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Compendium

CODING GIRL

GIRLS JUST WANT TO HAVE FUN CODING

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Introduction

The CodingGirl: Girls Want to Have Fun Coding project, funded by the Erasmus+ Programme, was created to empower girls in science, technology, engineering, arts, and mathematics (STEAM). Its vision is to inspire a new generation of girls to discover technology and creativity as interconnected pathways, while helping teachers and educators integrate gender-sensitive and inclusive pedagogical approaches into their classrooms.

Throughout the project, partners from five European countries organized a series of national and international hackathons designed specifically for educators. These events encouraged collaboration, creativity, and the exchange of ideas to develop innovative lesson plans that motivate girls to explore STEM subjects through hands-on, interdisciplinary, and emotionally engaging learning experiences.

The Compendium of Good Practices presented in this publication brings together the best results of these hackathons — the winning Lesson Plans selected for their originality, clarity, and pedagogical value. Each plan demonstrates how non-standard teaching methods can increase girls' motivation, confidence, and curiosity in STEAM fields by combining creativity, experimentation, and digital tools.

The Compendium is intended as a practical resource for teachers, educators, and trainers who wish to adopt or adapt these lesson plans in their own educational settings. It highlights the potential of hackathons as an educational innovation tool and the importance of supporting gender equality in the digital transformation of education.

Together, the examples presented here illustrate how the CodingGirl project contributes to a more inclusive, creative, and future-oriented approach to STEAM education — one that ensures that girls not only participate in technology but shape it.

Why Girls in STEAM Matter: Insights from Research

The persistent underrepresentation of girls and young women in STEAM disciplines (Science, Technology, Engineering, Arts, and Mathematics) remains a significant challenge globally. Addressing this gap requires a clear understanding of the factors that influence girls' motivation, confidence, and sustained engagement in these fields. This chapter synthesizes empirical research and theoretical insights focused specifically on pedagogical strategies and innovative practices that effectively support girls' participation in STEAM, with a particular emphasis on programming and coding education. The review highlights studies exploring hands-on coding experiences, problem-based learning, interdisciplinary teaching, and the integration of digital tools such as micro:bit, alongside collaborative learning and the empowerment through female role models.

The scope of this chapter encompasses studies that examine interventions and educational approaches in secondary and tertiary educational settings. It centers on research demonstrating how experiential learning, creative applications, and social support structures impact girls' self-efficacy and interest in STEAM disciplines. By drawing connections among diverse lines of inquiry, the review establishes a theoretical foundation relevant to the objectives of the Coding Girl project, especially in designing hackathons and lesson plans that foster motivation and confidence among girls engaging with coding activities.

This introduction sets the stage for a coherent exploration of the existing knowledge landscape, outlining the critical themes and evidencing the vital need for innovative, inclusive pedagogical frameworks in STEAM education for girls.

Gender Gap and Barriers in STEAM Education

Despite decades of initiatives, the under-representation of girls and women in STEAM disciplines remains persistent. Research consistently shows that even when girls match or exceed boys in academic achievement, they frequently report lower self-efficacy and less interest in technology-related fields. For instance, in a longitudinal study of engineering students, female participants earned higher grades than their male peers but reported significantly lower confidence in their abilities. Such findings highlight the critical role of identity, belonging, and confidence in STEM persistence. Further, early research reveals that children as young as six already internalize stereotypes about programming and robotics, and girls with stronger stereotypical beliefs show lower interest and self-efficacy – yet when given programming experience the gender gap can be eliminated.

These findings underscore that interventions cannot focus solely on cognitive skills: they must adopt inclusive pedagogies, promote positive female STEM identities, and tackle cultural and institutional barriers that deter girls from pursuing STEM pathways.

Why Girls in STEAM Matter: Insights from Research

Early Engagement and Experiential Learning

Early engagement in hands-on, meaningful STEM experiences has been shown to bolster girls' interest, motivation and confidence. The significance of experiential learning emerges from research showing that girls who engage in practical programming or robotics activities at a young age report higher interest in technology and stronger self-efficacy compared to girls without such experience.

Such activities not only build competence, but also contribute to the development of science capital — a concept that encompasses attitudes, knowledge, social contacts and dispositions supportive of learning and identity in STEAM. By participating early in collaborative, tactile and technology-rich experiences (such as maker-spaces or coding clubs), girls develop a sense of agency and belonging in STEAM contexts.

Innovative Pedagogical Approaches

Traditional didactic instruction has often failed to engage girls in STEM; by contrast, innovative pedagogical models like problem-based learning (PBL), project-based learning (PjBL) and interdisciplinary STEAM integration show strong potential for increasing motivation and persistence among girls in technology-related fields.

In particular, the integration of digital tools such as the micro:bit into teaching practice has been shown to stimulate creativity, collaboration and teacher self-efficacy. For example, research from the Micro:bit Educational Foundation indicates that use of micro:bit devices in UK schools enabled group-work and project-based computing tasks, enhancing students' engagement.

A systematic review of the micro:bit in K-12 education found that although hardware and programming challenges persist, the device enables tangible, student-centred making experiences and supports the development of computational thinking and design orientation.

Collaboration, Peer Learning and Mentorship

Collaborative and peer-supported learning environments have proven to be particularly effective in engaging girls in computing and technology education. Studies on girls' participation in coding and digital-making projects show that when they work in all-female or balanced teams, they tend to perceive collaboration as the most accessible and rewarding aspect of the learning process, while abstract reasoning and debugging tasks are often considered more challenging.

These findings highlight the importance of designing inclusive, team-based learning experiences where girls can share ideas, exchange knowledge, and support each other's learning processes. Such environments foster mutual encouragement, reduce anxiety associated with technical problem-solving, and strengthen confidence in STEM-related competencies.

Why Girls in STEAM Matter: Insights from Research

Online Game Creation

Game creation provides an interdisciplinary bridge between logic, storytelling, design, and digital literacy. It invites learners to think critically, code interactively, and design meaningful experiences for users. Empirical studies on project-based STEAM curricula show that game creation improves intrinsic motivation, creativity, and problem-solving skills, particularly among girls who appreciate narrative and collaborative learning (Tuomi & Ruuska, 2021). The process of developing even simple digital games — from conceptual design to coding and testing — helps to demystify programming and cultivate perseverance through iterative learning cycles. It also supports social learning, as teamwork and peer feedback are integral to the creative process.

