinating Erasmus+ projects to develop pedagogical methods and educational materials. abacusan.hu

Maker's Red Box Initiative: Supported by a grant from Google.org, Maker's Red Box focuses on bringing comprehensive STEAM education to underprivileged children, particularly those in foster care. The initiative provides storytelling-powered teaching methods to engage students in creative problem-solving activities. Courses are designed to improve both soft and hard skills, encouraging lifelong learning and better preparation for future employment opportunities. Maker's Red Box

Eco-School Network: Established in 2000, the Hungarian Eco-School Network promotes education for sustainable development (ESD) by integrating sustainability principles into all aspects of school life. With nearly 2,000 member institutions, the network encourages
and
S
e
[illegible]
th u hin linary
learning. ResearchGate

These initiatives demonstrate Hungary's commitment to fostering STEAM education through collaborative projects, targeted programs for underrepresented groups, integration of sustainability principles, and the use of innovative teaching methods.

Institutions, Organizations, and Schools in Romania Promoting the STEAM Approach

InRomania, several institutions and organizations promote and apply theSTEAM (Science, Technology, Engineering, Arts, and Mathematics) method in education. Here are some notable examples:

1. **Științescu Program**: Initiated by the Federation of Community Foundations in Romania with the support of the Romanian-American Foundation, this program funds educational projects that ignite a passion for science and technology among children and young people aged 3 to 19. The program is implemented through local community foundations in several counties across the country, including Vâlcea. (valcea.stiintescu.ro)

2. **STEAMonEdu Project**: This European project, in which the EOS Foundation from Romania participates, aims to enhance the adoption and impact of STE(A)M education by investing in stakeholder communities and the professional development of educators. The project provides training courses and resources for teachers, promoting collaboration and the exchange of best practices in STE(A)M education. (eos.ro) 3. **General Association of Engineers in Romania (AGIR)**: AGIR has promoted the integration of arts into STEM education, transforming it into STEAM to stimulate innovation and creativity among young people. This holistic approach is considered essential for developing the skills needed in a knowledge-based society. (agir.ro)

Best practices of promoting STEAM approach for different ages in Latvia

For families:

Latvia canbeproud with5sciencecentersthatallowtheirvisitorstoexploreSTEAM-based activities:
-One ofthemis specificallydesigned to promotenature science,
-One ofthescience centersspecifically coversthespace field.
-The restofthe venues combine different fieldsofSTEAM.

For adults:

State Employment Agency

Many organisations inc ollaboration with the State Employment Agency coordinate digital skills courses for unemployedadults and as a part of lifelong learning opportunities.
Link to courses: https://www.nva.gov.lv/lv/prasmju-apguve

Stars

Adult longlife learning opportunities in ICT&digital skills fields. It offers to test digital skills before applying to courses. European co-fundingis available.
https://stars.gov.lv/

Riga Tech Girls & Digital development school

Digital Development School (DGS) is an innovative digital school created by Riga Tech Girls to make digital skills education available to everyone. Their mission is to ensure supportive, encouraging and practical digital learning to support personal and professional development in today's rapidly changing world. Some of the courses are for free. RTG collaborate with local and international IT enterprises.
Links:
https://rigatechgirls.com/
https://www.digitalasizaugsmesskola.lv/

LIKTA:

LIKTA Mission: To develop awareness of the impact, efficiency and competitiveness of the field of ICT at all levels – at the level of the state, business and society.
Link to courses: https://likta.lv/digitalo-prasmju-projekts/

Izaugsme ar Google (“Growth with Google”)

In 2024 the main focus is on AI tools that improve business processes. "Growth with Google" is a long-term educational program for learningdigital skills, which aims to create a favorable environment for small and medium-sized enterprises in the independently changing world of business and technology. *Link to the website*: https://www.digijourney.com/izaugsme-ar-google/

National platform for business development

It offers support for local businesses, including digitalisation funding via European projects, Business incubators for new entrepreneurs to build networking possibilities. European co-funding is available. *Link to the website*: https://business.gov.lv/en

Salto is a Learning platform for youth and youth educators SALTO-YOUTH is a network of seven Resource Centres working on European priority areas within the youth field.
As part of the European Commission's Training Strategy, SALTO-YOUTH provides non-formal learning resources for youth workers and youth leaders and organises training and contact-making activities.
https://www.salto-youth.net/

Epale (Electronic Platform for Adult Learning in Europe))

On-site courses: https://epale.ec.europa.eu/en/on-site-course-catalogue
Online courses: https://epale.ec.europa.eu/en/online-course-catalogue

Best practices and inspiring examples on the promotion of STEAM among different age groups in Türkiye

The British International STEAM School

https://www.biss.k12.tr/

The BritishInternationalSTEAMSchoolinIstanbulisagreatplaceforlearning. It focuses on STEAM.Thisschoolhelpsstudentstothinkcreativelyandsolveproblems. In classes, students learnbydoingprojectsandaskingquestions.Theteachersencourage students to be curious andexplorenewideas.Theyusereal-worldproblemstomakelearning fun and interesting.Theschoolhasafriendlyatmospherewhereeveryonefeelswelcome. Students canlearnfromeachotherandworktogetherongroupprojects.There are special programs forpreschoolandprimaryschoolstudents.Thisschoolprovidesastrong foundation for students'futurelearning.Itpreparesthemforthechallengesofthe21stcentury.

The Polar Star project

https://polar-star.ea.gr/content/steam-education

The PolarStarprojectisagreatwaytolearnaboutSTEAMeducation.This project helps teachersusedifferentwaystoteachthesesubjectstogether.Itfocusesonstudent-centered learning,wherestudentsworktogetheronproblems.Theprojectgivesteachers special tools and templatestodesigntheirlessons.Thesetoolshelpteacherscreateactivities that mix science,art,engineering,andtechnology.ThePolarStarprojectalsooffers training for teacherstoimprovetheirskills.TeacherscanlearnhowtointroduceSTEAM topics in fun and engagingways.Theprojectencouragescreativityandcriticalthinkingamong students. It helps studentslearnbydoingrealprojectsandsolvingrealproblems.PolarStar is a valuable resourceforteacherswhowanttouseSTEAMintheirclassrooms.Itprepares students for future challengesandhelpsthemthinklikeinnovators.

SpicE Academy

https://spiceacademy.eu/

SpicE Academyisaprogramthathelpsteachersteach STEAMsubjectstostudents with mild learning difficulties.SpicEAcademyteachesteachershowtomaketheirlessons inclusive, so that all studentscanparticipateandlearntogether.TheSpicEprojectprovides tools and methods forteacherstouseintheirclassrooms.Teacherslearnhowtoadapttheir lessons for all students.Thishelpspreventeducationalandsocialexclusion.SpicEAcademy offers teachers anumberofbenefits,including"TrainingonhowtoteachSTEAM subjects effectively,Resourcesandmaterialstosupport STEAMteaching,Acommunity of other teachers whoareusingSTEAMeducationintheirclassrooms"

EDUSIMSTEAM

https://edusimsteam.eba.gov.tr/

EDUSIMSTEAMisaEuropean project coordinated by Turkish Ministry of Education. It uses online platformsand simulations to teach STEAM subjects. This can be a great way to engage students andmake learning more fun. The project is also collaborative, which means that teachers fromdifferent countries will be working together to share ideas and best practices. EDUSIMSTEAM is a promising project that has the potential to improve STEAM education in schoolsacross Europe. The benefits that EDUSIMSTEAM offers for teachers: “Access to innovativeonline platforms and simulations, The opportunity to collaborate with teachers from othercountries, Professional development opportunities in STEAM education”

Space Camp Turkey

https://www.spacecampturkey.com/steam-egitimi-nedir Space Camp TurkeyteachesSTEAMwithfunandhands-onactivities.Studentscando astronaut training, buildrockets,andwatchshowsinaplanetariumtolearnaboutspace.Here, students try astronauttrainingandlearnaboutspacewhilemeetingfriendsfromdifferent countries.For schoolgroups,SpaceCampTurkeyhasprogramswherestudentsworkon STEAM projects duringtheschoolyear.Theseactivitieshelpstudentsexplorespaceanduse creative and problem-solvingskills.TeacherscanlearnnewSTEAMideasatthecamp.They do activities like astronautmissionsandengineeringprojectstobringreal-worldlearningto their classrooms. Teachersalsomeetothereducatorsfromaroundtheworldandshare teaching ideas. Thishelpsthemfindnewwaystomakelearningfunandcreativefortheir students.

Sigma STEAM Club

https://cekirgeler.com/yarismalar/sigma-steam-club/ Sigma STEAM Clubisaprojectcompetitionforstudentsfrom1stto12thgrade.Students work in teams of2to5memberstocreateprojectsinscience,technology,engineering,arts, and mathematics.Thecompetitionhastwostages:inthefirststage,teamschoosetheirproject topics and prepare;inthesecondstage,theycompleteandpresenttheirprojects.Eachgrade level has differenttopicoptionstochoosefrom. All participatingstudentsreceivedigitalparticipationcertificates.Thetop5teamsineach grade level attheWorldFinalsareawardedwiththeSigmaOlympicsOutstanding Achievement Certificate,plaques,andmedals. Teachers benefitfromthesepracticesbyguidingstudentsthroughprojectdevelopment, enhancing theirownskillsinSTEAMeducation.Thisexperiencecaninspireteachersto incorporate more project-based learning in their classrooms, fostering ahands-on, collaborative learningenvironment.

