

Erasmus+ program Cooperation partnerships in school
education “Diversifying the STEM Ecosystem”
No 2024-1-LV01-KA220-SCH-000250755

*UNIVERSITY OF EASTERN
FINLAND TEACHER TRAINING
SCHOOL
STEM ECOSYSTEM
DEVELOPMENT STRATEGY
2025. – 2030.*

Framework and guidelines



Funded by
the European Union



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ABBREVIATIONS

STEM = Science, technology, engineering, mathematics

STEAM = Science, technology, engineering, arts, mathematics

SWOT = Strengths, weaknesses, opportunities, threats

1. THE OVERARCHING GOALS, DEVELOPMENT VISION AND STRATEGIC DIRECTION OF THE EDUCATIONAL INSTITUTION. GENERAL INFORMATION

1.1. Summary of education institution

Lower Secondary School (Grades 7–9, ages 13–15). The same building also has the Upper Secondary School (ages 16–18).

Our lower secondary school has approximately 250 students. The upper secondary school has 360 students.

1.2. School vision, goals related to STEM

Our school aims to provide an equitable and safe learning environment for young people in the surrounding area.

We are a teacher training school with the mission to deliver high-quality education, ensure the standard and development of teaching and curriculum work, and to innovate and pilot future-oriented school practices and teacher education within various national and international collaboration networks.

Our goal is to educate individuals who are capable of acting constructively within human communities, understanding the complexity of natural environments, and engaging with them in a sustainable manner. Our teaching is diverse and multidisciplinary. At the upper secondary level, we offer a dedicated science-focused track, and we have also made efforts to expand elective courses in lower secondary school to further support science education and learning.

1.3. National, local planning documents in STEM education and digital transformation

National curricula (contains STEM subjects): <https://www.oph.fi/fi/koulutus-ja-tutkinnot/perusopetuksen-opetussuunnitelman-perusteet>

Our local, school curriculum:
<https://peda.net/iy/po22/luku15>

2. ANALYSIS OF THE CURRENT SITUATION

2.1. Learning process, its results in the field of STEM

In our lower secondary school, we offer elective courses related to science (such as DigiErkit, an outdoor skills course, and an animal studies course), which have primarily attracted male students—especially the DigiErkit course.

Our goal has been to encourage more girls to choose these courses, particularly those related to technology. In terms of academic performance, boys and girls perform equally well on average in science subjects. Compared to national data, the gender gap is not significant and follows the general trend. Boys motivation tends to be lower than girls.

2.2. Competencies for STEM teachers

The teachers working at our school have completed comprehensive teacher education, which in principle ensures strong digital skills and excellent pedagogical competence.

As a teacher training school, we also operate under higher expectations regarding professional expertise.

In the survey conducted among our teaching staff (part 4.1.1), teachers rated both their pedagogical and digital competencies as either very good or good. However, there is room for development in the use of innovative solutions. Some teachers also reported challenges related to time management.

2.3. Offer of interest related education and extracurricular activities

Grade 5: From Norssi to Space

The aim of this course is to explore space and its conditions. Students will reflect on space travel and the limitations it involves. The course includes hands-on experiments that demonstrate the differences between conditions on Earth and in space. Students will also practice environmental observation through measurement. The course introduces basic stargazing skills. Depending on the year, students may visit the university or other nearby locations.

Grade 6: The Secret Lives of Organisms

The course focuses on different groups of organisms—their life, habitats, and structures. The local environment and its biodiversity serve as the main research area. Emphasis is placed on observing nature and conducting experiments. Activities may include

collecting samples, cultivating bacteria, learning about bird ringing, growing useful plants, and creating a miniature ecosystem. The course is thematically aligned with the seasons. Through hands-on activities and collaborative learning, students gain meaningful experiences, develop problem-solving skills, and deepen their understanding of natural phenomena. A positive and respectful relationship with nature is also fostered.

Grade 7: Animals Around Us

This course introduces students to various pet species, their care, related hobbies, and species-specific behavior. Farm animals and other domestic animals are also included. Each year, students visit different locations such as pet stores or breeders. They are introduced to therapy dogs, service dogs, and horse stables. When possible, students care for terrarium animals.

Course content and visits are adapted to students' interests. Students complete an animal welfare diploma as part of the course.

Grade 8: Hunting and Fishing

The course aims to spark interest in hunting and fishing and provide the knowledge and skills needed to begin these hobbies. It also supports students who already have experience. The goal is to improve fishing success and prepare future hunters for the hunting license exam. Students also develop their understanding of nature and learn about sustainable and respectful outdoor traditions.

The course includes species identification, beginner-friendly methods, basics of fish biology and wildlife ecology, and management of fish and game populations. Key legal, safety, and ethical aspects are covered. Students also learn about making equipment and processing catches. Field trips and fishing excursions may take place outside regular school hours.

Grades 5–6: Technologies of the Future

Welcome to explore new technologies made possible by our teacher training school environment. These include AI, AR, VR, 3D printing, programming, robotics, and game-based learning. Students will experiment and learn collaboratively through various project-based activities.

Grade 5: Technology Masters – Mini-Erkit

This course introduces students to robotics, AR/VR technologies, programming, and the use of digital tools and platforms available at school.

Students apply their skills by sharing them with others in the school community. The course is a two-year commitment and is therefore only available to fifth graders.

Grade 6: Craft and Electronics 1

The course focuses on electronics and includes building an electronic product or game using ready-made kits. Students also create fishing lures in collaboration with enthusiastic anglers.

Grade 7: “Digi-Erkit” 1

This elective is not tied to any specific subject. Each year, students help design the course content and gain learning experience through implementation.

Activities include participating in digital events and supporting the school community’s digital skills. Learning goals include understanding meaningful uses of ICT, key concepts, and responsible, creative, and investigative use of technology.

Students also explore the opportunities and challenges of technology in communication and networking.

Grade 7: Craft and Electronics 2

This course deepens students’ knowledge of electronics. Students design and build their own product or application using modules or kits.

Example project: “Who can design and build the most modern mini Bluetooth speaker?”

Objectives:

- Increase knowledge of electricity and electronics
- Develop fine motor skills and precision
- Improve project management skills

This elective is part of advanced craft studies and may improve the final grade in the subject.