Graphic Design

Graphic design acts as an inclusive and accessible gateway into STEAM by emphasising visual communication, human-centered design, and creative problem-solving. Integrating graphic design and user-interface development into STEM education helps learners understand that technology can be both functional and expressive. Frameworks based on design thinking demonstrate that combining arts and technology enhances engagement and self-expression among diverse learners, including girls who may not initially identify as technically oriented (Ng & Fergusson, 2020). By exploring digital composition, typography, and colour psychology, learners cultivate aesthetic awareness while building transferable skills relevant to media, marketing, and digital innovation sectors.

3D Printing and Modelling

The integration of 3D printing technologies into STEM classrooms transforms abstract design concepts into tangible realities. This process reinforces spatial reasoning, mathematical understanding, and creativity through physical prototyping. Empirical research in UAE and European schools reports that introducing 3D modelling and fabrication improves students' attitudes toward STEM careers, particularly among female learners who value the hands-on, design-oriented aspects of learning (Al Amri et al., 2023). Beyond technical skills, 3D printing nurtures patience, iteration, and precision — key engineering competencies — while allowing learners to visualize the societal and environmental relevance of their creations, such as sustainable materials or assistive technologies.

These five domains embody the shift from abstract programming concepts to tangible, design-oriented, collaborative projects that reflect inclusive pedagogy. They allow educators to structure experiences that connect with students' prior interests, support diverse entry points into technology, and build agency among girls. By focusing on creativity, iteration, and real-world making rather than solely syntactic mastery, such tool-driven approaches align with research highlighting how experiential, inclusive practices foster girls' participation and persistence in STEAM.

Why Girls in STEAM Matter: Insights from Research

By integrating such technologies into education, teachers can cultivate a learning environment that celebrates experimentation, diversity of approaches, and shared discovery. This digital ecosystem — spanning coding, design, and fabrication — exemplifies how accessible tools can make STEAM learning both equitable and inspiring for girls.

Empowerment Through Role Models and Representation

Representation and visibility of women in STEAM are essential for shaping girls' aspirations, self-concepts, and long-term engagement in technology-related careers. Numerous studies confirm that exposure to female scientists, engineers, and innovators significantly increases girls' sense of belonging, motivation, and confidence in their own abilities (Ellis et al., 2015; Cheryan et al., 2017). When learners see people who resemble them succeeding in scientific or technical domains, they internalize new possibilities and begin to perceive STEAM as a space where they can meaningfully contribute. This process helps counteract the so-called "stereotype threat" — the internalized fear of confirming negative stereotypes — which has been shown to lower girls' performance and persistence in STEM fields (Spencer et al., 2016).

In inclusive education, narratives and storytelling play a transformative role in bridging the gap between abstract career paths and personal identity formation. Approaches such as video-based personal stories, mentorship programmes, and interactive exhibitions provide learners with emotional engagement, relatability, and practical insight into women's real-life journeys. Storytelling humanises success and reframes technology as a socially and creatively fulfilling field rather than one dominated by complexity or competition.

The CodingGirl project embodies these principles through the creation of a digital "Living Library" of women in STEAM — an online collection of authentic video interviews presenting professionals from diverse technical and creative backgrounds. Each story serves as a "living book" that students can explore to understand not only career trajectories but also values such as perseverance, curiosity, and collaboration. This format moves beyond static role-modelling to offer dialogic and reflective learning experiences, encouraging girls to identify with specific skills, aspirations, or personal narratives.

Furthermore, peer and near-peer mentorship — where university students, young professionals, or educators mentor younger girls — has proven particularly effective in sustaining engagement. Research indicates that such horizontal mentorship models foster empathy, approachability, and empowerment, creating a supportive community of learning (Stoeger et al., 2021). By linking mentorship with digital storytelling, projects like CodingGirl demonstrate how visibility and connection can transform inclusion into active participation and leadership.

Why Girls in STEAM Matter: Insights from Research

Ultimately, representation in STEAM education is not only about visibility but also about voice and agency. Empowering girls to become both learners and storytellers allows them to redefine the narrative of technology itself — from a field that excludes to one that evolves through diversity, creativity, and collaboration.

Towards Gender-Inclusive STEAM Education

The pursuit of gender equality in STEAM education represents not only a matter of social justice but also a strategic imperative for innovation and sustainable development. Research consistently demonstrates that diversity in scientific and technological teams enhances creativity, problem-solving, and overall performance (UNESCO, 2023). Yet despite decades of initiatives, girls remain underrepresented in many STEAM domains, particularly in computer science and engineering. Creating truly inclusive learning environments, therefore, requires a systemic approach that goes beyond recruitment — one that transforms how technology, creativity, and identity are taught, represented, and valued.

Empirical evidence points to four key levers for promoting the inclusion of girls in STEAM:

1. **Early engagement** with hands-on, meaningful STEM activities that build curiosity, agency, and self-efficacy from the earliest educational stages;
2. **Innovative pedagogies** emphasizing project-based, interdisciplinary, and collaborative learning that link science and technology with creativity and social relevance;
3. **Accessible digital tools and learning environments** that lower entry barriers, support experimentation, and make technology an inclusive medium of expression;
4. **Visible female role models and inclusive narratives** that foster belonging, identity, and confidence among girls and young women.

These levers must work in synergy. Early experiences are only transformative when supported by innovative pedagogy; digital tools are only empowering when used within equitable and creative contexts; and role models are most effective when their stories are integrated into daily learning. Together, they form a holistic framework for gender-inclusive education, bridging cognitive, emotional, and social dimensions of learning.

The CodingGirl Hackathon Methodology embodies this comprehensive approach. It brings teachers, mentors, and students together in collaborative hackathons to co-create inclusive lesson plans and interdisciplinary activities that align with real classroom needs. By combining micro: bit programming, digital design, mobile app development, game creation, and 3D modelling, participants explore multiple pathways to STEAM engagement that appeal to diverse learning styles and interests. The hackathon format itself functions as a social laboratory for inclusion — encouraging teamwork, open communication, and creative problem-solving in a supportive environment.

Why Girls in STEAM Matter: Insights from Research

Moreover, the integration of storytelling and living libraries of women in STEAM connects these educational innovations with powerful narratives of representation and empowerment. This interplay between technical practice and human story transforms learning from the acquisition of skills into the formation of identity and purpose.