Deneyap Teknoloji Atölyeleri

https://www.deneyap.org/tr/ Deneyap Teknoloji Atölyeleriofferfree,36-monthtechnologyeducationprogramsfor students. The curriculum includessubjectslikerobotics,coding,anddesign,aimingto

develop students' creativity and problem-solving skills. Teachers at Deneyap are creative thinkers who enjoy learning and teaching. They work well in teams and solve problems effectively. By participating in Deneyap's programs, teachers can improve their teaching skills and learn new methods. They gain experience in project-based learning, which they can apply in their own classrooms. This experience helps teachers create engaging lessons that inspire students to exploreSTEAM subjects.

Deneyapalso organizes competitions in for secondary and high school students in various subjectsincluding STEAM.

SistersLab

https://sisterslab.org/ SistersLab is an organization that helps women and girls learn STEAM subjects: Science, Technology, Engineering, Arts, and Mathematics. They offer free online courses and mentoring to women aged 25-35 who have degrees in these fields but are not currently working. These programs help women improve their skills and find jobs in technology and science.

SistersLab also works to increase the number of women in STEAM careers. They organize bootcamps and hackathons for women studying or graduating from STEAM programs. These events provide training and opportunities to work with partner companies.

For teachers, SistersLab's programs offer valuable resources and support. By participating, teachers can learn new teaching methods and gain access to up-to-date materials in STEAM education. This experience helps teachers create engaging lessons and better support their students, especially girls, in pursuing STEAM subjects.

TÜBİTAK

https://tubitak.gov.tr/tr TÜBİTAK is the Scientific and Technological Research Council of Turkey. It supports education in science, technology, engineering, arts, and mathematics (STEAM). TÜBİTAK organizes workshops and programs to help teachers learn new STEAM methods. It also supports science fairs in schools. These fairs encourage students to create projects in STEAM fields. Teachers guide students during these projects, helping them learn by doing. This hands-on approach makes learning more engaging for students. Moreover, It organizes project competitions for lower and upper secondary school students. By participating in TÜBİTAK's programs, teachers can improve their teaching skills. They learn new ways to teach STEAM subjects and make lessons more interesting.

Pelikan College's STEAM Maker Club

https://pelikankoleji.com/steam-maker-kulubu/ Pelikan College's STEAM Maker Club helps students learn about science, technology,
engineering, art, and math. In this school club, students work on projects like building robots and writing computer programs. They start learning about mechanics, electronics, and software at a young age. This helps them understand engineering and programming better. Students also learn how to work well in teams, which is important for completing projects. The club encourages creativity and problem-solving skills. Teachers benefit by seeing students become more interested in technology and science. They can use these hands-on activities to make lessons more engaging. This approach helps students do better in subjects like math and physics.

SECTION II: Research & METHODS (repository content)

Existing quality resources that are ready to use in Austria

Science Pool – Science Labs
Science Pool offers ScienceLabs in Vienna-Simmering, designed for kindergarten groups, after-school care groups, and school classes. These 2–4-hour workshops allow children and students to explore and understand scientific phenomena through hands-on experiments

https://www.sciencepool.org/

Wissens.wert.welt – Kidsmobil Workshop
Thewissens.wert.weltinKlagenfurtoffersKidsmobil mobile workshops that travel directly to school classes throughout Carinthia. Topics such as "Stone Age," "How Moving Pictures Came to Be," and "Energy & Climate" are presented interactively and age-appropriately.

https://wissenswertwelt.at/

Graz Linux Days – Open Source Software & Hardware Workshops
TheGraz LinuxDays isanannualevent focusedon open-source software and hardware. In addition to lectures, numerous hands-on workshops are offered where participants can gain practical experience in Linux, programming, and network security.

https://www.linuxtage.at/de/

Engineering For Kids – Austria Programs
Engineering For Kids offers engaging workshops and camps in Vienna designed to introduce children aged 4 to 14 to the fields of engineering and technology. Through hands-on activities, participants explore concepts in robotics, aerospace, civil engineering, and more, fostering creativity and problem-solving skills.

https://www.engineeringforkids.com/international-locations/austria/

STEAM-Connect – Transdisciplinary Workshops
TheSTEAM-Connectproject aims to bridge disciplines by connecting teachers, parents, artists, educators, and researchers to develop innovative transdisciplinary workshops. These workshops focus on collaborative STEAM teaching and learning, utilizing digital tools and creative pedagogies to enhance education for secondary school students.

https://experienceworkshop.org/steam-connect-erasmus/

A STEAM Practice Approach to Integrate Architecture, Culture and History

This project enhances mathematics learning through architectural modeling while incorporating culture and history.

https://www.mdpi.com/2227-7102/12/1/9

EMIC-STEAM – Ecological Making in Intercultural Cooperation through STEAM

The EMIC-STEAM project aims to empower students to actively participate in shaping a sustainable future through ecological maker projects in intercultural cooperation. Creative projects on socio-ecological challenges are developed and international cooperation is promoted.

https://englisch.ph-weingarten.de/forschung/laufende-forschungsprojekte/emic-steam/

Existing quality resources that are ready to use in Hungary

Cabbage and the Life Cycle of the Cabbage Butterfly

An eco-tale titled “Miracle in the Garden” is explored using the STEAM methodology. Students create the story’s settings using a digital design program and make the scenes interactive by programming MicroBits. https://tka.hu/tudastar/dm/733/egy-kerti-csoda-kodolasa

BelmontaSmARtCity

Students design and build a smart city.

https://tka.hu/tudastar/dm/451/belmont-a-smart-city-okos-varos-ahol-a-bitekbol-atomok-leszn ek **Apple Tower**

~~The goal is forstudents to build a freestanding tower as tall as possible. The challenge: the t~~op of ~~the~~ towermust be able to support an apple. https://oraterv.hu/almatorony/ **Digital**

Exploration of Hungary’s Major Regions Students learn about the regions of Hungary by

creating digital pictures, and games https://tka.hu/tudastar/dm/743/digitalis-barangolasok-hazank-nagytajain

In Search of Bird Tales

Students explore Judit Berg's novel The Secret of the Four Birds through an experience-based project method. They then create board games using Bee-Bot and Blue-Bot floor robots, incorporating images with QR codes. https://tka.hu/tudastar/dm/742/madarmesek-nyomaban

"Ourhome.com"

Students found their first start-up company. The goal of the company is to design, build and sell smarthomes to customers. https://tka.hu/tudastar/dm/466/az-elso-start-up-cegunk-miotthonunk-com-vallalkozoi-kompete nciak-es-kezdemenyezokeszseg-komplex-fejlesztese-produktiv-tartalmak-eloallitasaval/addTo Fav

Leonardo the first STE@M Maker

Students learn about Leonardo de Vinci's era through coding, 3D and VR design https://tka.hu/tudastar/dm/535/leonardo-da-vinci-az-elso-ste-m-maker

Event Reconstruction

Students create the scenes of an event, order it according to the timeline.

https://hdidakt.hu/wp-content/uploads/2023/08/Mintafeladatok_Story21.pdf

"Tickets, please!"

Students design and create a ticket stamper robot.

https://hdidakt.hu/uj-spike-feladatsorok/

The Physics of Music

Students design and create their own musical instruments and investigate the physical properties of sounds

https://fizikaiszemle.elft.hu/uploads/2024/05/02_olahe-stonawskit_10_37_28_1714984648.7364.pdf

Wind turbine

Build a working wind turbine out of everyday materials that can lift a teabag in one minute or less. https://tryengineering.org/resource/lesson-plan/working-wind-energy/#toolkit

Transistor Power: Night Light Challenge

Students learn the necessity of transistors and their functionality while engaging in a hands-on project to design a night light. https://tryengineering.org/resource/lesson-plan/transistor-power-night-light-challenge/

Designing and Producing a Custom ID Tag
Using vector-based graphic designsoftware and an Epilog Laser cutter/engraver, students will learn to design and produce their very own custom backpack/luggage tag.

https://tryengineering.org/resource/lesson-plan/laser-creations-designing-and-producing-a-custom-id-tag/

Existing quality resources that are ready to use in Italy

ScienzaPerTutti

Onlineinteractive resources and experiments for STEM education.

http://scienzapertutti.infn.it/

Coding in Your Classroom, Now!

