



Universal Curriculum

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FullSTEAM: an approach to teaching science in non-formal contexts

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School Curricula: A Comparative Study of Portugal, Iceland, Finland, and Latvia with Focus on STEAM Education

Education plays a pivotal role in shaping the intellectual and social development of children. As countries around the world develop curricula to guide the education of their youth, certain patterns and trends emerge, especially in the context of science, technology, engineering, arts, and mathematics (STEAM) education. Countries like Portugal, Iceland, Finland, and Latvia, each with their unique educational frameworks, provide interesting insights into how STEAM education is integrated into the school curricula for students aged 10 to 15. This age group is critical as it encompasses the transition from primary to secondary education, where students develop foundational skills and explore more complex subjects.

Here we present the analysis done by the FullSTEAM partnership. The common themes identified will be addressed in the STEAM activities proposed in the training actions, and will be included in the activity's manual.

Similarities Across the Four Countries

- 1. Emphasis on Multidisciplinary Learning:** All four countries emphasize a broad-based curriculum that integrates multiple disciplines, creating a strong foundation in STEAM education. In each country, students are expected to engage with a variety of subjects, including mathematics, science, and technology. These subjects are not taught in isolation but rather interwoven, encouraging students to understand how different fields are connected. For example, **in Finland and Latvia, science and mathematics are taught as interrelated subjects, which allows students to see the real-world applications of their learning.**
- 2. Focus on Practical Learning:** A strong similarity is the emphasis on hands-on, project-based learning. For instance, Icelandic students, much like their counterparts in Portugal and Finland, engage in practical science experiments, coding, and technology-related projects. This approach helps foster creativity and problem-solving skills, which are central to STEAM education.
- 3. Curriculum Flexibility and Student-Centered Approaches:** Across all four countries, there is an **increasing move toward student-centered learning**, allowing for greater flexibility in the curriculum. Students have opportunities to explore their interests, particularly in

subjects like technology, design, and innovation. This flexibility supports the broader aims of STEAM education, where fostering curiosity and creativity is as important as the acquisition of knowledge.

Key Differences in Curricula

1. **National Education Priorities:** While all four countries integrate STEAM principles, their national priorities differ. **Finland**, known for its world-renowned education system, **places a strong emphasis on collaborative learning** and the integration of cross-curricular themes. The Finnish curriculum encourages interdisciplinary projects, where students might combine science with art or mathematics with technology, reflecting a holistic approach to STEAM education.

In contrast, **Portugal's curriculum places a greater focus on structured learning, with less flexibility** compared to Finland or Iceland. Although STEAM-related subjects are increasingly prioritized, the curriculum is more subject-specific. Portuguese students may have less opportunity to engage in project-based learning that blends multiple disciplines, focusing instead on acquiring knowledge in distinct fields.

2. **Cultural Context and Innovation:** Iceland and Latvia, while both smaller countries, have placed a significant emphasis on the development of new technologies and sustainable solutions. In **Iceland, there is a strong focus on the environment and the integration of sustainability into science curricula**. Students engage in projects that explore renewable energy, climate change, and the use of technology for environmental solutions.

Latvia, like Finland, has focused heavily on STEM education, but with an emphasis on preparing students for the modern workforce. Students in Latvia often engage with technological tools like coding and robotics, as well as interdisciplinary projects that blend art and engineering, with a goal of enhancing employability and fostering innovation.

3. **The Role of the Arts in STEAM:** The role of **arts in the STEAM framework differs notably between the countries**. While Finland integrates arts seamlessly into its education system, encouraging students to explore creativity through science and technology projects, arts education in Portugal, Iceland, and Latvia tends to be more distinct from the STEM subjects. However, there are efforts in all countries to bring art into science and technology education to encourage creativity, whether through design-based thinking or digital arts.

Table I- Main curricular subjects across the four countries.