From a broader policy perspective, the project aligns with the European Commission's Gender Equality Strategy (2020–2025) and the EU Digital Education Action Plan, both of which emphasize gender-responsive digital education and the active participation of girls in shaping technological futures. By equipping educators with concrete tools and methodologies, CodingGirl contributes to these policy goals, turning abstract principles of inclusion into tangible classroom practice.

Ultimately, each of the winning lesson plans presented in this compendium reflects this integrated philosophy. They showcase how inclusive, creative, and technology-rich pedagogy can transform learning experiences — not only motivating girls to participate in STEAM, but empowering them to lead and innovate within it.

Innovative Didactic Approaches

The lesson plan integrates multiple pedagogical innovations designed to make STEAM education more engaging, inclusive, and relevant to all learners — particularly girls. Its structure builds on evidence-based strategies that enhance curiosity, agency, and a sense of accomplishment through hands-on exploration and real-world connections.

Environmental Context Combined with Digital Technologies

Research shows that girls often demonstrate higher engagement when learning activities are linked to socially and environmentally meaningful topics (UNESCO, 2023). By combining environmental monitoring with programming and sensor technology, the lesson connects abstract technical concepts with issues that students perceive as personally and socially relevant — such as sustainability, climate awareness, and healthy living conditions. This connection fosters emotional resonance, encourages ethical reflection, and highlights the societal role of technology as a force for positive change.

Hands-On Discovery and Real Data Collection

Experiential learning lies at the heart of the CodingGirl methodology. Instead of relying on abstract explanations, students gather, record, and interpret real data from their surroundings, which strengthens understanding and critical thinking. This approach aligns with findings from problem-based and inquiry-based learning research, which confirm that hands-on discovery fosters deeper conceptual comprehension and long-term retention (Hmelo-Silver et al., 2007). The process of observation, measurement, and reflection supports students' autonomy and transforms learning into an investigative experience rather than a passive reception of facts.

Data Visualization and Analysis

Translating numerical data into visual forms — such as tables, graphs, and digital dashboards — enhances both data literacy and analytical reasoning. Visualization helps students to recognize patterns, make comparisons, and formulate conclusions in an accessible and intuitive way. For many girls, the aesthetic and communicative aspects of data presentation make scientific inquiry more engaging. It also mirrors practices in modern STEM professions, where data storytelling is a key skill. By integrating digital visualization tools, students experience how technology supports the understanding and communication of scientific information.

Innovative Didactic Approaches

Collaboration, Inclusion, and Emotional Support

Collaborative learning structures are essential for building an inclusive and supportive classroom culture. Working in mixed or all-female teams allows girls to participate actively, share ideas, and take on leadership roles. Cooperative tasks foster empathy, responsibility, and mutual encouragement — qualities associated with higher persistence in STEAM learning. Teachers facilitate this process through emotional scaffolding, creating a psychologically safe environment where mistakes are viewed as opportunities for learning. This aligns with research indicating that peer support and teacher empathy significantly improve girls' self-efficacy and engagement in technology-related education (Stoeger et al., 2021).

Creativity and Design Thinking

In the final phase, students design a functional prototype — a device that triggers an alarm when temperature or humidity thresholds are exceeded. This task introduces elements of design thinking, combining analytical reasoning with creative problem-solving. Students empathize with users, define problems, generate ideas, and iteratively refine their solutions. Such creative autonomy enhances motivation and demonstrates that coding and engineering can be expressive, artistic, and purposeful activities. For girls in particular, design-oriented challenges provide multiple entry points into technology, validating different strengths and perspectives.

Integration of CodingGirl Outputs

Materials developed within the CodingGirl project, especially the Living Libraries videos that portray real women working in STEAM fields, can enrich the lesson. By embedding these narratives, the activity situates technical learning within a broader human context. Storytelling and personal testimonies allow students to identify with authentic role models, breaking down stereotypes and making success in STEAM appear attainable and desirable. These visual narratives reinforce the message that innovation thrives on diversity, creativity, and collaboration (STEM Education Journal, 2022).

Methodology of the Lesson Plan

The lesson plans developed within the CodingGirl: Girls Want to Have Fun Coding project are grounded in modern, student-centred pedagogical frameworks that emphasise creativity, inquiry, collaboration, and inclusivity. Their methodological design follows the principles of experiential learning, connecting theory with practice and encouraging learners to construct knowledge through exploration, experimentation, and reflection. Each lesson is structured to promote engagement, confidence, and agency—particularly among girls—by presenting technology as an accessible, creative, and socially meaningful field.

Pedagogical Orientation

The methodological foundation combines several complementary approaches:

Design-Based Learning (DBL)

Design-Based Learning is a problem-solving approach in which students move through iterative cycles of investigation, design, prototyping, and testing. It reflects authentic processes used by engineers and designers, encouraging learners to apply knowledge in context. This model allows students to design their own solutions to real-world challenges and experience a sense of ownership and accomplishment. In CodingGirl lessons, DBL nurtures creativity, critical thinking, and resilience while fostering teamwork and self-directed learning.

Project-Based Learning (PBL)

Project-Based Learning situates knowledge within authentic, real-world tasks. Students work collaboratively on projects that have practical relevance, combining scientific reasoning with technological implementation. The PBL framework enhances long-term motivation by linking learning to meaningful outcomes—such as developing an app, building a prototype, or presenting data-driven conclusions. For girls, this format highlights the societal value of technology, helping them connect digital competence with empathy, community, and sustainability.

Inquiry-Based and Constructivist Learning (IBL)

Inquiry-Based Learning aligns with the constructivist notion that learners actively build understanding through discovery. Teachers guide students in formulating questions, testing hypotheses, analysing results, and drawing conclusions. This approach encourages curiosity, experimentation, and higher-order thinking. In inclusive classrooms, it also values diverse learning styles and empowers each student to progress at their own pace. The open-ended nature of inquiry allows for creativity, risk-taking, and collaboration—all vital for reducing gender-related performance anxiety in STEAM.

Methodology of the Lesson Plan

Learning Process and Structure

The general flow of each CodingGirl lesson follows an experiential and iterative sequence designed to engage learners cognitively, emotionally, and socially:

1. Introduction and Motivation – A real-world context or challenge is presented to capture interest and relate learning to everyday experience.
2. Exploration and Questioning – Students observe, discuss, and formulate hypotheses about the problem.
3. Design and Experimentation – Learners collaboratively design and build a solution (e.g., coding a programme, creating a model, or testing a prototype).
4. Data Collection and Analysis – Students gather evidence, evaluate performance, and refine their ideas based on feedback.
5. Presentation and Reflection – Each group shares outcomes, discusses lessons learned, and reflects on both process and teamwork.