A structured coding curriculum for teachers and students.

http://programmailfuturo.it/

Scuola di robotica

Roboticseducationthrough hands-on workshops.

http://scuoladirobotica.it

Explora - Museo dei Bambini di Roma

Interactive STEAM workshops for kids.

mdbr.it

Città della scienza

Sciencemuseumwith educational programs.

http://cittadellascienza.it

FabLab Kids

Makeractivities for young learners.

http://fablabforkids.it

Orto Botanico di Roma

Outdooreducationactivities focused on biodiversity.

http://ortobotanicodiroma.it

Bricks4kidz®

TeachingSTEAM with Lego® bricks.

https://www.bricks4kidz.it/

Existing quality resources that are ready to use in Latvia

Robotics: STEAM toolkit instructions in latvian
Instructions and the latest teachingmaterials forusing STEAM tools to help you get started. Below you will find ideas for educational activities from teachers in Latvia and Estonia, as well as from manufacturers and Insplay. All available materials are in Latvian.

https://www.insplay.lv/materiali

What swims? What sinks?
Asimple activitywithabingo-type worksheet that let's experiment with different nature elements to discover which of them sinks, but which floats.

https://macibumateriali.lv/product/steam-eksperiments-kas-peld-kas-grimst/

STEAM Activities in Preschool Throughout the Year

AmanualofSTEAMactivitiesthatcanbeusedinpreschool

https://www.manamarite.lv/wp-content/uploads/2022/03/STEAM-gramata27PII-pieredze-1.pdf

Roboschool
The first STEAM education, innovation, science, and technology center in Latvia. The center will offer an innovative and practical approach to learning, aiming to develop students' creativity, critical thinking, and problem-solving skills. It will provide access to modern learning tools and technologies for hands-on learning and real project development.

It will be a place for students to experiment, collaborate, and explore topics from robotics and programming to combining art and design with technology. This is a step toward future education that prepares the new generation for challenges and opportunities in the era of global innovation.

https://roboskola.lv/steam-centrs/

RTU SZTS
RTUInternational School of Science and Technology is licensed as a Cambridge International School. It offers education from grades 10 to 12 in accordance with the high school curriculum of the Republic of Latvia.

https://isst.rtu.lv/lv/

Futurimo Curiosity Center
RTU sciencecuriosity center where visitors of all ages can learn how the world works, the laws of science, and how engineering and technology improve human life today and in the future. The center aims to spark children's interest in engineering and help them connect it to future careers.

https://futurimo.lv/

Space Exploration Center
The main goal of the Space Exploration Center is to promote children's interest in science, engineering, technology, and mathematics, explain the relevance of these fields, and present them through the lens of space.

https://kosmosacentrs.lv/

Daugavpils Innovation Center
The Daugavpils Innovation Center is a competence-based educational institution that promotes the development of knowledge, skills, and career choices in STEM and entrepreneurship. It offers interactive exhibitions, lessons, and events that help visitors understand subjects like physics, chemistry, and biology in an engaging and simple way, making it easier to comprehend global processes. A better understanding of the world enables people to achieve more and live more meaningfully and happily.

https://dic.daugavpils.lv/iepazisti/par-mums/

Science and Education Innovation Centre of the Liepāja Education Department
The Science and Education Innovation Center (ZIIC) offers an interactive exhibition with more than 20 exhibits. The Nature House is one of its locations where students, teachers, families, and other visitors can explore natural processes in a fun and engaging way.

https://ziic.liepaja.edu.lv/izglitibas-iestadem/metodiskie-materiali/

VIZIUM
The mission of the Ventspils Science Center VIZIUM is to educate children and youth about STEM—science, technology, engineering, and mathematics—through exhibitions, creative workshops, and science shows.
https://vizium.lv/

Digital Skills Center

The "Digital Skills Center" is a professional continuing education institution and a structural unit of SIA Steam Education, which provides professional development and lifelong learning courses for adults.

https://www.dpc.lv/?fbclid=IwY2xjawIb65VleHRuA2FlbQIxMAABHTo3C051CrhE9pbS19PVK58X0mSaW73uo9TfWqLVWana-ULzMSVSSbEWkQ_aem_6L94njREe8ClqQO8DYfQOA

Innovation School

Our goal is to promote creativity, critical thinking, problem-solving skills, and innovation among children, while applying concepts related to science, technology, engineering, arts, and mathematics. Overall, STEAM learning helps students—children—develop a wide range of

skills needed for 21st-century education and the labor market. This approach motivates children and teenagers to create meaningful projects.

https://inovacijuskola.lv/par-mums/steam-metode/

Riga Tech Girls

We want to support and empower everyone to learn, grow and innovate in a safe environment for all. RTG is an inclusive COMMUNITY EMPOWERING through TECH, promoting DIVERSITY ang challenging stereotypes for a BETTER FUTURE. Women and girls are less represented and willing to join the technical professions because of society stereotypes, lack of role models and inclusive policies. Positive discrimination and inclusive programs can provide these opportunities.

https://rigatechgirls.com/

Baltic Computer Academy

The Baltic Computer Academy is one of the largest accredited training centers in Latvia. We offer accredited professional development education programs totaling 160 academic hours. These are courses aimed at improving digital skills for adults.https://www.bda.lv/

Existingquality resources that are ready to use in Romania

Digityouth

Digeya Tools Platform:

https://digeya.com/platform/

Digital Toolkits

Digital Tools Platform:

https://digityouth.com/listing-page.html

Digital Toolkits

Educational Platforms

https://linktr.ee/CPDIS

Boostingentrepreneurship

Educational Platforms

ENT-YOUTH.EU

Social Buzz

Educational Platforms

SBUZZ.EU

It's all in the game

Booklet educational games

https://itsallinthegamepuduri.wordpress.com/games/booklet/

It's all in thegame
Competences Board Game List
https://itsallinthegamepuduri.wordpress.com/wp-content/uploads/2015/10/booklet2.pdf

Compass Human Rights
Platform Compass with activities for educators
https://www.coe.int/en/web/compass/migration

Compass Human Rights
Complete Manual Compass platform with activities for educators
https://rm.coe.int/compass-2023-eng-final-web/1680af992c

Flower PowerBooklet
Flower Power - human and nature
https://www.canva.com/design/DAF5BV9NQfw/diR-5bUA2corZ2_KSr2h1A/view?utm_content=DAF5BV9NQfw&utm_campaign=designshare&utm_medium=link&utm_source=editor

Restart For Art - Music and Art
Restart For Art - Virtual Exibition, Music Catalogue, Cultural Examples, Art tools
https://restartforart.com/

Digit Youth Booklet
Digital Educational Platforms - to increase their digital skills and offer a digital toolbox of application for youth work
https://digityouth.com/?i=1

Urban Green booklet
Booklet Environment Sustainability
https://www.canva.com/design/DAFccp5aCOk/unhiCSmvUcUIpNw0C1sczg/view?utm_content=DAFccp5aCOk&utm_campaign=designshare&utm_medium=link&utm_source=editor

Folk Engagement
Folk Engagement Booklet methods
https://www.canva.com/design/DAFxgeVafmI/TaHk8PzbvyYrR9QQZuM2-w/view?utm_content=DAFxgeVafmI&utm_campaign=designshare&utm_medium=link&utm_source=editor

eNEET
eLEARNING and collaborative platform
https://eneet-project.eu/wp-content/uploads/2021/02/NEWSLETTER_VIII_December_2020.pdf

OEL 4 ADU

OutdoorExperiencial Learning - adults

~~https://www.canva.com/design/DAE9qzlqJSM/9_dJkfarERzzGh6i9ckAmw/view?utm_content=DAE9qzlqJSM&utm_campaign=designshare&utm_medium=link&utm_source=publishsharelink#35~~

Skills for new horizons

Skillsfornewhorizons - youtube educational videos

Existing quality resources that are ready to use in Turkey

An article about a STEAM Project

Thisproject is agreat example of STEAM education for primary school students in Turkey. It focuses on teaching students about simple electric circuits. The project includes four fun activities that help students learn by doing. For teachers, this project shows how STEAM subjects work together in real life. Teachers can see how students become more interested in learning. They also learn to work in groups and think critically. This project is a useful guide for teachers who want to use STEAM methods in their classrooms.

https://drive.google.com/file/d/1Xty6DXhuYOM_DDGTt9S2IJF8IZ_joYYT/view?usp=drive_link

Cyber Arcade: Programming and Making with micro:bit

This is a fun and creative course for children aged 9 to 14. Using a small computer called Micro:bit and free coding software, students learn basic computer science and hands-on making. They work together to create interactive arcade games, learning about problem-solving, teamwork, and different subjects like engineering, art, and game design.

https://makered.org/resources/cyber-arcade-programming-and-making-with-microbit/

A sample STEAM scenario

AScenarioabout"DetectingInefficient Street Lighting"

https://drive.google.com/file/d/1trEPirULOMYxLc2kDLuk11dFx2eJIXOK/view?usp=drive_link

A STEAM Project idea

It is an activity about building fizz inflator to reinforce STEAM learning

https://sciencebob.com/build-a-fizz-inflator/

A research about STEAM Implementation

Itis a research aboutaSTEAMimplementation about nutrition. It also includes lesson plan about nutrition.

https://drive.google.com/file/d/1lmObbp17wwYqqagba4UhQRvPn4-ARp28/view?usp=drive_link

The BISS

It is an International STEAM School.

https://www.biss.k12.tr/

EDUSIMSTEAM

ItisanErasmusProject about STEAM education carried out by the Turkish Education Ministry. You can find info, scenarios and interactive tools about STEAM.

https://edusimsteam.eba.gov.tr/

A Space Camp Itisaspacecamp based in İzmir. It organizes STEAM activities for students.