Grade 8: “Digi-Erkit” 2

This elective continues the work from grade 7. Students take more responsibility for planning and implementation. In addition to deepening previous goals, students practice using technology in communication and collaboration. Grade 8 students also begin mentoring grade 7 students in digital skills within the school community.

Grade 9: “Digi-Erkit” 3

In the final year, students independently plan and implement course content. They select the next cohort of Digi-Erkit students by organizing an entrance task. They also take on a leadership role in mentoring younger students and supporting the school’s digital development.

2.4. Career education in STEM

Our school organizes work-life weeks during which students can visit workplaces of their choice. Unfortunately, only a small number of these placements are related to the natural sciences.

We also host a limited number of guest lectures. As a teacher training school located near the university, we are well-positioned to arrange visits to the local STEM-Centre and university departments, which are easily accessible.

In student counselling, we aim to present and explore a wide range of professions, including those related to STEM subjects.

2.5. Cooperation partners in the STEM/ STEAM ecosystem

- University of Eastern Finland
- LUMA/STEM-center
- Botana Tropical Garden
- Koli Science center

2.6. STEAM (interdisciplinarity)

Within subject teaching, efforts have been made to create interdisciplinary learning modules, particularly between mathematics, physics, and chemistry.

For example, in physics and chemistry, mathematical concepts are frequently applied, while in mathematics, equations used in physics are utilized in solving algebraic problems.

2.7. Revision of resources, materials and environment

Here is a list of resources.

Physics equipment	Chemistry equipment	Mathematics Equipment
Multimeters (extensive supply) Scales and balances Density blocks (stone, metal, various materials) Pulleys Calipers Stands and clamps	Atomic model kits (2000 pieces) Balloons Basic kitchen materials (salt, baking soda, sugar, potato starch, food coloring, flour, egg, milk...) pH sensors, indicators (drops, paper)	Dice (large supply) Playing cards (10 decks) Fraction cakes (2), fraction rods (large supply) Puzzle games (10 types), puzzle cards Pentomino sets (10) Fillable plastic 3D shapes

Demonstration kits (e.g., friction plates, stones) Heating plates (25 units), kettles (10), pots (25) Safety goggles, lab coats, protective gloves (for all students) Gas burners (40 units), heating meshes, tripods Vacuum pump Air track carts Photonics Explorer Kit Laser Demo Kit (8 units) Optics kits (5 units), prisms, diffraction gratings, slits Stroboscope, polarizer, mirrors, lenses, lamps (30 units) Batteries (20), battery holders (10) Resistors (41), capacitors, coils (15), transformers, motors Van de Graaff generator, electroscopes (6), electrophoresis kits Conductivity meter, ion exchange water generator Vernier sensors: pH, O₂, CO₂, nitrate, light, magnetic field, voltage, current, pressure, temperature, microphone, force, ultrasound, light gate, jump height Spectroscope (10 units), calorimeters (6), thermal radiation tubes (bright and black, 3 each) Heat conduction plates (6), AC/DC power supplies (6) Digital multimeters (24), analog ammeters and voltmeters (6 each) Electrodes: zinc (10), copper (10) Cable reels, moment of inertia kits, component assortments Theodolite, fog machine, tube radio Radiation and nuclear physics demonstration kits UV black light	Non-metals: activated carbon, antimony, graphite, coal, bone char, medicinal charcoal, sulfur, ash Metals: aluminum, calcium, copper, lead, magnesium, iron, zinc, tin, Wood's metal, steel wool Glassware: beakers, pipettes, measuring cylinders, funnels, petri dishes, evaporating dishes, boiling flasks (250 ml, 100 ml), glass rods Spectrophotometer, precision pipettes (18), centrifuge Fume hoods in every lab All common laboratory chemicals	Multiple Pythagorean theorem kits LEGO and other building blocks
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Mechanics demonstration kits: wooden car, ramp, balloon, Newton's cradle, gyroscope Compasses (10), weights, tennis balls (6), measuring tapes (2 × 5 m) Micrometers (8), metal springs, plastic soda bottles (2 × 0.5 L) Hydrostatic pressure indicators (12), bicycle pumps (2) Tuning forks (various frequencies), digital thermometers (1) Rocks (5–12 cm, large collection) Heat conductivity apparatus (6)		
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Every pupil has their own Chromebook.

Needs: Virtual Reality (VR) Equipment: Additional VR tools are desired to enhance immersive learning experiences. 3D Printer: A dedicated 3D printer for the lower secondary school would support hands-on STEM projects. Atomic Model Kits: New sets are needed, as existing ones are incomplete and incompatible with each other.

2.8. Digital transformation

What the institution already does digitally, what tools are used:

1. In administrative work

Teams, Classroom, Adobe, O365, Wilma

2. In the learning process

MentiMeter, Molview, Padlet, Classroom, SanomaPro, Otava, Lukulummo, Blooket, GimKit, GeoGebra, Ville, Nspire, LoggerPro + Vernier, Graphical Analysis, pHet-simulaatiot, Thinglink, Garageband, Musescore

3. In evaluating, summarizing

MentiMeter, Kahoot, Padlet, Qridi, itslearning, OneNote, Wilma

4. In inclusive education

Ville, GeoGebra, Classroom, SanomaPro, Otava, Kahoot, GimKit, Blooket

5. In the implementation of projects

O365, Classroom, Padlet, Canva

2.9. Internationalization

A joint project with Turkish partners (Erasmus)

This project (Erasmus)

3. COLLECTION OF IDEAS, INNOVATIVE PRACTICES, SOLUTIONS

This section presents an informal collection of ideas regarding the potential components of a LUMA (STEM) ecosystem.

- The chemistry of cosmetology
- Kitchen chemistry
- Hands-on workshop activities
- Facilitating workshops at science festivals
- Field trips across Finland (e.g., Heureka Science Centre, Ahaa Science Centre)
- Local excursions (e.g., Noljakka nature area, Botania botanical garden, Science Park)
- Full-day thematic events
- Pop-up science activities during the school day
- Science-themed celebration events
- Collaboration with primary schools, including guiding activity stations for younger pupils
- Guest lectures by female scientists and professionals from universities and local companies
- Company visits integrated into career education
- Playing or designing escape room games with a science theme
- Parents talking about their careers

4. ANALYSIS OF NEEDS TO IMPROVE THE STEM ECOSYSTEM

4.1. Results from surveys to teachers, parents and pupils:

This section presents the results of surveys conducted among teachers, guardians, and students. The surveys were administered electronically using Google Forms. A link to the surveys was sent to students and their guardians via the Wilma- student communication platform. Teachers were contacted by email.