This structured yet flexible framework encourages active participation, iterative thinking, and creativity. It integrates digital tools as enablers of problem-solving and promotes cross-disciplinary connections between science, technology, art, and society.

Inclusion and Gender Sensitivity

All CodingGirl lesson plans are explicitly designed to foster gender-inclusive participation. This is achieved through:

- Collaborative team structures that value equal contribution and peer support;
- Emphasis on creativity, social impact, and aesthetics to appeal to diverse interests;
- Accessible entry points for beginners through intuitive tools and visual programming;
- Positive reinforcement and mentoring that strengthen girls' confidence in technical roles.

Teachers are encouraged to act as facilitators, guiding rather than directing learning. Representation of women in STEAM—through examples, discussions, and storytelling—is integrated into lessons to normalise girls' presence in technological contexts and counteract stereotypes.

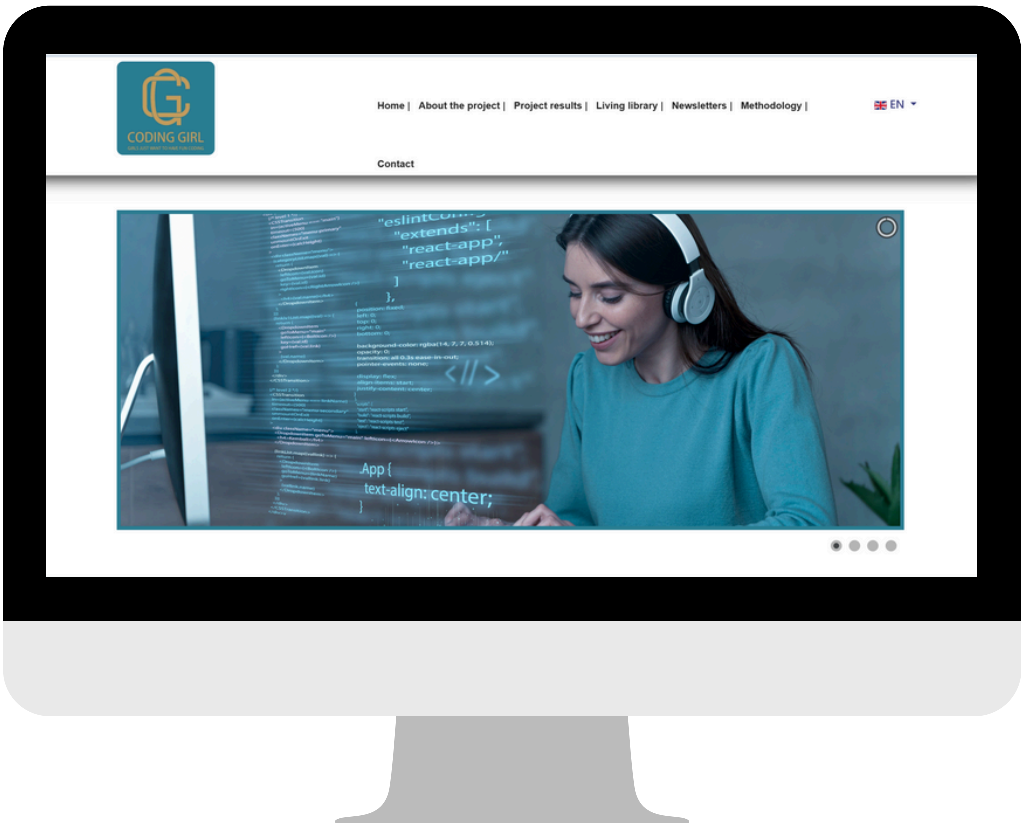
Methodology of the Lesson Plan

Pedagogical Outcomes

The methodological framework enables students to:

- Develop problem-solving and computational thinking skills;
- Connect abstract STEAM concepts to real-world applications;
- Collaborate effectively in diverse teams;
- Build confidence in digital creativity and innovation;
- Recognise the social and environmental relevance of technology.

For educators, the methodology offers a replicable model for creating engaging, inclusive, and future-oriented STEAM activities. It demonstrates how coding, design, and digital making can be used not only to teach technical skills but to empower learners—especially girls—to think critically, act collaboratively, and innovate with purpose.



Contribution to Girls' Motivation in STEAM

The methodological and thematic design of the lesson plan directly supports intrinsic and extrinsic motivation by connecting learning with meaning, creativity, and belonging. It builds confidence and curiosity by showing that technology is not reserved for experts but is accessible, relevant, and fun to explore.

1. Relevance and Meaning: Environmental topics connect technology with values of care, sustainability, and responsibility. This real-world significance resonates strongly with girls, who often prefer learning contexts with visible social impact.
2. Active Learning: Students play an active role in the learning process — formulating questions, collecting data, and interpreting results. This sense of autonomy and agency is critical for maintaining long-term engagement in STEAM disciplines.
3. Accessible Technology: The micro:bit and similar educational tools lower entry barriers to programming. Their intuitive interfaces allow all students to participate successfully, regardless of prior experience, fostering a sense of mastery and competence.
4. Visualisation and Teamwork: The process of converting data into graphs and discussing results within groups supports collaborative problem-solving and provides visible evidence of achievement. For girls, the social and aesthetic dimensions of teamwork enhance motivation and reinforce learning through shared success.
5. Role Models and Representation: Integrating female role models through the Living Libraries offers positive, relatable examples of women thriving in STEAM professions. This visibility counters stereotypes and helps students develop a stronger STEM identity and belief in their own potential.
6. Interdisciplinarity: The lesson bridges science, mathematics, technology, environmental education, and creativity. This multidisciplinary connection mirrors real-world problem-solving and demonstrates that innovation arises from collaboration across domains, rather than isolation within a single subject.

Through these elements, the CodingGirl lesson plan exemplifies how inclusive didactic innovation can transform traditional STEM learning into a dynamic, inspiring, and equitable experience. It supports not only the development of technical competence but also emotional engagement, self-confidence, and a sense of belonging—key factors for sustaining girls' participation and leadership in STEAM education and careers.

Innovation in Practice: Teaching Ideas Born in Hackathons

The CodingGirl Hackathons brought together teachers, educators, and mentors from across partner countries to co-create lesson plans that promote girls' engagement in STEAM education. Each hackathon provided a collaborative, creative, and time-bound environment in which participants combined pedagogical expertise with innovative technologies to design lessons that are both inclusive and inspiring.