https://www.spacecampturkey.com/steam-egitimi-nedir

Sigma STEAM Club Competition

ItisaSTEAMProjectCompetitionfor primary secondary and high school students

https://cekirgeler.com/yarismalar/sigma-steam-club/

DENEYAP Workshops

It isan organizationbased in different cities and provides coding, robotics, AI and STEAM workshops and trainings for students. It is founded by the Department of Trade and industry. It also organizes competitions in these fields.

https://www.deneyap.org/tr/

TÜBİTAK

TÜBİTAK is the Scientific and Technological Research Council of Turkey. It supports education in science, technology, engineering, arts, and mathematics (STEAM). TÜBİTAK organizes workshops and programs to help teachers learn new STEAM methods. It also supports science fairs in schools. These fairs encourage students to create projects in STEAM fields.

https://tubitak.gov.tr/tr

STEAM Education Applications

Itisa video describing STEAMeducation and its benefits for students. It provides a STEAM lesson plan about global connections. Solving real Life problems.

https://www.youtube.com/watch?v=VjklXMITCJo&t=501s

Inexplosive Balloon

Itisavideodescribing a STEAM activity about Inexplosive Balloon for Pre-primary students.

https://www.youtube.com/watch?v=WdY4SuENG30

SECTION III: Integration of Inclusion, Creativity and Entrepreneurship into STEAM approach

Introduction

The modernworld is changing fast, and education must keep up. It is not enough to teach only facts and formulas. Students today need a wide set of skills to succeed in life and work. The STEAM approach—Science, Technology, Engineering, Arts, and Mathematics—helps students develop skills like critical thinking, collaboration, and innovation. However, to make STEAM even more powerful, we should include values such as **inclusion**, **creativity**, and **entrepreneurship**.

Inclusion means making sure that every learner, no matter their background, ability, gender, or language, can take part and succeed. Inclusive STEAM classrooms use different teaching strategies, group work, and tools to support all learners. When students feel safe and respected, they are more motivated and confident. Inclusive learning also teaches important social values, like respect and teamwork.

Creativity is essential for innovation. In the STEAM approach, creativity is not only part of the "Arts"—it is present in every subject. Creative thinking allows students to explore different solutions, ask questions, and express their ideas in new ways. STEAM projects that encourage imagination can make learning more enjoyable and help students discover their strengths.

Entrepreneurship helps students learn how to turn their ideas into real solutions. It teaches them how to take risks, solve problems, and work as a team. When students build their own projects or mini-businesses, they learn leadership, responsibility, and how to create value in society.

Bringing inclusion, creativity, and entrepreneurship into the STEAM approach builds a more complete education. It prepares students for future jobs and active participation in their communities. In this chapter, we will explore how teachers and schools can combine these ideasto build stronger, more inspiring learning environments for everyone.

The Practical Application and Importance of STEAM

ConnectingSTEAMtoOtherSubjects

STEAM education focuses on real-world learning. It connects different subjects and helps students solve problems by using knowledge from science, technology, engineering, arts, and mathematics. For example, students might build a model bridge to learn about engineering, or create a climate change video to combine science, art, and technology. In this way, students don’t just learn theory—they **apply what they learn** in projects that have meaning and purpose. These practical tasks help learners develop important life skills like teamwork, creativity, and decision-making.

Many schools also include digital tools such as robots, 3D printers, or coding software in STEAM projects. This allows students to use modern technology and become more confident in digital environments. These experiences can also inspire them to choose careers in growing fields like IT, environmental science, or design.

Why Is STEAM Important?

STEAM is important because it prepares students for the 21st-century world. Today's jobs often require more than one skill—people must think critically, solve problems, communicate clearly, and be creative. STEAM helps students develop these skills by encouraging **active learning** and **interdisciplinary thinking**.

STEAM also helps students become more engaged in school. When they see how subjects are connected and used in real life, they become more interested and motivated. This approach helps all types of learners succeed, including those who may struggle in traditional learning environments.

How Is STEAM Related to Non-STEAM Subjects?

STEAM is not separate from other school subjects—it can work **together with areas like** . For example, students can use math to analyze

hhiisstt oorr iyc,a lla d**nagtu**a,**a** o**gre** Theartsalsohelpstud**nd s ocial st udies**

,creaateasciencepresentationusingstorytellingtechniquesfromliterature. ents express complex scientific ideas in creative ways, such as posters, plays, or animations.

In this way, STEAM helps make learning deeper, more connected, and more meaningful.

Benefits of STEAM for Students

STEAM education gives students more than just knowledge—it helps them grow as confident, independent thinkers. One of the biggest benefits of STEAM is that it **encourages curiosity**. Instead of simply following instructions, students ask questions, test ideas, and explore new ways to solve problems.

Another important benefit is **collaboration**. Many STEAM tasks are done in small groups, which helps students practice working with others, sharing ideas, and listening to different opinions. These skills are useful both in school and in future jobs.

STEAM also supports **creative thinking**. Students learn that there is often more than one solution to a problem. This mindset helps them become more flexible and open-minded. For some students, especially those who do not enjoy traditional subjects, STEAM can make learning more fun and relevant.

STEAM is also helpful for building **self-confidence**. When students complete a project they designed themselves—like building a robot, creating a website, or presenting a solution to a local issue—they feel proud of their work.

Examples of Inclusive STEAM Projects

Inclusive STEAM projects are designed so **every student can take part**, no matter their background, learning style, or ability. Here areafewexamples:

- **Design a Smart Garden**: Students work in teams to design a garden that uses sensors to water plants. This includes science (plant growth), technology (sensors), and art (garden design). Roles can be adapted for different skill levels. ● **Build a Story Robot**: Younger students build simple robots that tell a story. This combines programming with language and art and allows students with different strengths to contribute.
- **Local Problem-Solving**: Students identify a problem in their community (like waste or safety), research it, and present a solution. They can build models, write reports, or create videos.

Thesetypes of projectspromote **equal participation**, support diverse learners, and connect learningto the real world.

Benefits of STEAM for Teachers

STEAM education not only helps students—it also offers many **advantages for teachers**. One of the biggest benefits is that STEAM allows teachers to be more creative in their work. Instead of teaching each subject separately, they can create **interdisciplinary lessons** that connect science, art, and other areas in interesting ways. This makes teaching more dynamic and enjoyable.

STEAM also supports **collaboration between teachers**. For example, a science teacher might work with an art or technology teacher on a joint project. This teamwork helps teachers share ideas, learn new methods, and feel more connected as professionals.

Another advantage is that STEAM encourages **student-centered learning**. Teachers can take the role of facilitators or guides, while students take more responsibility for their own learning. This can lead to a more engaging classroom environment, where students are more motivated and active.

STEAM also helps teachers reach a **wider range of learners**. Because STEAM includes hands-on activities, creative thinking, and real-world tasks, it can support students with different learning styles. Teachers can use STEAM to include visual learners, kinesthetic learners, and students with special needs.

In addition, STEAM projects can improve **classroom management**. When students are interested in their work and have clear goals, they are often more focused and cooperative. Group projects also build stronger relationships among students, which leads to a better classroom atmosphere.

Finally, STEAM helps teachers **prepare students for the future**. By teaching important skills like critical thinking, communication, and problem-solving, teachers play an essential role in

shaping tomorrow's innovators, workers, and leaders. Knowing this gives many teachers a deeper sense of purpose and satisfaction in their job.

Connection to ICE (Inclusion, Creativity and Entrepreneurship)

Relation todifferent levelsof education

~~The shift from STEM (Science, Technolo~~gy, Engineering and Mathematics) to STEAM (Science, Technology, Engineering, Arts and Mathematics) marks a significant evolution in educational philosophy and practice. This change places creativity and innovation at the core of scientific and technological learning. Originally introduced by the U.S. National Science Foundation (NSF) in 2001, STEM education was developed to promote science and technology careers and support economic growth and social mobility. However, educators and researchers soon identified a critical gap: the absence of the humanistic and artistic dimensions necessary to cultivate well-rounded, adaptive and emotionally intelligent learners. This insight led to the inclusion of the "A" for Arts, encompassing not only visual and performing arts but also humanities and design thinking, enhancing students' creativity, critical thinking and interdisciplinary problem-solving capabilities. Today, STEAM education is a global phenomenon, influencing educational policies and pedagogies from the United States to Europe, Asia and Australia. It emphasizes inquiry-based learning, hands-on experimentation and creative engagement in science and technology, fostering essential 21st-century skills. Research consistently underscores the importance of creativity in STEAM learning, highlighting its role in enhancing student motivation, problem-solving, adaptability and collaboration. STEAM education not only deepens scientific understanding but also nurtures competencies such as innovation, self-efficacy and the ability to work across disciplines. At the European level, recent policies and initiatives have emphasized the reform of STEM education to incorporate more inclusive and interdisciplinary approaches. The European Commission has underscored the need for curricula that better align with societal needs and labor market demands, particularly in light of the digital and green transitions. Projects such as the SENSE initiative aim to create a flexible roadmap for integrating STEAM education with real-world applications, ensuring learners are equipped with both creative and technical skills for the future workforce. Teachers play a pivotal role in this transformation. Their capacity to cultivate creative classroom environments, model inquiry-based learning and support collaborative exploration directly impacts student outcomes. Research published in *Frontiers in Education* emphasizes that fostering a creative environment significantly enhances student competencies, while other studies point to the importance of arts in helping learners visualize, design and communicate complex ideas. As STEAM education continues to evolve, its relevance expands beyond traditional classrooms into broader societal contexts—supporting entrepreneurship, sustainability and social innovation. By combining scientific literacy with creativity and problem-solving, STEAM prepares learners to thrive in a rapidly changing and interconnected world.