4.1.1 Teachers

The aim of the survey was to explore teachers' needs and perspectives related to the teaching of STEM subjects.

To this end, a questionnaire was developed, translated into Finnish, and distributed via email to all subject teachers of STEM disciplines (science, mathematics, and technology) as well as to class teachers. The survey was sent to a total of 56 teachers, and three reminder messages were sent to increase the response rate. In total, 13 responses were received. Two of the respondents were class teachers teaching grades 1–6. One of them taught grades 1–3, and the other grades 4–6. Nine respondents were subject teachers teaching grades 7–12.

The subjects taught by the respondents were distributed as follows:

Three taught mathematics, two taught both chemistry and physics, three taught a combination of mathematics, physics, and chemistry, one taught biology, geography, and health education and four class teachers taught a wide range of subjects across the curriculum.

The survey examined how and to what extent teachers use information and communication technology (ICT) both during lessons and in lesson planning. The results are presented in tabular form, showing how many teachers selected each response option. The responses indicate that the school's computer lab is not used at all, as teachers rely on their personal laptops daily. Printers, projectors, smartboards, and document cameras are also in active use.

	Every day	At least once a week	At least once a month	At least once a semester	At least once a school year	Never
Teacher's computer	13					
Printer/copier	4	9				
Mobile Classroom	7	5	1			
Interactive board, projector	12	1				
Computer class						13
Document camera	5	5	3			
Other	8	3				2

We also asked what kind of useful IT equipment we don't have yet at our school.

7 answered nothing, 3 answered that we should get VR- or AR goggles, 1 answered that a 3D-printer would be a good addition to our IT equipment, 1 answered (with some humor) that we should have a fundus scanner (for eyeground checking) and a X-ray scanner and 1 answered that we should get a moon rocket so they could get away.

The online tools being used in the learning/teaching process were (how many answered): O365 (Teams, OneNote, 8), Padlet (7), Kahoot (7), Classroom (6), Padlet (6), Canva (5), Blooket (4), ViLLE (University of Turku: STEM-online games for children, 4), Publisher materials (3), Mentimeter (2), pHet-simulator (2), ThingLink (2), Nspire (Texas Instruments) (2), LoggerPro+ Vernier –sensors (2), GeoGebra (2), E-book –sites (1), Graphical analysis (1), Garage Band (1), Muscores (1), Copilot (1), Adobe Spark (1), GimKit (1), Qridi (1), Itslearning (1) and Molview (1).

The next question was about digital and pedagogical skills. The teachers rated their skills at pedagogical topics as follows:

	I am very good at it	I am good at it	I rated neutrally	It is necessary to develop	I need to improve significantly
Selection and use of appropriate IT tools, online programs in lessons	7	4	2		
Time management	8	3	1	1	
Knowledge of how to get students interested in learning my subject	4	6	3		
Cooperation with colleagues, parents	4	5	4		
Encouraging relationships with students, ability to provide a fear-free atmosphere	8	5			

	I am very good at it	I am good at it	I rated neutrally	It is necessary to develop	I need to improve significantly
Student support actions and diagnostics	3	6	4		
Overcoming discipline problems	7	3	3		
General and subject didactic standards (teaching techniques, methods)	4	9			
Digital literacy: the ability to find, evaluate, use information, create new content, as well as computational thinking competence.	4	9			
Use of non-standard, innovative techniques, techniques in the lesson (for example, research methods in nature)	4	4	3	2	

We asked the teachers to give specific examples of how to get students interested in learning STEM-subjects. The answers were as follows (mentioned by the main topic):

Teaching Methods and Approaches

Experimental and hands-on learning: Mentioned by 6 teachers, including the use of experimental methods, hands-on activities, and practical tasks appropriate for the students' age and level. Use of diverse teaching methods and environments: Mentioned by 3 teachers, highlighting the importance of combining various teaching approaches and settings. Phenomenon-based learning: Highlighted by 1 teacher as a way to integrate multiple subjects into engaging, thematic units.

Student Engagement

Creating real-world connections: Mentioned by 4 teachers, including the use of real-life examples and relevance to students' everyday lives. Fostering excitement and curiosity: Mentioned by 3 teachers, with strategies such as surprise facts, analogies, or demonstrations to spark a "wow" effect. Teacher's enthusiasm: Noted by 4 teachers as a key motivator, emphasizing the teacher's own interest and passion for the subject.

Instructional Tools and Materials

Digital tools and gamification: Mentioned by 2 teachers, including platforms like GeoGebra, Blooket, GimKit, and Kahoot, used in moderation. Clear instructions and goals: Mentioned by 2 teachers, emphasizing structured guidance, clear objectives, and transparency in assessment.

Collaboration and Community

Cross-grade collaboration: Highlighted by 1 teacher as a way to involve older students or trainee teachers in activities for younger students. Special events and teamwork: Suggested by 1 teacher, such as theme days planned with school's STEM teachers and collaboration with external labs.

Assessment and Feedback

Varied assessments: Mentioned by 1 teacher, proposing diverse assessment methods beyond traditional paper tests. Transparent and ongoing evaluation: Highlighted by 1 teacher, including the integration of continuous task completion into grading.

Motivation and Rewards

Recognition and incentives: Mentioned by 1 teacher, including rewards like Wilma (a platform for student management) marks, stickers, treats, and field trips. Support and encouragement: Mentioned by 1 teacher, combining high expectations with supportive measures like tutoring.

General Educational Philosophy

Building understanding through practice: Mentioned by 2 teachers, with mottos like "Practice makes perfect" and emphasizing gradual mastery. Fostering self-discovery: Mentioned by 2 teachers, aiming to create situations where students make their own realizations and discoveries.