The hackathon format encouraged experimentation, teamwork, and cross-disciplinary dialogue — mirroring the very principles that underlie the CodingGirl methodology. Participants explored how digital tools including micro:bit programming, mobile app development, online game creation, graphic design, and 3D printing can be integrated into classroom activities to enhance curiosity, confidence, and creativity among students.

The lesson plans presented in this section represent the best practices and winning entries selected during the hackathons. They illustrate how inclusive didactic approaches can transform abstract technical content into meaningful, hands-on learning experiences. Each plan demonstrates the potential of accessible digital tools, collaborative learning, and real-world relevance to motivate girls and make technology education more engaging for all learners.

Lesson Plan 1 – How to Keep Secrets?

The lesson plan “*How to Keep Secrets?*” represents an inspiring and innovative approach to teaching topics related to safety, digital literacy, and algorithmic thinking for students aged 8–15. The lesson was developed during the CodingGirl Hackathon as a cross-curricular activity combining computer science, mathematics, and art. It demonstrates how experiential learning can effectively foster logical reasoning, creativity, and responsible technology use.

The main goal of the lesson is to teach students the principles of creating secure passwords, raise awareness about the risks of sharing personal information, and let them explore—through interactive activities—how data protection can be strengthened both technically and logically. The title itself, “How to Keep Secrets?”, personally engages students and encourages them to reflect on their own experiences with securing accounts, passwords, and personal data.

The lesson begins with a **motivational phase**, where students watch a short video about creating strong passwords and discuss what makes a password resistant to hackers. They then work in groups of three and use the online tool passwordmonster.com to test the “strength” of their invented passwords. This activity stimulates active participation, develops critical thinking, and provides immediate feedback.

In the **expositional phase**, the topic connects with mathematics and computer science. Students apply principles of combinatorics—calculating how many password combinations can be created with a given number of characters—and verify these calculations using makecode.org for micro:bit. They create a simple program that demonstrates how increasing the number of characters also increases the number of possible combinations and thus the security of the password. Learning becomes interactive and tangible even for younger students, who better understand the concept of cybersecurity through practical experimentation.

The activity also integrates art education: students design and create their own “girls' diary,” which can be opened only by entering a secret code. This approach successfully links the technical and creative dimensions of learning, strengthening motivation—especially among girls—for whom the theme of secrets and privacy is emotionally resonant. The opportunity to design a personal digital “safe” for their thoughts and secrets that is secured by a unique code appeals to their natural need for privacy and individuality. This combination of cybersecurity and creativity makes the plan especially accessible and engaging, as it connects technology with emotional intelligence.

In the **fixation phase**, students test each other's creations. Each group sets an eight-character password, exchanges their micro:bit with another group, and tries to “crack” the other team's code. This fun and competitive activity reinforces the understanding of security principles. The winning team then presents their project to the rest of the class, promoting the principle of peer learning.

Lesson Plan 1 – How to Keep Secrets?

From a pedagogical perspective, this lesson plan is an example of an innovative **STEAM-based approach** that integrates digital skills, mathematical thinking, artistic creativity, and social competence. Learning is structured around inquiry and creation—students do not passively receive information but instead experiment, test, compare, and draw conclusions. The teacher's role shifts to that of a facilitator, providing a safe environment for curiosity, exploration, and creativity.

The lesson is also exceptional in that it leads students to a **practical understanding of digital responsibility**. It shows them that internet safety is not a theoretical concept but a real-life issue that affects them directly. Through collaborative, logical, and programming-based activities, students learn that even small actions—such as creating a strong password—can have a big impact.

Thus, "*How to Keep Secrets?*" represents a model innovation in teaching computer science and digital safety, combining critical thinking, experiential learning, and creativity. It enables students to experience success, develop digital competencies, and supports equality in access to technology by merging rational thinking with playfulness and design. This approach fully aligns with the philosophy of the CodingGirl project—it sparks curiosity, builds confidence, and shows that the world of technology can be safe, engaging, and creative.

Lesson Plan 2 – Healthy Meal Plan

The lesson plan "*Healthy Meal Plan*" presents a modern and innovative approach to education that connects healthy nutrition with digital technologies and visual creativity. Developed during the CodingGirl Hackathon, it serves as a model example of interdisciplinary learning that combines elements of biology, computer science, chemistry, and art. The lesson aims to help students understand the principles of a balanced diet, think critically about food and its nutritional value, and at the same time develop their digital and creative skills through accessible and familiar tools.

The lesson begins with **a motivational phase**, where students, after watching a short video and engaging in a discussion, reflect on their eating habits, assess them critically, and formulate what "healthy eating" means to them. Already in this stage, they practice reasoning and argumentation. In the first practical activity, they use Canva to create a memory card game (pexeso) connecting less healthy foods with their healthier alternatives. This allows them to understand the difference between energy content and nutritional value.

In the next stage, students work in groups to design and program a nutrition quiz using micro:bit or an online tool. This activity requires continuous and effective communication, as they must collaborate on researching information, justify their choices for correct and incorrect quiz answers, and coordinate programming. The learning process thus becomes experiential, fostering teamwork, critical thinking, data verification from multiple sources, and above all, communication and logical reasoning skills.

The final phase of the lesson focuses on consolidating knowledge through the creation of an infographic titled "My Ideal Meal Plan" in Canva. Students take into account the recommended daily energy intake and create a balanced meal plan, which they then present to their classmates. Their work is compiled into a digital portfolio that can serve as inspiration for other classes. Reflection at the end of the lesson helps students realize how technology can support a healthy lifestyle and how visual communication can be used to share scientific knowledge.

While creating high-quality infographics, students also develop essential interpersonal skills such as communication, teamwork, and conflict management. A good infographic must tell a coherent story or clearly visualize complex data quickly and attractively. The key is to have a well-defined topic and use relevant, verified data. Visual elements—such as charts, diagrams, icons, and images—must be harmonious, support the text, and be aesthetically appealing, using a contrasting yet balanced color palette.

Lesson Plan 2 – Healthy Meal Plan

From a pedagogical perspective, this lesson plan exemplifies an innovative learning approach that connects theoretical knowledge with practical application, using technology as a tool for creative and meaningful learning. It builds on the principles of constructivist, project-based, and experiential learning. Students are not passive recipients of information; they explore, create, and evaluate independently. Throughout the lesson, they learn to link science with everyday life and to present information clearly, aesthetically, and persuasively. Using Canva enhances visual literacy, aesthetic awareness, and the ability to translate complex data into an understandable visual form.