The added value of STEAM becomes evident when analyzing its impact across different educational levels, where it adapts to specific goals and learner profiles. In general and school education, STEAM nurtures curiosity, critical thinking and engagement from an early age, while also contributing to foundational knowledge and values essential to lifelong learning. The European Commission's *Key Competences for Lifelong Learning* framework highlights creativity, digital competence and entrepreneurial thinking as core goals of education. Through interdisciplinary projects and active learning, STEAM enables students to explore problems from multiple perspectives and apply knowledge in meaningful ways. Research by Conradty and Bogner (2018) confirms that integrating arts into science and technology curricula boosts students' motivation and knowledge transfer. The European Schoolnet's *Scientix* project also supports teachers with resources to embed STEAM in their practices, promoting inclusive and innovative teaching across general education pathways. In Vocational Education and Training (VET), both initial and continuous, STEAM equips learners with technical and transversal skills needed in today's dynamic labor markets. The European Centre for the Development of Vocational Training (Cedefop) emphasizes creativity and entrepreneurship as essential for VET learners. The New Skills Agenda for Europe reinforces the importance of STEAM in supporting digitalization and the green transition, enabling students to engage in real-world problem- solving and innovation. Integrating design thinking and interdisciplinary approaches into VET curricula also helps prepare learners for future job roles that demand both technical expertise and creative capacity. In adult education, STEAM supports lifelong learning by offering upskilling and reskilling pathways. According to the Erasmus+ Programme Guide, adult education refers to non-vocational learning opportunities that foster personal development and social inclusion. The *European Agenda for Adult Learning* stresses the importance of access to high-quality learning experiences, particularly for older or marginalized learners. STEAM programs targeting adults often focus on experiential learning and practical applications of science and technology. Initiatives like *STEAMonEdu* help educators develop creative digital teaching methods, while the EU's former *Grundtvig* programme demonstrated how STEAM can address the needs of ageing populations and promote inclusive education. In non-formal education, STEAM creates flexible, engaging, and often community-based learning opportunities. UNESCO defines non-formal education as structured, intentional learning outside traditional institutions. This sector is crucial for reaching learners excluded from formal systems. The *European Youth Strategy (2019–2027)* prioritizes creativity, digital competence and entrepreneurial thinking in youth work and non-formal education. Programs like *DOIT* empower young people to tackle local and global challenges using STEAM tools and methods. Projects such as *STEAM Builders* offer inclusive, project-based learning that connects learners to real- world innovation and fosters social entrepreneurship. The STEAM framework is thus not only an academic model but also a vehicle for promoting three interrelated pillars of modern education: Inclusion, Creativity and Entrepreneurship (ICE). These three dimensions are fundamental in shaping a responsive, participatory and future-ready learning environment.

Indeed, inclusion in STEAM ensures that all learners—regardless of background, ability, or learning style—have access to meaningful and relevant education. This is achieved through Universal Design for Learning (UDL) principles, differentiated instruction and the integration of culturally responsive pedagogies. Inclusive STEAM education breaks down barriers and creates equitable opportunities for all learners to thrive, particularly in underserved or marginalized communities.

Creativity lies at the heart of STEAM and is not merely an artistic add-on but a core engine for innovation and problem-solving. The shift from STEM to STEAM was rooted in the recognition that complex societal and technological challenges require imaginative thinking. STEAM encourages learners to think divergently, to make connections across disciplines and to co-create solutions that are both functional and meaningful.

Entrepreneurship in the context of STEAM transcends business creation—it involves developing a mindset that embraces initiative, risk-taking, resilience and collaboration. STEAM-based entrepreneurship empowers learners to turn ideas into action, apply knowledge to real-world contexts, and create social, cultural, or economic value. Educational initiatives such as the *EntreComp* framework by the European Commission illustrate how entrepreneurial competence can be cultivated alongside scientific and creative skills.

Why Does Creativity Matter in STEAM Subjects?

The Role of Creativity in Science, Technology, Engineering, Arts, and Mathematics

Introduction

Creativity is essential for innovation in STEAM subjects (Science, Technology, Engineering, Arts, and Mathematics). It enables problem-solving, the development of new ideas, and the simplification of complex concepts (Robinson, 2011).

In **vocational education and training (VET)**, creativity is particularly crucial. Employers seek professionals who not only have technical knowledge but also demonstrate flexibility, problem-solving abilities, and innovative thinking (Henriksen, Mishra, & Mehta, 2015). This chapter explores how **Design Thinking, Theatre and Visual Techniques, and Computational Thinking** can be integrated into vocational education to enhance creativity and practical problem-solving.

1. Design Thinking in STEAM

What is Design Thinking?

Design Thinking is a **creative problem-solvingapproach** that emphasizes **experimentation, prototyping, and user-centered solutions** (Brown, 2009).

Why is Design Thinking Important in VET?

In vocational education, Design Thinking helps students develop **practicaland innovative solutions** to real-world challenges. It is widely used in fields such as **mechanical engineering, product design, and architecture** (Razzouk & Shute, 2012). **VET Examples of Design Thinking**

- **Product Design:** Students create sustainable packaging by testing different materials.
- **Engineering:** Technicians use 3D printers to develop **prototypes for new machine components**.
- **Fashion and Textile Industry:** Learners combine **art and technology** to design clothing using innovative materials.

Design Thinking fosters **collaboration, critical thinking, and creativity**, all essential skills for modern careers.

2. Theatre and Visual Techniques in STEAM How Do Theatre and Visual Techniques Support Learning?

Theatre and visual methods make abstract STEAM concepts **more engaging and understandable** (Nicholson, 2005). These techniques are particularly beneficial for careers that require **communication, presentation, and interpersonal skills** (Egan, 2005).

Why Are Theatre Methods Useful in VET?

- **Enhancing presentation and sales skills** (Fleming, 2013).
- **Developing teamwork and customer communication skills**.
- **Increasing confidence in public speaking and professional interactions**.

VET Examples of Theatre and Visual Techniques

- **Healthcare andSocial Professions:** Studentsparticipate in role-playing exercises to improve **patientcommunicationandempathy** .
- **Sales and Customer Service:** Role-playing is used to practice **effective customer interactionsand negotiations** .
- **Craft and Design Professions:** Apprentices use 3D modeling and digital sketching to visualize architectural and industrial designs.

By integrating theatre and visual methods, vocational learners can develop **effective communication and presentation skills**.

3. Computational Thinking in STEAM

What is Computational Thinking?

Computational Thinking involves breaking down problems into **logical steps and developing algorithmic solutions** (Wing, 2006). This skill is particularly important in technical professions. **Why is Computational Thinking Important in VET?**

- **Encourages structured problem-solving and logical reasoning** (Grover & Pea, 2013).
- **Supports the automation of work processes**.
- **Isacore skill in IT, mechatronics, and electrical engineering** (Brennan & Resnick, 2012).

VET Examples of Computational Thinking

- **IT and Software Development:** Students develop **a mobile app for managing customer data**.
- **Robotics and Mechatronics:** Learners design **a robot to optimize industrial production lines**.
- **Generative Artand3DModeling:** Computer programs are used to **create complex digital designs**.

Computational Thinking connects **logical analysis with creative problem-solving** and is essential for the digital workforce.

4. Creativity as a Key to Success in Vocational Education

Why DoVET Learners NeedCreative STEAM Methods?

- They make**abstractconcepts moreaccessible** (Robinson, 2011).
- They develop**problem-solving skills** (Henriksen et al.,2015).
- They enhance **teamworkand innovation** in workplaces(Brown, 2009).

How CanVETEducatorsPromote Creativity?

1. **Project-BasedLearning:** Engaging students in real-world problems fosters creative thinking.
2. **Open-EndedChallenges:** Encouraging students to develop their own solutions.
3. **Collaboration:** Encouraging teamwork and interdisciplinary projects.
4. **UseofDigitalandVisualTools:** Implementing simulations, computer-aided designs, and interactive models.

Conclusion: Creativity is Essential for Vocational STEAM Education

Creativity is a **fundamental skill for the future workforce**. It bridges **technology, science, and art**, enabling learners to develop innovative solutions for real-world challenges.

Key Takeaways:

- **Design Thinking** promotes creative problem-solving in technical and artistic fields.
- **Theatre and Visual Techniques** improve communication and presentation skills.
- **Computational Thinking** enhances logical reasoning and digital competencies.
- Creativity in STEAM education strengthens **employability in modern industries**.

Why DoesSTEAM Matterin Entrepreneurship?

STEAM(Science, Technology, Engineering,Arts, andMathematics) plays a crucial role in **entrepreneurship**by fostering **criticalthinking, leadership,teamwork,andindividual innovation**. Entrepreneurs need a combination of analytical skills, creativity, and adaptability to **solveproblems, leadteams, anddriveinnovation** .