Curricular Subject	Portugal	Iceland	Latvia	Finland
Mathematics	Arithmetic, Algebra, Geometry, Statistics	Arithmetic, Algebra, Geometry, Measurement	Arithmetic, Algebra, Geometry, Data Analysis	Number Theory, Algebra, Geometry, Statistics, Probability
Science	Biology, Physics, Chemistry, Environmental Studies	Natural Sciences, Biology, Physics, Earth Sciences	Natural Sciences, Biology, Chemistry, Physics, Environmental Science	Biology, Chemistry, Physics, Earth Science
Language and Literature	Portuguese Language & Literature (Grammar, Writing, Literature)	Icelandic Language & Literature (Grammar, Literature, Writing)	Latvian Language & Literature (Reading, Writing, Grammar)	Finnish/Swedish Language & Literature (Grammar, Writing, Oral Skills)
Foreign Languages	English (primary), other languages	English (primary), Danish (secondary)	English (primary), Russian, German (secondary)	English (primary), Swedish (secondary), other languages (e.g., German, French)
Social Studies/History	History, Geography, Civics (Portuguese and World History)	History, Geography, Civics (Icelandic History and Geography)	History, Geography, Civics (Latvian and World History)	History, Geography, Civics (Finnish History, Geography, Societal Structures)
Arts	Visual Arts, Music	Visual Arts, Music, Drama	Visual Arts, Music	Visual Arts, Music, Crafts

The Relationship Between Curricula and STEAM Education

STEAM education focuses on fostering a dynamic, integrated approach to learning that blends Science, Technology, Engineering, Arts, and Mathematics. While all four countries support this philosophy, their approaches vary based on their unique educational goals and cultural contexts.

- **Finland** is arguably the **leader in integrating all five components of STEAM education**, particularly because of its emphasis on inquiry-based learning and cross-curricular teaching. Finnish teachers often design interdisciplinary projects that involve real-world challenges, promoting critical thinking and problem-solving skills. The Finnish curriculum allows flexibility for schools to tailor STEAM programs, meaning that students can experience STEAM subjects not only in science and technology classes but also through creative disciplines such as visual arts, design, and music.
- **Portugal** is making strides in introducing STEAM-related education, but there is still a **tendency to keep arts and technology as separate domains**. While this can hinder a fully integrated STEAM approach, Portugal's emphasis on mathematics and scientific literacy provides a solid foundation for future expansion into a more cohesive STEAM model. In Portugal, STEAM education is gaining momentum as part of a broader effort to modernize and enhance the educational system. The country is focused on increasing digital literacy and preparing students for the challenges of a rapidly changing world. Portugal has fostered collaboration between educational institutions and the private sector to develop innovative solutions in education aiming at train young people in programming, ensuring that they gain practical coding skills, which are an essential part of modern STEAM education.
- **Iceland** provides an interesting example of how small nations can leverage their unique strengths. With a focus on **sustainable development and environmental studies**, Iceland's curricula aim to equip students with the skills necessary to address global challenges. In Iceland, STEAM education takes on a more **specific cultural context** by incorporating Iceland's geography, energy resources, and environmental priorities into its science curriculum. Iceland's educational system promotes creativity and hands-on learning, which are key components of effective STEAM education. Schools encourage students to work on projects that combine scientific inquiry with artistic expression, whether through designing eco-friendly solutions or creating art using technology. The use of outdoor learning, such as exploring Iceland's natural landscapes, is also common, helping students understand environmental issues from a STEAM perspective. Furthermore, Icelandic schools have embraced the integration of coding and digital

technologies into the curriculum, aiming to equip students with the technical skills needed for the future workforce.

- **Latvia** focuses on developing technology skills, particularly coding and robotics, which aligns closely with global STEAM priorities. However, its **approach as been more career-oriented**, seeking to prepare students for future job markets that require technical and creative skills. Latvia's initiatives to support STEAM education are often closely tied to international projects, like the European Union's Horizon 2020 program, which supports innovative education practices. Schools in Latvia are beginning to adopt project-based learning, where students engage in cross-disciplinary tasks that combine the arts, sciences, and technology. Latvia's educational reforms include providing teachers with professional development opportunities to better integrate these subjects into their classrooms, and there is an increasing focus on encouraging girls to pursue STEAM fields through targeted outreach programs.