Then we asked what kind of additional extracurricular activities, events and excursions for motivating students to learn STEM we should focus on at our school. Answers were as follows (mentioned by a main topic):

Real-World Applications and Contextual Learning

Practical applications in daily life: Mentioned by 2 teachers, including activities like calculating product prices in a store, optimizing shopping within a budget, or solving practical math problems such as planning a route in city navigation. Connecting subjects to personal interests: Mentioned by 1 teacher, highlighting the importance of linking science to students' hobbies and life goals, such as calculating the costs of a dream purchase or analyzing sports-related statistics.

Outdoor and Experiential Learning

Outdoor education and field trips: Mentioned by 4 teachers, emphasizing nature schools, science-related excursions, or activities in natural settings as engaging ways to connect with science. Active participation in science fairs and competitions: Mentioned by 2 teachers, with examples like SciFest or robotics competitions.

Visits and Collaborations

Visits to science-focused facilities: Mentioned by 7 teachers, including trips to: Universities and research facilities like physics and chemistry departments, STE(A)M-laboratories for hands-on experiments, science centers such as Heureka in Helsinki and companies in science-related fields to explore real-world applications and career paths.

Multidisciplinary centers and programs: Mentioned by 2 teachers, with examples like Yrityskylä, where students engage in interdisciplinary activities related to science and economics.

Digital and Community-Based Learning

Digital learning environments and games: Mentioned by 1 teacher, proposing the use of science-themed games and other interactive tools to enhance engagement and collaborative and community learning: Mentioned by 1 teacher, highlighting shared learning experiences, both in-person and online.

Projects and Independent Work

Home-based experimental tasks: Mentioned by 1 teacher as a way to involve students in hands-on activities outside the classroom and large independent projects: Mentioned by 1 teacher, suggesting long-term assignments that students can work on at their own pace.

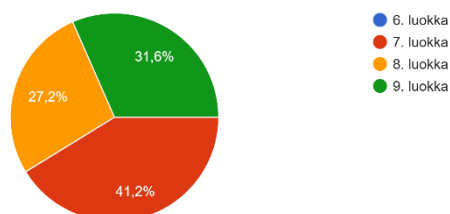
We also got some general suggestions including visiting museums and exhibitions: Mentioned by 3 teachers as valuable for providing historical and contextual perspectives on science and visiting science festivals and events: Mentioned by 3 teachers, with SciFest (our university's science event for children) noted as particularly engaging.

4.1.2. Pupils

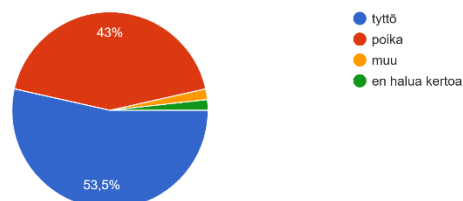
We received responses from 114 students. Of these, 49 were boys, 61 were girls, 2 identified as other, and 2 preferred not to disclose their gender.

1. What grade are you in?

114 vastausta



Are...
114 vastausta



Among the respondents, 21 indicated that they plan to continue their studies at our own upper secondary school, 23 at another upper secondary school, and 22 at a vocational institution. The majority, 48 students, reported that they are still undecided about their post-lower-secondary education path.

3. Missä aiot jatkaa opintojasi peruskoulun jälkeen?

114 vastausta



57 students also reported not knowing what they want to do after completing their studies. 13 responded that they would like to work in the fields of culture, arts, and creative industries, 11 in medicine and natural sciences, 5 in programming and technology, 4 as entrepreneurs, 3 in tourism and services, 2 as police officers, 2 in the automotive sector, and 1 as a teacher or coach. Individual responses were received related to the following professions: psychologist, child guidance and education, mental health services, journalist, ice hockey referee, restaurant industry, metal sheet welding, construction, surface treatment, and football player.

14 respondents reported having participated in a school-organized orientation or presentation event where a professional introduced their field. 19 reported having been introduced to a field through someone they know who works in it. 21 reported that they have not had the opportunity to explore a field of interest. 47 responded that they do not yet know which field interests them, and therefore have not had the chance to explore any. One respondent said they had been

introduced to some fields of interest, but not all. One responded that they had been introduced to a field, but the presentation was poor and brief, so it was not very informative.

We asked students which of the listed activities would be most suitable for them to explore a field and future opportunities. 45 responded "School-organized meetings with professionals," 42 "Visits to companies," 28 "Independent project work or researching information related to the field," and 39 "Observing practical work at a workplace that interests you." Other responses to this question were inappropriate or unrelated (5 responses).

As a follow-up question, students had the opportunity to give additional examples of ways they could explore a field of interest. Responses included (some mentioned more than once): "Getting to try practical things in the field during orientation, e.g., handling a camera," "Talking with professionals in one's close circle (parents, etc.)," "Looking up information online," "During school's work-life orientation days," "Watching a series on Yle Areena," "Visits," "Going there," "Self-learning online or through clubs," "Work experience / summer jobs," "Guardian," "Presentations, on-site visits," "A talk in the auditorium, for example," "Discussed during guidance counselling lessons," "Looking it up on the phone," "More professionals visiting the school," "For example, a joint visit to a hospital for those interested in medicine would be nice. Or a visit to a laboratory. It would also be great if professionals from many different fields could come to school to talk about their work," "Listening to their stories," "Watching videos about it," and "Through websites."

Next, we asked which clubs, courses, or other career-oriented programs students attend at school or outside of school. Responses to this question were fairly limited, which may also indicate a need for more activities. 5 respondents reported participating in visual arts activities. Similarly, 5 reported dancing, 4 music (e.g., at a conservatory), 3 cooking club, 2 handicrafts club, 2 Finnish baseball, 2 cheerleading, 4 TeamGym or gymnastics, and 2 theatre. Individual students reported hobbies such as skateboarding, shooting, karate, climbing, ice hockey, circus, fishing and hunting, or Japanese language. As many as 36 students, or 31.6% of respondents, reported not participating in any.