STEAM provides entrepreneurs with a **holistic skill set** , balancing **technical knowledge, creativity, leadership, and adaptability** . Whether working as a **team player or an independent innovator** , understanding STEAM principles helps **turn ideas into reality, solve real-world problems, and drive sustainable business growth**.

1. Critical Thinking & Problem-Solving

- Entrepreneurs face complex challenges that require **logical analysis and innovative solutions**.
- STEAM disciplines encourage **data-driven decision-making** and the ability to **evaluate risks and opportunities**.
- Example: A startup founder uses **engineering principles** to improve product design while applying **mathematical models**to optimize business costs.

2. Leadership & Vision

- A successful entrepreneur needs to **inspire a team, make strategic decisions, and driveinnovation** .
- STEAM fosters **future-orientedthinking** , essential for **market disruption and technologicaladvancements** .
- Example: Elon Musk’s leadership in **engineering and technology**has transformed multiple industries (Tesla, SpaceX).

3. Teamwork & Collaboration

- Entrepreneurship thrives on **interdisciplinaryteamwork** , much like STEAM projects, where professionals from different fields **collaboratetoinnovate** .

- Effective **communicationbetweenengineers,designers, and marketers** is crucial for product development and business success.
- Example: Tech startups blend **coding,design,and business strategy** to develop user-friendly apps and platforms.

4. Individual Innovation & Creativity

- STEAM empowers individuals to experiment, prototype, and think outside the box—a key entrepreneurial mindset.
- The Arts in STEAM bring in creativity, storytelling, and branding, which are essential for customer engagement and product differentiation.
- Example: A solo entrepreneur uses technology, design, and data analytics to create a new e-commerce brand.

STEAM + Entrepreneurship = Future Success

By mixing entrepreneurship with STEAM, young people learn to be creative, solve problems, and turn ideas into reality. Whether they want to invent a new gadget, start a tech company, or create a solution for climate change, the skills learned through STEAM will help them succeed!

- **Thinking Smart (Critical Thinking)**

  Imagine you want to invent a backpack that also charges your phone using solar energy. To make this work, you need to test ideas, understand how solar power works (Science), design a working system (Engineering), and make it easy to use (Art). STEAM teaches you how to think logically, experiment, and improve ideas—just like real entrepreneurs do!
- **Being a Leader**
  Think about a school project where you need to create an app for helping students organize homework. A leader makes sure everyone in the team has a task and that the project is finished on time. STEAM activities often involve group projects where students practice leading and organizing, just like in real businesses.
- **Working in a Team (Teamwork & Collaboration)**

  No business is built alone! Even famous entrepreneurs like Elon Musk and Steve Jobs had teams behind them. In a STEAM project, you might work with others to build a robot or design a website. Some people focus on coding (Technology), others on the design (Art), and someone else on the mechanics (Engineering). Working together and listening to different ideas makes projects better!

Working Alone & Adapting (Independent Work & Problem-Solving)

Entrepreneurs often have to solve problems on their own. Imagine youwant to start a small business making and selling 3D-printed toys. You have to learn how a 3Dprinter works, design the toys, and figure out how to sell them. STEAM teaches studentsto be independent, adapt to challenges, and not give up when things get hard.

Idea proposal for STEM VS STEAM to emphasize advantages

The debate between STEM (Science, Technology, Engineering, and Math) and liberal arts has been ongoing for years, with proponents on both sides presenting compelling arguments. Here's a balanced view of the debate:

STEM Arguments 1. *Job prospects and career stability*: STEM fields are often in high demand, offering better job prospects and career stability.

2. *Innovation and problem-solving*: STEM education fosters critical thinking, analytical skills, and creativity, leading to innovative solutions and technological advancements.

3. *Economic growth and competitiveness*: STEM fields drive economic growth, and countries with strong STEM education systems tend to be more competitive globally.

4. *Addressing real-world challenges*: STEM fields address pressing global issues like climate change, healthcare, and sustainable energy.

Liberal Arts Arguments

1. *Critical thinking and communication*: Liberal arts education emphasizes critical thinking, writing, and communication skills, which are valuable in many professions.

2. *Well-rounded education*: Liberal arts programs provide a broad-based education, exposing students to various subjects, including history, philosophy, languages, and social sciences. 3. *Cultural understanding and empathy*: Liberal arts education fosters cultural understanding, empathy, and tolerance, essential for a globalized world.

4. *Creativity and adaptability*: Liberal arts graduates are often adept at thinking creatively and adapting to new situations, making them valuable in a rapidly changing job market.

The Middle Ground

1. *Interdisciplinary approaches*: Many institutions now offer interdisciplinary programs that combine STEM and liberal arts, recognizing the value of both.

2. *Transferable skills*: Skills like critical thinking, problem-solving, and communication are transferable across disciplines, making graduates from both STEM and liberal arts programs valuable in various industries. 3. *Lifelong learning*: In today's fast-paced, ever-changing world, the ability to learn and adapt throughout one's life is crucial, regardless of the undergraduate major.

Ultimately, the choice between STEM and liberal arts depends on individual interests, strengths, and career goals. A well-rounded education that incorporates elements from both disciplines can provide a strong foundation for success in various fields.

STEAM and Inclusion

STEAM education—Science, Technology, Engineering, Arts, and Mathematics—helps students develop creativity, problem-solving, and critical thinking skills. To make STEAM fair for everyone, teachers must support students with different abilities, backgrounds, and learning styles (Quigley & Herro, 2016). Some students may have learning disabilities or face challenges with language, making it harder for them to understand lessons (Rose & Meyer, 2002). Teachers can use different strategies, such as visual aids, hands-on activities, and assistive technology, to help all students learn and feel included (Tomlinson, 2014).

Types of Learners

Every student learns in a different way. This means teachers need to use different methods and teaching styles to help all students understand STEAM subjects (Tomlinson, 2014).

- ***Visual Learners:*** These students understand ideas better when they see information in a clear way. So, a teacher can use pictures and diagrams in a science lesson to help them learn.
- ***Auditory Learners:*** These students understand better when they hear the teacher explain ideas or listen to discussions. Teachers can help them by using stories, recordings, and group conversations.
- ***Kinesthetic Learners:*** These students learn best by doing experiments, building models, and using their hands. In a STEAM class, they can learn by making a small bridge or mixing chemicals in a science experiment.
- ***Verbal learners:*** These stydents understand best by reading, writing, and speaking (Gardner, 1983). In a STEAM classroom, teachers can support them by using written instructions, group discussions, and storytelling to explain STEAM concepts (Tomlinson, 2014).
- ***Logical Learners:*** These students like to **solve problems and find patterns**. Teachers can help them by giving them problem-solving activities and logical games (Gardner, 1983).
- ***Social Learners:*** These students learn best when they talk, share ideas, and work in teams. In a STEAM class, they enjoy group projects like designing a robot with friends.
- ***Solitary Learners:*** These students prefer to **study alone**. They focus better when they work quietly by themselves. Teachers can help them by giving them self-paced tasks and private study time.

Presentation Skills

Good presentation skills help students share their STEAM projects in a clear and interesting way. Whether they are speaking to classmates, teachers, or a bigger audience, they need to explain their ideas well. Learning how to present builds confidence and helps students prepare for jobs in STEAM fields (Reynolds, 2012).

● Students should begin their presentation with an interesting fact, a question, or a short story about their topic. This will catch the audience's attention and make them interested in the presentation. ● Using simple words is important so that everyone can understand. Students should
explain difficult words clearly, broke complex ideas into small, easy parts.
- A good slide should have clear pictures, charts or videos and only a little text. Too much information on one slide can confuse the audience (Duarte, 2008).
- Students should speak clearly, confidently, loudly, and with different tones to keep people interested.
- Using body language like eye contact, hand movements, and smiling can make a presentation better and help students look confident and professional.
- Working in groups makes speaking easier. Each student can do a part and use their strong skills.
- Talking with the audience makes a presentation more interesting. Asking questions and listening helps make it like a conversation.
- Practice helps students feel better when they speak. Rehearsing and getting feedback helps them improve and feel confident.

Teachers should encourage students to think about their presentation skills and find ways to get better. Learning how to present well is an important skill that will help students in school and in their future jobs.

Communication Skills

Good communication skills help students share their ideas clearly in STEAM subjects. When they work in groups, give presentations, or write reports, they need to express their thoughts well (Garmston & Wellman, 2013). ***Listening*** is just as important as speaking. Students should listen carefully to their classmates, ask questions, and think about different ideas. Good listening helps students work together and build new ideas. ***Asking questions*** helps students learn better. When they ask questions, they can understand difficult topics more easily. Teachers should make the class a safe place to ask and share ideas. ***Writing skills*** are important for science and engineering projects. Students need to write reports, keep notes, and explain their ideas in a clear way. They should learn how to organize their writing so others can understand it easily. ***Body language*** also helps students communicate. Eye contact, hand movements, and a confident posture make presentations stronger. A smile or a small gesture can help explain an idea better.

Group discussions give students the chance to explain their thoughts and listen to others. By talking about their ideas, they can learn from their classmates and improve their speaking skills.

Respectful debates help students think carefully about problems. They should learn how to share their ideas politely and listen to different points of view.