Girls often naturally gravitate toward aesthetic infographic design, as creative visualization allows them to connect logical data processing with visual expression and self-realization—an approach that resonates with their typically well-developed expressive and communication skills. Designing data visually and telling a story through design also gives them a sense of ownership and control over information, making learning more personal and engaging.

Another important element of innovation lies in **the active role of the teacher**, who acts more as a guide and mentor. The teacher supports independent discovery, assists in problem-solving, and provides individual feedback. The lesson also contributes to strengthening girls' confidence in STEAM fields, as it connects topics of health and nutrition with technology and creative design—areas that are naturally attractive and relatable to them.

Lesson Plan 3 – Lifestyle and Digital Planning

The lesson plan "*Lifestyle and Digital Planning*" presents a comprehensive and well-structured approach to developing students' digital competences, critical thinking, and personal responsibility through creative activities focused on organizing everyday life. The lesson was created during the CodingGirl Hackathon as a model example of linking STEM education with topics of personal development, mental health, and time management.

The aim of the lesson is to help students recognize how digital tools can be used to manage their lifestyle, reduce stress, and maintain balance between school, work, and leisure. At the same time, students apply engineering and design thinking principles to develop their own solutions in the field of digital planning — from simple calendars to prototypes of virtual applications.

The lesson begins with the **motivational phase "A Day in a Digital Planner"**, where students explore real-life applications such as Google Calendar, Notion, or Trello. They enter their daily activities, timetables, and goals, while discussing how digital planning helps them better manage school responsibilities and free time. This activity fosters self-awareness and helps them learn how to organize their day realistically.

In **the expositional phase "Design Your Smart Daily Routine"**, students investigate how technology can be used to optimize a healthy lifestyle. Based on their research, they create a visual map of their ideal daily routine in a 3D environment or using online planning tools — including exercise, study time, rest, and social activities. Within the simulation, they observe how digital tools can be used to adjust schedules dynamically according to their needs, thereby learning the principles of digital flexibility and time management. A follow-up discussion allows them to reflect on how they perceive the balance between activities and rest in real life.

The fixation phase "Lifestyle Tech Challenge" represents the culmination of the lesson — students design and present their own digital planner or application addressing a specific lifestyle challenge. They can choose from three scenarios: tracking healthy habits (e.g. physical activity, hydration, sleep), planning balance between school and personal life, or creating an app for digital minimalism to reduce screen time. They use platforms such as Scratch, CoSpaces, or Tynker to design interactive prototypes. Team collaboration, brainstorming, testing, and presentation of results mirror the real process of engineering design — from identifying a problem to proposing and improving a solution based on feedback.

From a methodological perspective, the lesson is based on the principles of project-based learning (PBL), the engineering design cycle, and the constructivist approach. Students acquire knowledge through exploration and hands-on verification, learning not only to use technology but also to critically evaluate it. A significant innovation lies in the use of 3D environments, which visually link planning with spatial thinking and creative expression.

Lesson Plan 3 – Lifestyle and Digital Planning

From the perspective of **STEAM integration**, the lesson connects science (understanding healthy lifestyle principles), technology (digital planning), engineering (design of functional solutions), mathematics (optimization of time and activities), and art (visual expression and design). In this way, it develops not only digital, but also social and creative competences.

The innovative nature of this approach lies in the practical development of digital literacy — technology is not presented as a goal, but as a means to better manage life, foster self-reflection, and build responsibility. For girls, who are the target group of the CodingGirl project, this activity is particularly valuable because it connects the digital world with personal values and self-organization. From a psychological point of view, effective time management is crucial for girls, as it helps them balance high expectations in social relationships, academic performance, and extracurricular activities, thereby minimizing stress and reinforcing their sense of control over their own lives. This approach strengthens their confidence and motivation to pursue further studies in STEAM disciplines.

Student assessment is based on participation, creativity, and the ability to apply acquired knowledge in practice. The teacher evaluates the quality of proposed solutions, teamwork, and students' ability to explain how their digital tool addresses a specific challenge. The final presentations enhance communication skills and allow students to share different approaches to personal time and lifestyle management.

Lesson Plan 4 – Let's Make Waste Separators with 3D Technology

The lesson plan "*Let's Make Waste Separators with 3D Technology*" represents an inspiring example of how environmental education, technology, engineering, and mathematics can be effectively interconnected. It serves as a model activity demonstrating how ecological topics can become a platform for developing students' digital, creative, and scientific skills. The lesson was created during the CodingGirl Hackathon and reflects the need to teach young people sustainable approaches to the environment through experiential and experimental learning.

The goal of the lesson is to develop students' environmental awareness and help them understand the role of technology—particularly 3D printing—in promoting recycling and waste reduction. Students aged 13–14 work with a real-world problem: excessive waste production and the need for effective sorting. Through the process of engineering design, they progress through all stages of creation—from identifying the problem to developing and testing a functional prototype of a waste separator.

The motivational phase focuses on sparking curiosity and raising awareness that technology can contribute to solving environmental challenges. The teacher presents inspiring examples of 3D-printed devices that improve recycling processes. Students watch a short video about 3D-printed waste separators and discuss how technology can support environmental protection. This creates space for understanding human responsibility towards the planet and connecting theory with real-world issues.

I**n the expositional phase**, students explore the cycles of substances—water, oxygen, nitrogen, and carbon—and analyze how disruptions in these cycles affect ecosystems. They then move on to the practical part, where they begin designing their own models of waste separators in Tinkercad. They discuss functionality, sustainability, and aesthetics of their designs and compare them with existing real-life solutions. The activity combines scientific thinking with design skills and teamwork.

The fixation phase focuses on creation itself—students produce 3D models, print prototypes, and test their usability. During the process, they apply knowledge from mathematics (measurement, proportions, scaling) and technology (printing parameters, material handling). They learn to identify shortcomings, propose improvements, and reflect on their work. At the end, they present their models to the class, explaining which environmental problem their design addresses and how it benefits society.

The lesson plan is based on the principles of **engineering design and STEAM education**. Students follow the six steps of the engineering process: problem identification, research, planning, creation, testing, and re-engineering. This approach develops their ability to think systemically, experiment, and apply scientific knowledge in practice. An important part is also the "promotion" phase, during which students publicly present their solutions and learn to argue, defend their ideas, and respond to feedback.