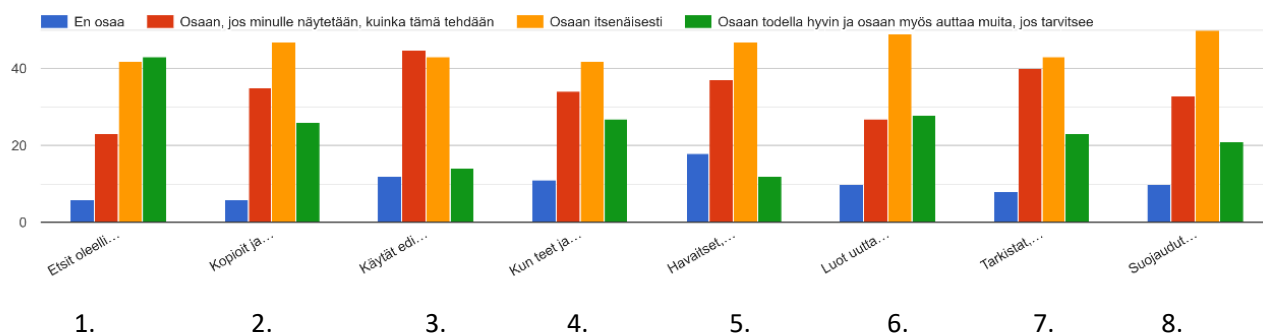
As a follow-up to the previous question, we asked what kind of club or extracurricular activity students would like to attend but is not currently offered at school. Responses to this question were similar to the previous one. 51 responded "none," 7 mentioned sports-related activities, and individual responses included photography, baking, welding, visual arts, circus, handicrafts, and a Greek language club. No one expressed a desire for science-related activities, nor did anyone report participating in such activities.

In the next question, students were asked to assess their digital skills. Overall, students reported being able to perform the listed tasks at least independently. In the chart:

1. Searching for relevant information online: 43 reported being able to help others if needed, 42 reported being able to do it independently, 23 reported being able to do it with a model, and 6 reported not being able to do it.

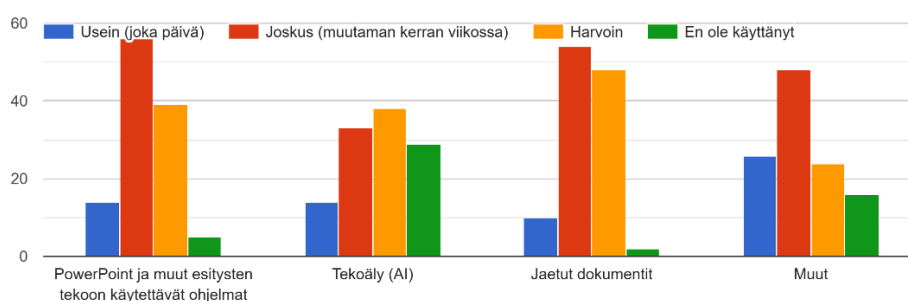
2. Copying and transferring files (such as documents, images, videos between folders, devices, or cloud services): 26 reported being able to help others if needed, 47 reported being able to do it independently, 35 reported being able to do it with a model, and 6 reported not being able to do it.
3. Using advanced video conferencing features (such as moderation, audio and video recording): 14 reported being able to help others if needed, 43 reported being able to do it independently, 45 reported being able to do it with a model, and 12 reported not being able to do it.
4. When working on a shared document, inviting others and assigning appropriate permissions: 27 reported being able to help others if needed, 42 reported being able to do it independently, 34 reported being able to do it with a model, and 11 reported not being able to do it.
5. Recognizing if digital content has been made available illegally (e.g., software, movies, music, books, TV series): 12 reported being able to help others if needed, 47 reported being able to do it independently, 37 reported being able to do it with a model, and 18 reported not being able to do it.
6. Creating new content by combining different types of media (such as text and images): 28 reported being able to help others if needed, 49 reported being able to do it independently, 27 reported being able to do it with a model, and 10 reported not being able to do it.
7. Checking whether a website requiring personal information is secure (e.g., https site, security logo or certificate): 23 reported being able to help others if needed, 43 reported being able to do it independently, 40 reported being able to do it with a model, and 8 reported not being able to do it.
8. Protecting oneself from unwanted and offensive online contacts and content (e.g., spam, identity theft): 21 reported being able to help others if needed, 50 reported being able to do it independently, 33 reported being able to do it with a model, and 10 reported not being able to do it.

The weakest areas of student digital skills were the use of advanced video conferencing features, recognizing illegally distributed content, and assessing website security. These are areas that should be taken into account when developing the LUMA ecosystem.



Next, students were asked about their use of digital tools when doing homework. PowerPoint and other presentation software are used by students as follows: 14 students use them daily, 56 students use them sometimes (a few times a week), and 39 students use them rarely. 5 students mentioned they have never used such programs. Artificial intelligence is clearly the least used among these options; a relatively large portion (29; 25.4%) had never used it, 14 respondents use it daily, 33 sometimes, and 38 rarely. Shared documents are used more frequently than AI. 10 respondents use such documents often, 54 sometimes, and 48 rarely. Only two students responded that they have never used such documents. In the “other” category, students reported using other digital tools for homework as follows: 26 often, 48 sometimes, and 24 rarely. 16 responded that they have not used any other digital tools.

11. Kuinka usein käytät näitä verkkopohjaisia työkaluja ja ympäristöjä kotitehtävien tekemiseen?



Finally, students were asked what kinds of activities would make STEM subjects more interesting and easier to learn. This question was important in terms of developing the ecosystem, but unfortunately the responses were limited, as 51 respondents either did not know how to answer or gave a response that did not address the question. However, the following themes could be identified from the answers:

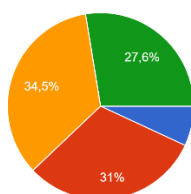
Many students wished for more practical, hands-on learning, such as field trips, experiments, and manual activities (a total of 10 respondents). The development of teaching methods also emerged: a calmer pace, the opportunity to ask questions, breaks, and inspiring and fun teachers (11 respondents). In terms of content, students hoped for more technology and mathematics, as well as gamification and visual elements (10 respondents). Some students suggested promoting science education through posters and other forms of advertising.

4.1.3 Guardians

A survey was also conducted for guardians, as they are intended to be an essential part of the ecosystem being developed.