Digital communication is very important for STEAM careers. Students should practice writing emails, making video presentations, and using online forums. Knowing how to use digital tools will help them in their future jobs.

Teachers should create a classroom where students feel comfortable speaking and sharing ideas. Giving positive feedback and encouraging open discussions will help students improve their communication skills.

Learning Barriers

Some students have difficulties learning STEAM subjects. These difficulties can be about thinking, feelings, social life, or the environment. These problems can make it hard for students to join lessons. The first step to helping them is to find these problems and create a classroom where every student can learn (Rose & Meyer, 2002).

- One common problem is *language*. Some students do not speak the lesson's language well. They may find it hard to understand science or math words. This can make them feel shy and stop them from talking in class. Teachers can help by using pictures, easy words, and friends to support them.
- Students with *disabilities*- like not hearing or seeing well- need special help. Students who cannot hear may need sign language or subtitles. Students who cannot see well may need special books or computer programs that read texts. Teachers can use different ways to teach so that all students can learn (Rose & Meyer, 2002).
- *Lack of confidence* is another problem. Some students do not feel confident in science or math. They think they are not good and do not try. Teachers should help them believe they can improve with practice. (Dweck, 2006).
- *Money problems* can make learning difficult for some students. They may not have a computer or internet at home. Schools can help by giving them time to use school computers or giving extra materials.
- *Stereotypes and bias* can stop some students from choosing STEAM subjects. Some students think that boys are better at math or that girls should not study engineering. Teachers can help by showing students examples of different people who are successful in STEAM (Bandura, 1997).
- Students also need *different ways to learn*. Some students do not like reading long texts. They may learn better with hands-on activities or games. Teachers should use different teaching methods, like experiments and videos, to help all students understand (Tomlinson, 2014).

- Some students have *emotional or behavior* problems. They may feel worried, have trouble paying attention, or find it hard to work with others. A friendly classroom and flexible lessons can help them feel comfortable.

Teaching students about effort and resilience can help them overcome difficulties. When students believe that hard work brings success, they do not give up easily. Teachers can help by giving positive feedback and celebrating students' efforts (Dweck, 2006).

Schools should create a welcoming and supportive place for learning. Every student should feel important and able to succeed. Programs with mentors, friends helping each other, and easy-to-use learning materials can help students enjoy STEAM subjects and do their best.

STEAM for Inclusion: Social aspects of Learning Disabilities & Language Barriers

STEAM is a hands-onlearning methodthatallows learnersofallagestoacquireregularitiesaswell as analytic and critical thinking skills through practice.

Sensory activities have been a tool for treating psychological difficulties for a while now. In this chapter you will discover how the STEAM method can be beneficial for inclusion, in particular,

learners with language barriers and learningdifficulties.

STEAM for Language Learning: A Project for All Ages

Thisproject explores the benefitsofintegrating STEAM (Science, Technology, Engineering, Art, and Math) into language learning, particularly for individuals with learning barriers and difficulties. We'll examine how STEAM's multi-sensory approach can enhance language acquisition and create a more inclusive learning environment.

STEAM as a Multi-Sensory Approach to Language Learning:

Traditional language learning often relies heavily on auditory and visual input. STEAM activities provide tactile, kinesthetic, and even olfactory experiences, creating deeper connections and improving memory retention. It strongly improves learning experience for those with dyslexia, ADHD, or other learning differences who may struggle with traditional methods.

Sensory Integration & Language: Throughout the centuries and generations hands-on learning has proved itself as efficient and beneficial in a sense that it provides a multidisciplinary approach in education through practical experience, thus improving learning outcomes.

- **Example**: Walk the itinerary, understand directions, explore objects around you, describe them, hear thesounds and feel the space around you.

Science & Language:

Exploring scientific concepts through hands-on experiments provides a context for language learning. Students can learn vocabulary related to scientific processes, tools, and observations. This is particularly beneficial for visual learners and those who learn from practical activities.Describing their observations using labels and drawings, is a way to develop language skills and vocabulary not only about scientific matters, but also equivalent real-life situations.

- **Example 1:** Conducting a simple experiment like growing plants while learning the names of plant parts, the process of photosynthesis, and related vocabulary in the target language. (Science&Language)
- **Example 2** :Research different animal habitats (Science) and then create a diorama (Art & Practical Life).

Technology & Language:
Technologyenhancedlanguagelearning (TELL) and Assistive Technology for Language Learning Disabilities(ATforLLD)dohavedifferent specifics and targets, however the overall goal is the same - to build engaging,motivationaland inclusive learning experiences for all students to support their individual needs.

TELL targetsalllanguagelearnersaiming to enhance their learning engagement and efficiency. A wide varietyoftechnologicaladvancements can be used-any technology used in language learning will suffice,thusimprovingthelearning experience for all students. Some tools to mention: Virtual reality (VR)orAugmentedreality(AR), language learning apps (Duolingo, Memrise, Quizlet, Quizziz),Interactivewhiteboards,online dictionaries, multimedia resources (audio, video, recordings) and manymore.

MeanwhileATforLLDtargetsmainly individuals with diagnosed language learning disabilities to accommodateandcompensateforlearning deficits. To facilitate these experiences, specific tools designedforlearningdisabilitiesarerequested to overcome specific learning barriers, such as Audiobooks,captioning/subtitles,speech-to-text or text-to-speech software.

Engineering & Language:
Engineeringprojectsencourageproblem-solving and collaboration, providing opportunities for students to communicateinthetargetlanguage. It goes beyond the acquired vocabulary and provides opportunitiestouseitinreallifesettings to solve real-life problems. Designing and building structures or machineswhileusingthetargetlanguage to discuss the process, materials, and challenges can enhance vocabulary and fluency.

- **Example:**Building a model bridge and describing the design, materials, and construction processinthe target language.

Art & Language:
Art provides a creative outlet for language expression. Drawing, painting, sculpting, and other art forms can be used to represent concepts, tell stories, and express emotions, all while using the target language. It particularly benefits learners who are more visual or kinesthetic or introverted or less language skills.

- **Example:** Create a collage to represent a chosen story in the target language or paint a picture and describeitin the target language.

Math & Language:
Math offers a structured context for language learning. Students can learn vocabulary related to numbers, shapes, measurements, and mathematical operations. Connecting math concepts to real-world situations can make learning more relevant and engaging.

- **Example 1:** Cooking: Measure ingredients for a recipe while learning the names of the ingredients and the units of measurement in the target language.
- **Example 2**: Build a miniature house, describe its materials, texture, colors, spatial aspects, dimensions etc.

Addressing Learning Barriers

STEAM's multi-sensory nature and focus on hands-on activities benefit particularly students with learning disabilities. The use of visual aids, manipulatives, and technology promote accessible and engaging learning methods.

- **Example 1:** Provide Text-to-speech software for students with dyslexia, use colors to
- highlight important details, and break down tasks into smaller steps.
  Example 2: For students with ADHD, beneficial would be movement and hands-on activities to improve their focus and engagement.

Although this differs quite strongly from traditional learning methods, the techniques recommended to students with learning neurodiversity can be beneficial for everyone in the classroom and build the overall experience more engaging and effective in the long term. Even if it seems not too time-efficient at first sight, such activities could be used in the long term to support diversity as the hands- on experiments and practical activities will differ with each student and group, therefore the long-term effect will be beneficial and more motivating also for educators.

EnterSTEAM Research – survey results

As part of the Erasmus+ funded EnterSTEAM project, we are researching the key characteristics and best practices of teaching STEAM—Science, Technology, Engineering, Arts, and Mathematics—across Europe. The project aims to support innovation in education and better prepare students for a changing world. One of its main goals is to create a methodological guide and a digital toolkit to help teachers apply STEAM in their classrooms more confidently and effectively.

In December 2024, a survey was conducted in six European countries: Austria, Hungary,

Italy, Latvia, Romania, and Türkiye. The survey assessed the awareness and application of the STEAM approach among educators and explored their perceptions of its impact—particularly in developing students' entrepreneurial skills, creativity, and inclusive attitudes. Teachers from various educational levels and school types responded, providing a diverse and valuable picture of how STEAM is being understood and used across Europe.

General Awareness and Understanding of STEAM

Teachers in the survey reported a moderate level of knowledge about STEAM. On a scale from 0 to 5, the average knowledge score was 3.0, suggesting that while many educators are aware of the approach, they often lack the experience or training needed to apply it effectively in their teaching. This highlights a clear need for more professional development, particularly in the form of practical training sessions, workshops, and examples of real-life applications.

Some educators said they were already using strategies that match STEAM principles, such as project-based learning, cross-curricular activities, and collaborative problem-solving. However, others said their schools follow a more traditional teaching model, and they feel unsure how to start implementing STEAM without extra support or guidance.

The Role and Value of Arts in STEAM

There was strong support for including Arts as an essential part of the STEAM model. Around 70% of teachers said the artistic and creative elements of STEAM were very important, while 30% considered them somewhat important. These responses confirm that almost all teachers value creativity and expression as important parts of student development.

Many educators noted that Arts help students understand complex ideas in science and

technology by allowing them to visualize, design, or build what they are learning. Including Arts also makes lessons more inclusive and motivating, especially for students who learn best through creative tasks rather than traditional academic work.