Lesson Plan 4 – Let’s Make Waste Separators with 3D Technology

From a pedagogical perspective, the innovative value of this lesson lies in the way it connects ecological thinking with digital creativity. 3D printing is not seen simply as a technical tool, but as a means of environmental education and the development of responsible citizenship. Students thus perceive a direct link between technology and sustainability, while at the same time acquiring the digital skills necessary for modern careers in engineering, manufacturing or design.

Girls, who are the primary target group of the CodingGirl project, learn to use technology as a tool for creation and positive change through creative tasks. This strengthens their self-confidence and interest in STEAM fields. The connection between environmental education and the psychology of girls is particularly strong, as it builds on their natural empathy and desire for meaningful engagement. Girls often demonstrate a high level of environmental awareness, which manifests itself as compassion for nature and living beings, giving them a deep emotional basis for protective attitudes and behaviors.

Actively engaging in environmental issues and solving local problems fosters a sense of competence and control in girls. When they see that their practical efforts have a positive impact on their surroundings, it strengthens their self-confidence and self-esteem – they begin to see themselves as active and responsible citizens capable of changing the world for the better.

The lesson plan “Let’s make waste separators using 3D technology” is therefore an example of modern, environmentally-oriented education that combines the technical, ecological and aesthetic dimensions of learning. It allows students to understand complex ecological processes through practical creation and shows that technology can serve as a tool for responsible and sustainable thinking. At the same time, it provides an ideal environment for practicing effective communication, collaboration and mutual support – skills that are particularly valuable for girls in both academic and social contexts.

Lesson Plan 5:
MoveApp - Track your movement

The lesson is called MoveApp – track your movement and combines the topic of physical activity with technology. Its main goal is to raise awareness of the importance of movement for health and develop digital literacy through the practical design of a simple application.
The content standard of the lesson covers the importance of movement for health and familiarization with digital tools for tracking sports activity. The performance standard focuses on practical skills: students are to design and simulate an application for measuring steps and movement length and then evaluate and present the obtained data in the form of a graph. The lesson integrates knowledge from several subjects – physical education, biology, computer science and mathematics – and develops key skills such as digital literacy, data visualization and self-reflection.

The lesson begins with an introductory motivational phase, where students discuss how much time they spend on average moving. The discussion is enriched by the screening of an educational video that emphasizes the importance of regular activity. Each student creates a personal estimate of their daily movement, which they later compare with real data.
In the central exposition phase, the teacher first introduces the principle of operation of modern pedometer-type applications. Then, the students move on to practical creation. Using the MIT App Inventor tool, they design an application that simulates step counting. Although they do not use a real sensor, they simulate the functionality using a button labeled "step", after clicking which the value of steps increases. The application is programmed to automatically calculate the distance traveled and calories burned. To increase engagement and visual motivation, students add a visual motivator to the application - an image (for example, a runner or a medal), which changes depending on the performance achieved.
After completing the creation, a strengthening fixation phase occurs, in which students test the functionality of their applications in pairs. Then, they compare simulated and real data and discuss how movement affects their health. The final practical task is data visualization: students create a graph called "My Week in Motion" in the online tool Canva, in which they interpret the obtained data.

The resulting work of the students is evaluated based on the functionality of the application - whether the created pedometer simulation works according to the assignment. The teacher, together with the students, also evaluates creativity and data interpretation - they assess the visual motivator and the quality of data processing and interpretation in the graph from Canva. No less important is the final reflection on physical habits - the extent to which the students were able to critically evaluate and reflect on their own physical habits in the context of the knowledge acquired.

Lesson Plan 5:
MoveApp - Track your movement

Movement and physical activity are absolutely crucial for girls during childhood and adolescence. In addition to the obvious health benefits, regular physical activity is essential for mental and psychosocial development.
For girls, adolescence is often associated with fluctuations in self-esteem and dealing with body image issues. Participating in sports or other activities provides a sense of achievement, competence and helps girls appreciate their bodies for what they can do, not just for how they look. Physical activity is also a natural antidepressant. Endorphins, which improve mood, effectively reduce stress hormones (cortisol). It is important for coping with the emotionally demanding period of adolescence, anxiety and stress.

In terms of developing social and cognitive skills, participating in team sports or group activities teaches girls teamwork, communication, conflict resolution, respect for authority and the rules of the game. These skills are invaluable for their social lives. Movement increases blood flow to the brain and oxygen supply, which has a direct impact on improving cognitive functions, memory, attention and the ability to learn.
Creating a positive attitude towards movement at a young age shapes habits that girls will carry into adulthood, thus reducing the risks of civilization diseases and maintaining overall vitality throughout their lives.
In the age of social networks, we must also remember that the infamous "bodyshaming", rooted in rigid social standards of beauty, is an important risk factor for the development of eating disorders, anxiety and small girls in schoolchildren. Regular physical activity acts as a powerful intervention that overcomes the focus on aesthetics and instead promotes the functional autonomy of the body.

Regular physical activity is more than just a tool for maintaining physical fitness; It is a didactic tool that helps girls internalize respect for their own bodies, thereby protecting them from internal and external criticism and fostering a healthy, functional body image.

Hackathon as an Innovative Educational Format

A hackathon is an intensive, time-limited event during which teams composed of various specializations collaborate on the design, development, and presentation of a functional solution (application, prototype, strategy) for a specific real-life challenge or problem. It is an innovative educational format because it goes beyond traditional classroom and subject boundaries. Instead of **passive knowledge acquisition**, **team-based, project-oriented learning** is applied, where **theoretical knowledge is immediately transformed into practice**. Participants learn under time pressure, which simulates a real work environment and forces them to adapt quickly, create, and think critically.

However, the principles of a hackathon can be flexibly transferred into a regular school environment to serve as an innovative educational tool. Instead of long-term and often demotivating projects, mini-hackathons can be implemented – short, intensive challenges lasting, for example, two lessons with short home preparation, culminating in a presentation at the end of the week. This format teaches students to manage their time effectively and make quick decisions. For a deeper connection of knowledge, an interdisciplinary hackathon is ideal. By combining various subjects in solving a single complex topic, students learn a holistic understanding of problems and the practical use of knowledge. At the same time, a hackathon can be directly integrated into the assessment of student performance, for example, in the form of a hackathon within a subject. Instead of a classic final test, students are required to create a functional output within a time limit, so the assessment is based on creation and application of skills, not on reproduction of theory. Last but not least, by involving external experts in short, targeted mentoring sessions in the classroom, students are given a real perspective on the labor market and valuable feedback, which increases the meaningfulness of the entire educational process.