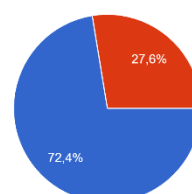
We sent the survey to the guardians of students in grades 6–9 via the Wilma communication platform. We received responses from 29 guardians. Among the respondents, 2 were guardians of 12-year-olds, 9 of 13-year-olds, 10 of 14-year-olds, and 8 of 15-year-olds. Of these children, 21 were girls and 8 were boys.

Kuinka vanha lapsesi on?
29 vastausta



● 12-vuotias
● 13-vuotias
● 14-vuotias
● 15-vuotias

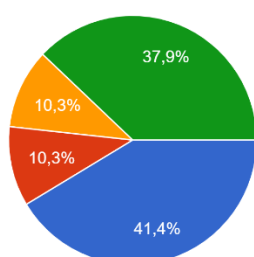
Mikä on lapsesi sukupuoli?
29 vastausta



● tyttö
● poika
● muu
● en halua kertoa

We asked the guardians whether they believed their child could be employed in the field of natural sciences in the future. The responses were as follows:

29 vastausta



● Kyllä
● Ehkä
● Ei
● Lapseni ei ole päättänyt vielä

12 responded yes, 3 maybe, 3 no, and 11 stated that their child has not yet decided.

Next, we asked what could help the child choose the most suitable future profession or further education path. These questions proved fruitful for the development of the ecosystem, as they provided direct ideas for our ecosystem.

9 respondents emphasized the importance of strong practical exposure to working life, such as visits to workplaces and educational institutions, opportunities to try out jobs in practice through short work experience periods, projects, and problem-solving tasks that showcase working methods in different fields. It was noted that the visits and visitors must be of high quality to avoid negative experiences that could stigmatize an entire field.

7 respondents mentioned supporting the student's strengths and interests, for example, by utilizing a personal learning plan in STEM subjects, encouraging the student toward their natural strengths and passions, providing positive feedback and confidence in their abilities, and offering opportunities to delve deeper into areas of interest through elective courses and extracurricular clubs.

6 emphasized that schools should invest in providing information about professions, for example, by offering comprehensive information about different careers and further education opportunities, showing videos about job content, organizing visits and guest speakers, and explaining which subjects and grades are required for specific careers.

6 guardians highlighted the importance of high-quality career guidance and the development of educational support. It is important to ensure sufficient and individualized career counseling, support for basic studies and school well-being, increased teacher competence in neuropsychiatric issues, and differentiated instruction based on student interests.

Some respondents (4) mentioned that it is important to offer students the opportunity to reflect on questions together before workplace visits and to provide realistic and relatable examples of professions, as young people often do not have access to summer jobs.

3 guardians considered it important to take societal and technological perspectives into account. An example of this could be exploring solutions related to combating climate change as part of STEM education.

We asked the guardians whether they influence their child's decisions when choosing extracurricular activities, clubs, or courses. The responses were quite varied.

11 responded yes, because they want their child to have regular hobbies. 6 responded yes, because they want their child to learn certain additional skills that will be useful in the future. 1 responded yes, because they support their child's passions. 1 stated that they discuss these matters together with their child. 1 responded no without further explanation. 3 responded no, stating that the child decides what to pursue (although support is available, nothing is forced). 5 responded that the child engages in hobbies at home.

Finally, we asked the guardians about their children's hobbies. First, we asked what the child currently engages in. Mentions from different categories were as follows:

Physical activity was by far the most popular hobby (11 mentions), and many young people participate at a club level. 7 guardians mentioned hobbies related to visual arts, music, and other forms of expression. 4 guardians reported that their child engages in computer gaming or technical projects, such as dismantling and repairing devices. 5 mentioned that the child has home-based hobbies such as handicrafts, cooking, and reading. 3 mentioned language learning as a hobby.

One guardian responded that hobbies had to be discontinued to support the child's well-being at school.

The final question asked what types of activities are missing from the school's extracurricular offerings. The responses were highly diverse.

Many guardians reflected that their child might not want to participate in school-organized activities, as school activities often feel obligatory and school days are already long. However, activities that support friendships might be of interest. Suggestions for such activities included a board game club, band club, math club, or visual arts club. Many considered the significance of recess and, for example, the development of the schoolyard. Animal and nature-related activities also received support.

4.2 SWOT-analysis for development of the STEM ecosystem

Strengths • a university-affiliated school, with a stable financial situation • students accustomed to working in diverse group settings • equipment and facilities already in good condition, with no need for major acquisitions • subject teachers possess a wide range of expertise • students have Chromebook laptops; iPads are also in use	Weaknesses • local businesses are poorly utilized as a resource • limited selection of elective subjects at the lower secondary level • guardians have not been involved in school activities • facilities are limited • smartphones and students' poor concentration skills
Opportunities • a large number of businesses and potential visit destinations in the surrounding area • a nearby LUMA (STEM) center • student teachers who can provide support and bring in new ideas	Threats • it is difficult to motivate teachers to engage in development work, as they are already overwhelmed with existing responsibilities • the school's relatively rigid curriculum makes it

• support from guardians and the opportunity to utilize their expertise • the potential to make productive use of smartphones	challenging to implement flexible changes • students' growing cynicism and the tendency for prejudices to surface easily
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5. PROGRAM FOR THE 2025/26 ACADEMIC YEAR WITH INNOVATIVE SOLUTIONS

This section presents a program designed to diversify STEM (LUMA) education for the academic year 2025–2026, which will be implemented starting in August 2025.

The main goal of the program is to offer an innovative and new type of elective, club-based subject for eighth-grade students, focusing on STEM subjects (science, mathematics, and technology) during the 2025–2026 school year. The primary objective of this elective club is to create ten activities for the broader school community that enhance vocational awareness in STEM fields. In addition, the program includes school-wide events involving all students from grades 7 to 9, as well as first-year upper secondary students. The aim is also to organize excursions that further increase students' interest in STEM careers. Students in the elective group will participate in the planning and implementation of these events together with the teacher or teachers responsible for each event.

A central goal of the program is to increase interest in STEM field and subjects especially among girls. To achieve this, teachers of each STEM subject have proposed and planned activities during joint team meetings, which will be carried out regularly throughout the school year. The elective group is scheduled to have one lesson per week, with the taught STEM subjects rotating so that each subject is equally represented over the course of the year. School-wide events will be organized less frequently, but still on a regular basis, with the aim of holding at least ten (10) major events that engage the entire school community.