STEAM and Student Creativity

A major finding from the survey is that teachers believe STEAM greatly supports the development of student creativity. Over 90% of respondents said STEAM either strongly or moderately increases students' creative abilities. Teachers described how STEAM activities—such as designing solutions to real-world problems, building prototypes, or combining science with visual arts—help learners generate original ideas, think critically, and experiment with different approaches.

Educators also emphasized that creativity in STEAM is not just about making art. It is about

encouraging students to ask questions, take risks, and develop new ways of thinking. Many teachers said that STEAM projects give students freedom to explore and offer space to express themselves, which leads to greater ownership of their learning.

Several teachers also mentioned that creativity through STEAM can improve motivation,

focus, and self-confidence, especially for students who may not do well in traditional tests or lectures. One teacher wrote, "When students are allowed to be creative, they become more curious and willing to try. They are not afraid of making mistakes."

STEAM and Entrepreneurial Thinking

Another key focus of the survey was the connection between STEAM and entrepreneurship. Teachers were asked if they believe that the STEAM approach helps students develop entrepreneurial skills such as creativity, initiative, teamwork, and problem-solving. The average response was 4.0 out of 5, showing that most teachers believe STEAM supports the growth of entrepreneurial mindsets.

Many respondents explained that STEAM projects help students take ownership of their

learning in ways that are similar to entrepreneurship. For example, students often work in teams, identify real problems, brainstorm creative ideas, test their solutions, and present their results. These steps are similar to launching a small business or developing a startup idea.

Teachers also pointed out that students learn to communicate their ideas, listen to others, and adapt their plans—all key entrepreneurial traits. Some teachers said they would like more tools and lesson plans that help them link STEAM directly to entrepreneurship, including partnerships with local businesses or simulation activities.

STEAM and Inclusive Education

Another major area of interest in the survey was how STEAM relates to inclusive education. The average rating for STEAM's contribution to inclusion was 3.9 out of 5, suggesting that most teachers find the approach useful and supportive of all learners, regardless of their backgrounds, needs, or abilities.

Teachers reported that STEAM offers multiple ways to learn, including hands-on work, visual communication, and group discussion. This makes it easier to engage students with different learning styles and needs. For example, students with special educational needs (SEN) or language difficulties can participate more easily when tasks are not only based on reading or writing but involve building, drawing, or performing.

Educators also said that STEAM promotes collaboration and mutual respect, which are essential for creating an inclusive classroom. Team projects allow students to contribute in their own way, and they learn to value each other's strengths. One respondent commented, "STEAM helps all students find their voice. Some might lead with ideas, others with drawing, building, or explaining. Everyone has something to give."

However, teachers also noted challenges. Inclusive STEAM teaching requires adapted resources, extra time for planning, and sometimes support from teaching assistants. Some educators requested training focused on inclusion within STEAM and guidance on how to use universal design principles to reach all students effectively.

Student Engagement and Cross-Curricular Benefits

Most teachers agreed that STEAM greatly increases student engagement. In the survey, 61% of respondents said STEAM strongly boosts student interest and motivation, and 37% reported a moderate increase. These results confirm that STEAM can help make lessons more exciting, dynamic, and meaningful.

In terms of cross-subject benefits, the average response was 3.2 out of 5. Teachers said that STEAM encourages students to connect knowledge from different areas, such as applying math in science, or using technology to support creative expression. However, many noted that it can be difficult to organize cross-curricular projects without proper planning time and support from school leadership.

Teachers' Needs and Challenges

While most educators support STEAM and recognize its benefits, the survey also revealed several common needs and obstacles:

1. ***Professional Development***

- Many teachers reported that they have never had any formal STEAM training.
- They requested hands-on workshops, online courses, and easy-to-follow lesson examples.

2. Time and Curriculum Pressure

- Teachers said the national curriculum often leaves little room for innovation.
- They need more time for planning and collaboration.

3. Lack of Resources

- Schools often don't have enough materials, tools, or technology for STEAM.
- Teachers want affordable and reusable teaching materials that fit different learning contexts.

4. Collaboration Opportunities

- STEAM teaching often requires teamwork between teachers, but many schools don't have systems for joint planning or co-teaching.

- Teachers called for more team-teaching time, shared planning platforms, and cross-subject coordination.

Conclusion and Next Steps

The EnterSTEAM survey has provided valuable insight into how STEAM is being perceived and practiced in schools across six European countries. Teachers strongly support STEAM for its ability to promote creativity, entrepreneurship, and inclusive education, while also making learning more engaging and cross-disciplinary.

However, successful implementation still requires overcoming major challenges, including lack of training, limited resources, and structural constraints. Teachers are calling for clear guidance, practical tools, and supportive policies to make STEAM teaching sustainable and effective.

These findings will directly inform the next stages of the EnterSTEAM project, which will include:

- A methodological guide with clear strategies for integrating STEAM into daily teaching.

- A digital toolkit containing adaptable lesson plans, teacher training resources, and inclusion-friendly practices.

By addressing the real needs of teachers, the EnterSTEAM project aims to empower educators to bring creative, inclusive, and entrepreneurial STEAM learning into classrooms across Europe.

Conclusion

The*EnterSTEAM* guidebook shows how the STEAM approach—Science, Technology, Engineering, Arts, and Mathematics—can make a big difference in education. It is useful in both formal (school-based) and non-formal (community or lifelong learning) education. In our world today, where technology is growing fast and problems are becoming more complex, we need education that does more than just teach facts. STEAM helps students build important life skills —such as creativity, teamwork, communication, critical thinking, and entrepreneurial thinking. These are the skills students need for the jobs and challenges of the 21st century.

One of the most important ideas in this guidebook is that STEAM is more than just a way to teach. It is a way to include more learners and support diversity in education. When we include the arts in STEM subjects, we create new learning opportunities for more students. Arts help students express themselves, solve problems in creative ways, and understand difficult ideas more easily. With STEAM, learners from different backgrounds, languages, and abilities can all take part. This makes learning more fair, more fun, and more meaningful for everyone. STEAM also supports inclusion by using real-world projects, teamwork, and hands-on learning. These methods help students who may struggle in traditional lessons. For example, a student who has difficulty reading may shine when building a model or designing a creative solution. A student who speaks a different language may understand better through pictures or group work. With STEAM, all learners can contribute their strengths and feel proud of what they achieve. Inclusive education builds student confidence and helps them feel respected and valued. Another key point in this guidebook is the role of **creativity** in learning. STEAM encourages students to think in new ways, look at problems from different angles, and design original solutions. Educators can use creative tools such as **design thinking**, **theatre techniques**, **visual arts**, and **computational thinking** to help students understand and enjoy learning. These tools make lessons more exciting and easier to remember. In vocational education, creativity is especially important because students must solve real problems in jobs and daily life. Creative thinking helps them become flexible and ready for change. **Entrepreneurship** is also a big part of STEAM. It means more than just starting a business—it means being curious, brave, and ready to act on good ideas. When students work on STEAM projects, they often need to plan, test, and improve their ideas. They also learn how to work with others, lead a team, and solve problems together. These are all important entrepreneurial skills. Through STEAM, students become more confident, motivated, and independent. They learn how to turn their ideas into real solutions that help their communities or even the world. This guidebook shares many helpful **examples and resources** from partner countries. These include good practices that show how STEAM can work for different age groups, learning needs, and education levels. For example, we see science and art workshops for children, coding and robotics clubs for teens, and digital skills courses for adults. There are also programs that focus on helping girls, learners with disabilities, or those from minority backgrounds. These examples show that STEAM is flexible—it can be used in many ways, in many places, and with many types of learners.

Educators are at the heart of this change. They are not just following a method—they are the ones making learning come alive. When educators use the STEAM approach, they become creators of exciting, modern, and inclusive lessons. They build learning environments where students can explore, question, and grow. To do this successfully, educators need **training**, **access to modern tools**, and **opportunities to work together** with other professionals. When educators feel confident and supported, they can create lessons that really inspire their students. This guidebook also encourages collaboration. STEAM works best when educators from different subjects work together. For example, a science educator and an art educator can plan a project together that mixes their subjects in a creative way. Working as a team helps educators share ideas, solve problems, and improve their teaching methods. Collaboration between schools, non-formal education centers, and communities also helps students see how their learning connects to real life.

In summary, STEAM education is not just a new trend. It is a strong, smart way to prepare learners for the future. It combines knowledge, creativity, and social skills in a way that makes education more complete and meaningful. With STEAM, students don't just learn facts—they learn how to think, create, and take action.

When educators include the values of **Inclusion**, **Creativity**, and **Entrepreneurship** (ICE) in their STEAM lessons, they help students become active and responsible members of society. These students will be more ready to face global challenges like climate change, digital transformation, and social change. They will be able to use their knowledge in real life, not just in school. The *EnterSTEAM* project is a clear message to educators and education leaders: it is time to rethink how we teach. It is time to move toward education that is open to all, connected to the real world, and focused on developing each learner's potential. This guidebook offers the ideas, tools, and inspiration needed to begin or strengthen that journey.

Together, we can build stronger learning communities, create better futures for learners, and bring positive change to our education systems through the power of STEAM.

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