Table II- Key STEAM topics integrated into the school curricula in Portugal, Finland, Latvia, and Iceland. These topics highlight the main focus areas for STEAM education within each country.

Country	Science	Technology	Engineering	Arts	Mathematics
Portugal	- Biology (ecology, genetics, health)	- Digital literacy (coding, software tools)	- Robotics & automation (using kits)	- Design and digital arts (graphic design)	- Algebra, geometry, statistics
	- Chemistry (chemical reactions, elements)	- Programming (Scratch, Python)	- 3D printing & design	- Art history and visual arts	- Data analysis, probability
	- Physics (forces, energy, magnetism)	- Internet safety, cybersecurity	- Structural engineering (simple machines)	- Music (sound, rhythm, composition)	- Mathematical modeling, problem-solving
Finland	- Physics (motion, energy, circuits)	- Robotics and programming (Arduino, Python)	- Engineering challenges (construction)	- Art (visual arts, multimedia)	- Problem-solving, algebra, geometry
	- Biology (ecosystems, genetics)	- Digital tools (3D modeling, simulations)	- Sustainable design (green engineering)	- Music (composition, instruments, theory)	- Mathematical reasoning, patterns
	- Chemistry (substances, reactions)	- Coding (game development, app creation)	- Architecture (designing simple structures)	- Drama (creative expression, performance)	- Statistics, probability, functions
Latvia	- Biology (cells, plants, evolution)	- Programming (block-based languages)	- Robotics (building robots for tasks)	- Visual arts (painting, drawing)	- Arithmetic, geometry, algebra
	- Physics (energy, motion, forces)	- Digital technologies (web design, apps)	- Renewable energy projects (solar panels)	- Music (sound and technology integration)	- Mathematical games, logic puzzles
	- Chemistry (acids, bases, reactions)	- Coding (microcontrollers, sensors)	- 3D printing (creating models)	- Theatre arts (storytelling, set design)	- Data visualization, statistics
Iceland	- Physics (light, sound, forces)	- Digital literacy (computing basics)	- Robotics (programming robots, building)	- Art (sculpture, painting, photography)	- Problem-solving, algebra, calculus basics
	- Biology (ecosystems, evolution)	- Coding (interactive media, games)	- Engineering design (mechanical structures)	- Music (production, composing with software)	- Geometry (volumes, surface areas)
	- Chemistry (materials, reactions)	- Technology integration (smart devices)	- Sustainability (eco-friendly engineering)	- Creative arts (using digital tools)	- Trigonometry, statistics
Common Themes	- Environmental science	- Coding (Scratch, Python, robotics)	- Design and problem-solving	- Creative expression through arts	- Algebra, geometry, and real-world math

Key Insights:

1. **Science:** All countries emphasize **biology** (ecology, health, genetics), **physics** (motion, energy, forces), and **chemistry** (substances, reactions). **Environmental science** and **sustainability** are frequently highlighted.
2. **Technology:** There is a strong focus on digital literacy and coding across all countries, with an emphasis on programming languages such as Python and Scratch. Robotics is also widely integrated into curricula.
3. **Engineering:** Engineering topics include structural design, renewable energy, and 3D printing. Projects often integrate technology to solve practical, real-world problems.
4. **Arts:** The arts play an important role in fostering creativity within STEAM education. **Visual arts, music, and drama** are incorporated to enhance students' creative expression and problem-solving.
5. **Mathematics:** Mathematics in these curricula generally focuses on **algebra, geometry, and data analysis**. Problem-solving and logical thinking are key components of math education.

Conclusion

Across all four nations, there is a growing recognition of the importance of STEAM education in equipping students with the skills needed to succeed in a rapidly evolving world. Through a focus on digital literacy, sustainability, and curiosity-driven learning, these countries aim to prepare their students not only for academic excellence but also for creative problem-solving and adaptability in real-world scenarios.