Hackathons are extremely attractive to **young people** thanks to the combination of challenges, real application of skills, and social benefits.

- **They require solving real problems and meaning.** Young people want to change the world, and a hackathon allows them to do that. They work on challenges that have a real impact on their surroundings (e.g., smart solutions, environmental projects, improvement of education), which gives their efforts meaning and motivation.
- **They intensively develop skills ("fast learning").** Students have the opportunity to learn quickly and apply new technologies and tools under the guidance of experienced mentors and professionals from practice. They intensively practice digital skills, critical thinking, teamwork, and presentation skills (pitching).
- **They support the creation of communities (networking).** A hackathon provides a great opportunity to meet like-minded and motivated peers, as well as experts from companies and startups. Establishing contacts can lead to new friendships, collaborations, and even job opportunities.

Hackathon as an Innovative Educational Format

An important motivational tool of hackathons is playful competition and reward. The competitive element and the possibility to win valuable prizes, gain financial capital for project development, or advance to international competitions add adrenaline and fun to the event.

Compared to the classic way of working on assignments, hackathons bring a sense of creative freedom. Participants receive a task, but the method by which they reach the solution depends on their creativity. This strengthens autonomy and teaches them to take responsibility for the entire process from idea to prototype.

A hackathon serves as a strong tool for overcoming psychological barriers and stereotypes that often prevent girls from entering STEAM fields. A hackathon can become a truly effective format for girls because it changes the traditional perception of technologies and minimizes psychological barriers:

- **Eliminating the "lone genius" stereotype:** Hackathons are based on teamwork. Technical skills are balanced by skills in organization, design, project management, and presentation. This breaks the stereotype that IT is only for solitary programmers and emphasizes that technology is about creative problem solving in a team – an environment in which girls often excel.
- **Increasing self-confidence through success (Self-Efficacy):** Girls tend to hesitate if they do not feel 100% prepared. The intensive, short-term format of a hackathon forces them to act, experiment, and prototype quickly. They see that even an imperfect but functional prototype is a success. This quick success cycle builds their self-confidence in technical skills.
- **Mentoring by successful role models:** The direct involvement of successful women from IT and STEAM sectors as mentors gives girls clear examples and helps to eliminate prejudices about what a "programmer" should look like. When they see that women with their values and communication style are successful in technology, their motivation and self-reflection are significantly strengthened.
- **Sense of mission and engagement:** If hackathon themes focus on social, environmental, or community problems, it connects with the previously mentioned empathy. Technology becomes a tool for achieving positive change, making technical fields deeply meaningful and attractive for girls.

Conclusion

The *CodingGirl: Girls Want to Have Fun Coding Compendium* concludes two years of joint effort among project partners who combined research, pedagogical innovation, and practical experience to support the participation of girls in STEAM fields. The document represents a synthesis of theoretical knowledge, methodological approaches, and concrete outputs that demonstrate how seemingly technical topics can be transformed into creative, meaningful, and inclusive educational experiences.

The main added value of the Compendium lies in its practical nature. Unlike conventional methodologies that focus on a single model of instruction, CodingGirl offers a variety of flexible tools that teachers can adapt to the age, level, and interests of their students. Each of the presented lesson plans was created in a collaborative learning environment during hackathons, ensuring a strong connection to the real needs of schools and teachers. At the same time, they reflect the principles of modern education—active student engagement, experimentation, interdisciplinarity, and the use of digital technologies as a means of fostering creativity rather than as an end in itself.

The CodingGirl project has proven that girls' interest in technology and science can be significantly increased when topics are presented in a way that connects logical thinking with aesthetics, practicality, and emotional value. The lessons therefore include themes such as health and technology, lifestyle and digital planning, environmental awareness, and safe online behavior. Such integration allows girls to identify with the content and perceive STEAM not only as a field of science but also as a space for creativity, communication, and personal growth.

The success of this approach is based on a combination of research insights and pedagogical practice. The Compendium draws on empirical studies confirming that girls' long-term motivation is best supported by collaborative, practical, and meaningful forms of learning. It also highlights the importance of female role models—Living Libraries—that, through personal stories, show that a career in technology and science is achievable, interesting, and socially valuable. This model is unique in that it combines the cognitive dimension of learning with emotional identification, thus strengthening girls' self-confidence and their perception of their own potential.

Equally important is the emphasis on the digital skills of teachers. The hackathons that gave rise to these outputs provided opportunities for mutual learning among educators from different countries, disciplines, and educational levels. The result is a set of practical methodological materials that help teachers not only in lesson preparation but also in planning interdisciplinary activities and creating their own innovative teaching concepts. This process has strengthened a community of educators who perceive technology as a tool for creativity, not as an obstacle.

Conclusion

From the perspective of the European educational framework, the CodingGirl Compendium contributes to fulfilling the goals of digital transformation, gender equality, and sustainable development. It demonstrates that inclusive education does not simply mean removing barriers but also creating an environment where every student feels that their ideas, perspectives, and interests have value. This philosophy forms the core of the project—empowering girls in technical and scientific disciplines through a balance of rational and emotional learning.

A major added value of the project is also **the sustainability of its results**. All methodologies, videos, and examples of good practice are publicly available through the project's educational platform, allowing for further use beyond the grant period. The materials are clear, user-friendly, and designed to be easily adapted to various national curricula and school contexts. Thanks to this, CodingGirl has the potential to contribute long-term to the development of modern education—not only for girls but for all students who wish to learn about technology in an engaging, creative, and meaningful way.

In conclusion, the CodingGirl Compendium is more than just a collection of methodological sheets—it is a showcase of an innovative educational approach that bridges science and art, creativity and technology, learning and real life. The project demonstrates that when girls are supported through positive role models, experiential learning, and opportunities for self-expression, they can become active creators—not just users—of technology.

The Compendium thus represents an important step toward building **an inclusive, modern, and value-based education system** that prepares young people not only for the digital future but also for responsible citizenship and a creative approach to the world around them. Thanks to the work of partners, teachers, and students involved in the project, CodingGirl has become not only an educational initiative but also an inspiration for change—for schools that want to teach with both heart and technology.