The program employs a variety of methods, including in-school STEM-themed competitions, field trips, introductory workshops on artificial intelligence, pop-up events for each STEM subject, hands-on chemistry workshops related to everyday life, age-appropriate lectures, board game and escape room-themed events, family-inclusive workshops, career path presentations related to STEM (delivered by both university representatives and guardians), experimental workshops on surprising physics phenomena, and participation in the school-wide STEM celebration. While most event contents have already been planned, some remain open to allow flexibility and the incorporation of feedback once the program is underway.

Guest speakers from the University of Eastern Finland (UEF; physics, mathematics, chemistry, sustainable technologies) and local companies (e.g., Dispelix, Chipmetrics, Kelluu, Narskuttelu) will be invited to the school during the academic year. Whenever possible, female speakers from companies will be prioritized to inspire girls with their career stories. Additionally, guardians working in science-related fields will be invited on three separate days to give short career talks during recess. These events will be open to the entire school. Field trips will also be organized to local destinations such as the Botania botanical garden and the Noljakka birdwatching tower, which will also serve as nature excursions. More distant destinations include Koli National Park and the Heureka Science Centre.

To support the program, a visual event pathway has been created, summarizing the school year's events on a monthly basis. This pathway is presented in the final section of this document, which also outlines how the goals described in the pathway will be achieved. The pathway allows participants to easily grasp upcoming events at a glance. Copies will be posted on school bulletin boards as posters, and detailed dates and times will be communicated via the Wilma messaging system closer to each event.

Teachers responsible for individual events will independently plan the content in accordance with the national curriculum. A ready-made lesson plan template (Figure 1) has been developed to support teachers in planning, which they may use if they wish. After each event, participants will be surveyed to assess how engaging the activity was and whether it increased their interest in the subject.

Itä-Suomen yliopiston harjoittelukoulu Opetuksen suunnitelma				
Ajankohta: Luokka-aste:		Aihe / Teema / Ilmiö:		Opettaja:
Sisällöt (S1 – Sx) ja tavoitteet (T1 – Tx) opetussuunnitelmasta täsmennettyinä:			Keskeiset käsitteet / taidot	
Työskentelyn tavoitteet:				
Laaja-alaisen osaamisen tavoitteet (L1 – L7) täsmennettyinä:				
Opiskelijan omia tavoitteita ja niiden saavuttamisen arviointia:				
Toimintasuunnitelma				
ajankäytön suunnitelma (min.)	toiminta ja teoreettinen perusta	organisointi	osaamisen ja työskentelyn arviointi; formatiivinen, oppimista edistävä arviointi	muuta (esim. etukäteistyöt, jälkityöt)

Figure 1. Lesson plan base provided for helping the planning of events.

6. ACTION PLAN

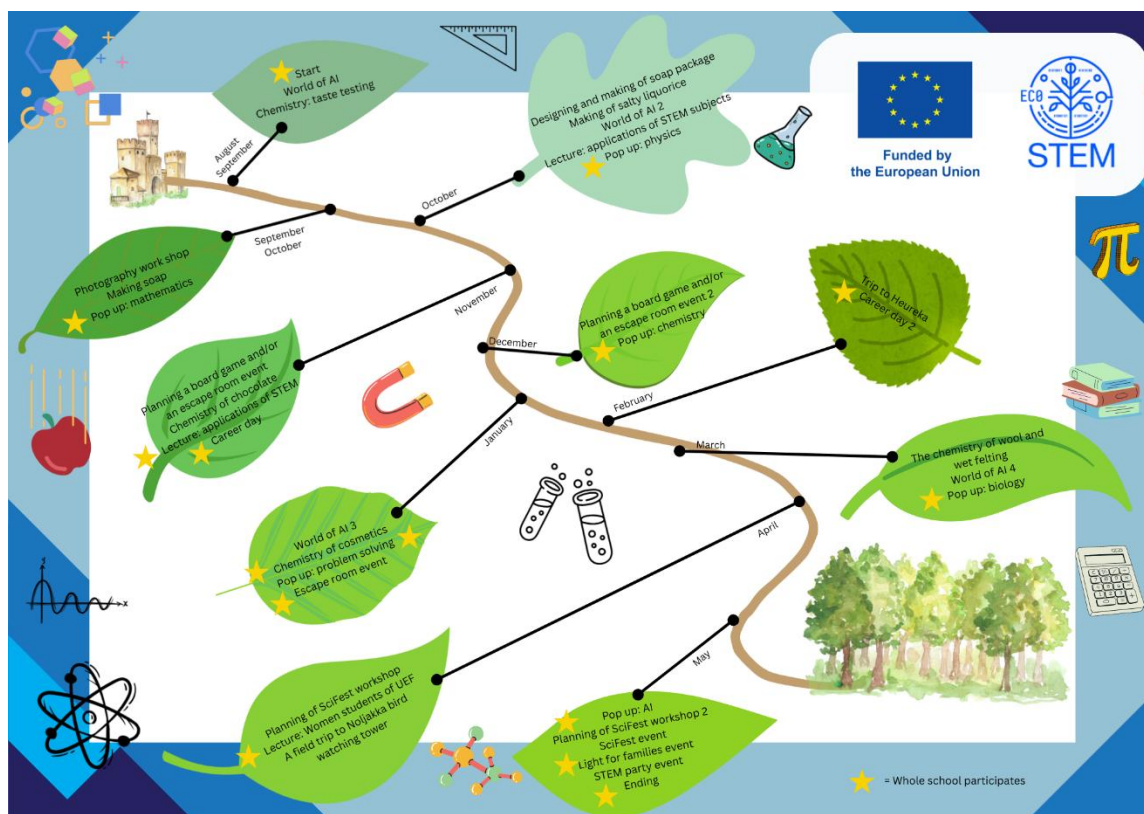
Area	Tasks	Results	Target group
1. Competences of teachers	Student teachers are already being trained in adopting the appropriate professional approach and in how to teach STEM subjects in an engaging way that takes individual learners into account. Teachers have the opportunity to showcase their expertise by voluntarily teaching elective STEM lessons. The developed lesson plans and materials will be shared with other STEM teachers. A shared resource bank will be created to support collaboration and the dissemination of best practices.	Ready-made lesson plans that can be reused and further developed in the future Practical experience for student teachers, which will benefit them in their professional careers Teachers actively involved in delivering elective STEM lessons Shared teaching materials accessible to all educators	Subject teachers Student teachers
2. Interest education and career education	Collaboration with UEF and LUMA-center, visitors and visits Collaboration with the Botania Tropical Garden Collaboration with the Heureka Science Centre and Koli National Park Guest lecturers from the University of Eastern Finland (UEF) and partner companies Activation of guardians through dedicated presentation days, during which guardians are invited to share their career experiences in STEM fields (a survey will be conducted in early autumn 2025 to support this)	At least three expert lectures during the academic year One field trip to the Botania Tropical Garden One field trip to the Heureka Science Centre Four excursions to either local companies or the LUMA Center Three guardian presentation days, during which guardians will share insights into their professions in STEM fields	The program is designed to include the entire school community, approximately 250 lower secondary students and potentially 120 first-year upper secondary students.

	Career guidance lessons will aim to include videos related to STEM professions		
3. Learning process	Continuity in the learning process will be supported through the use of both summative and formative assessment methods. To enhance reflective learning, an application that supports the concept of a learning diary will be introduced, taking advantage of the fact that all students have access to Chromebooks. The program will also make use of multimedia tools and content to enrich the learning experience.	Learning diary entries from the pupils.	Students, especially those participating in active STEM groups This includes students in grade 7, those enrolled in the grade 8 elective STEM course, and participants in the Lithuania–Poland mobility program (year 25-26).
4. Internationalization	The school will actively participate in the spring 2026 project as part of this initiative. All materials created during the project will be actively shared in English via the school’s social media and official website.	The project emphasizes the development of collaborative networks and the co-creation of shared teaching materials among participating educators and institutions. The initiative also explores the possibility of establishing international partner school relationships to support long-term collaboration and cultural exchange.	All the students
5. A special emphasis on the use of digital resources	Students will begin learning digital literacy skills from the start of grade 7. Particular emphasis will be placed on safe internet use and understanding the legal aspects of using digital materials. An initial assessment will be conducted to determine students’ current level of digital competence. Since all students have access to Chromebooks, they will also be	Students will learn to navigate the internet with a critical mindset, interpreting information thoughtfully and evaluating its reliability. They will be taught to use a variety of digital tools in genuinely meaningful and productive ways. The program will also emphasize the importance of recognizing both the risks and	Lower secondary school students

	taught how to use them in versatile and effective ways to support learning. Special attention will be given to the responsible and critical use of artificial intelligence, with guidance provided from an early stage.	opportunities associated with digital environments and technologies.	
6. Investments needed in the IT tools and infrastructure	A competitive bidding process for 3D printers will be organized in early autumn 2025 A dedicated 3D printer will be acquired for the lower secondary school At some point, students will be provided with more durable and efficient devices to replace the current Chromebooks	A 3D printer is available for use at the school, supporting hands-on learning and project-based activities, particularly in STEM subjects.	will benefit the whole school community, including lower secondary students, upper secondary students, and staff members

7. A ROADMAP FOR BUILDING A STEM ECOSYSTEM

This section outlines, month by month, the events and activities planned for the 2025–2026 school year. The program’s visual event pathway is presented below. A similar sequence of events can be adapted for use in any school year.



August/September

- Joint planning meeting, if everything wasn't finalized at the end of the previous school year
- Room reservations for the entire program: classrooms, pop-up spaces, auditorium, etc.
- Confirmation of participants in the elective STEM club (approximately 15 eighth-grade students)

1. Whole-school STEM event: STEM kickoff event held either in the gym or auditorium. STEM teachers give presentations and introduce the structure of the school year. Whole-school egg drop competition (budget approx. €50)

--> Appointment of responsible person(s)

--> Classes design their devices according to instructions from the STEM teacher

--> Eggs are dropped class by class

--> The event is recorded, and the results are evaluated based on success (the egg must not break)

- Email communication with Botania Tropical Garden:
Confirming the date and time of the visit (budget approx. €170)

September (or when the elective club begins, latest in October)

Workshop: Introduction to the World of Artificial Intelligence
Topics include theoretical foundations of AI, text generation (LLM language models), and image generation using AI.

Chemistry activity: Taste tests

Photography workshop
Topics include camera technology, how the human eye works, lenses, and the art of photography.

Chemistry activity: Soap making

2. Whole-School STEM Event:
Pop-up: Mathematics – engaging mathematical problems and challenge

October

Visual design and production of soap packaging, incorporating elements from visual arts (budget approx. €50)

Chemistry activity: Making salty liquorice (salmiakki)

AI Workshop 2 – Topics include fundamentals of AI, as well as sound and video generation using artificial intelligence

3. Whole-School STEM Event:
Pop-up: Physics – Exploring visible phenomena in physics such as optics, electromagnetism, motion, and force

November

Designing a board game and escape room game (budget approx. €200), incorporating presentations and themes from STEM fields

Chemistry activity: The chemistry of chocolate

11. Whole-School STEM Event:
Pop-up: Biology – Exploring living organisms and genetics

April

SciFest event planning workshop – Students begin preparing for participation in SciFest

12. Whole-School STEM Event:
Lecture: Female university students on stage – Inspiring talks and role models from STEM fields

Excursion to Noljakka birdwatching tower and nature day – Outdoor learning and exploration of local biodiversity

May

13. Whole-School STEM Event: Pop-up: Artificial Intelligence

SciFest Event Planning Workshop 2

14. Whole-School STEM Event: SciFest Event, featuring a workshop led by our students and attended by students from nearby municipalities/schools.

"Light for Families" Event, where we organize a workshop/play activities for small children.

15. Whole-School STEM Event: STEM Celebration, showcasing the achievements of the entire year (budget approx. €200). Possibly held at the same time as an activity day for younger students (primary school), providing an opportunity to introduce STEM subjects to them as well.

When implementing the activities, it is important to ensure that teaching materials and guidance support the participation of all students. Lessons and pop-up events should include diverse examples that reflect a variety of interests.