GEM Empower Girls to Embrace their Digital and Entrepreneurial Potential

Co-funded by the European Union

GEM Guidelines

How to organize successful

STEM summer camps for girls

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Contents

Contents 2

Colophon 2

Introduction 3

1. Theoretical starting points 5

1.A Content of activities the Summer Camp 5

1.B Pedagogical formats of activities 10

2. Practical guidelines 13

3. Do's and don'ts 25

4. Suggestions for activities 26

5. References and suggestions for further reading 28

6. Appendix 33

Colophon

Guidelines for organizing STEM summer camps for girls

Deliverable 2.1

Project GEM - Empower Girls to Embrace their Digital and Entrepreneurial Potential

Work Package - Guidelines - NL - Utrecht University

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Introduction

The GEM-project

The GEM project - Empower Girls to Embrace their Digital and Entrepreneurial Potential, is a European Union co-funded pilot project running from 2020 to 2022. GEM aims at encouraging girls' interest in STEM and ICT subjects and inspiring them to choose careers and become entrepreneurs in these fields. To achieve this aim, the project consortium organizes exciting cost-free summer camps for girls aged 12-18 and establishes a wide-reaching network of schools, higher education institutions, companies and policy makers, thus supporting girls in pursuing STEM pathways on all educational and professional levels.[1]

The summer camps have their focus on inspiring girls and offer them the opportunity to enjoy STEM in an inclusive and supportive educational environment, working jointly on a variety of STEM projects. GEM Summer Schools create a space where girls learn about, from and for STEM and each other and take many positive experiences home.

The guidelines

The aim of the guidelines for organizing STEM summer camps for girls is to support partners and other countries and institutions in planning, performing and evaluation of summer schools. The main elements of these guidelines are research-based starting points for organizing these summer camps, exemplary activities and materials for projects and pedagogical formats with a STEM, ICT and entrepreneurial focus, and a roadmap description of all necessary steps (preparation-operation-evaluation-follow-up) involving possible costs, resources and infrastructure.

The guidelines are adaptable to national contexts and help interested stakeholders to organize their own future summer camps, or similar events, in various local settings across Europe. Drawing from our guidelines users can choose suitable pedagogical approaches for their particular learning purpose (e.g. stakeholders might locally wish to focus on developing entrepreneurial mind-sets, acquiring digital subject knowledge or inspiring through role models and thus the combination of activities varies). This is expected to strongly facilitate the willingness to perform similar measures as well as increase the probability that future activities will run successfully.

In this final version we made a strong connection with the experiences from 2020, 2021[2] and 2022, but we also strongly recommend to read the case studies from this GEM Project (see website).

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[1] https://icse.eu/international-projects/gem/

[2] see Report on piloting and evaluation of GEM summer camps, December 2021, WP 3 - Piloting and Evaluation on the GEM Website

Structure of the document

This guideline document consists of four main sections.

1. In the first section literature is discussed, and suggestions for the content and pedagogical formats of STEM summer camps for girls are derived.
2. This theoretical section is followed by practical guidelines for organizing STEM summer camps for girls. A description of necessary organizational steps for preparing, operating and evaluating summer camps, including possible costs and requirements for resources and infrastructure. This section describes guidelines to support the planning, performing and evaluation of summer schools involving example lists of regional partners (industry in the region, associations in the area, parents with science/ICT/entrepreneurship related jobs, etc.) willing to cooperate. This section will also provide suggestions for how to adapt the general guidelines to national contexts with references to the Summer Camp support website (GEM Deliverable 3.1) and the Summer Camp Learn Plan (GEM Deliverable 3.2).
3. The practical guidelines are followed by a checklist of do's and don'ts for organizing the camps.
4. The final section consists of suggestions for activities and a reference list including suggestions for further reading.

1. Theoretical starting points

The guidelines for organizing summer camps are the results based upon published research and of two years of experience organizing summer schools. The findings from relevant publications are grouped in two categories:

A. Publications relevant for the content of the activities during the summer camp are listed.
B. Publications relevant for pedagogical formats of these activities are summarized.

1.A Content of activities the Summer Camp

- Spark the girls' interest by highlighting the social impact and interdisciplinary nature of STEM to evoke a sense of belonging and to demonstrate the relevance of the topic and the opportunities for success in the STEM field. Show how STEM skills can be used to help others (Milgram, 2011). Research shows that, as a group, women care most about how STEM will be used to make a difference in the world, such as using engineering to make prostheses, while men are often fascinated with the technology itself. Moreover, based on our pilots we advise to minimize the lecturing kind of activities as much as possible – participants enjoy most and learn most from hands on tasks and problem - solving approach.

Example - A GEM activity from Spain, Summer 2022

A better University Campus

www.fi.uu.nl/toepassingen/29138

Girls were invited to critically observe a University campus (the University of Jaen, Spain) from the point of view of space, arrangement of buildings, presence of gardens, local flora and fauna and use of resources and energy. They analyzed the impact of the UJA campus on environment with a focus on sustainability, usability and people's accessibility. Afterwards they discussed different architectural solutions used in other places of the world and design their own proposals to improve the UJA campus.

- Socio-scientific issues (SSIs) are promising contexts for addressing the role of science in society by examining issues from multiple perspectives when discussing problems, information and solutions

(Sadler et al., 2007). SSIs can motivate girls to illustrate how STEM can make a difference and consequently get involved in STEM activity.

- In line with the promising role of SSIs is the advice to use authentic contexts that are derived from current societal issues such as climate change, waste reduction and animal welfare (Chapman & Vivian, 2016). Types of contexts that raise girls' interests relate to STEM fields which bear socially positive potential: Health and medicine, beauty and the human body, ethics, aesthetics, wonder, speculation (Sjøberg & Schreiner, 2010).

Examples for STEM summer school topics in real life contexts:

STEM is all around us and there are unlimited possibilities to learn STEM while engaging in authentic STEM practices. Nevertheless, if you have never done it before, it might me challenging to come up with a manageable and interesting content. In the following we are offering some topics, that allow you to introduce the participants to contexts that provides a sense of meaning and purpose:

Artificial intelligence and machine learning to improve society. Science meets caring about society and the environment. Working on this topic you can introduce girls to such techniques as neuronal networks, genetics algorithm or fuzzy logic to build computer-based models that allow prediction and smart decision-making in a wide variety of fields such as medicine, agriculture, energy production, environment and climate change, etc.

Talking to robots. Application of Human Language Technologies (TLH) is a very relevant area of artificial intelligence, whose main objective is for computers to be able to understand and generate language just as we humans do. These technologies, also known as Natural Language Processing (NLP), currently have great potential and are what we can find in assistants such as SIRI or Alexa. But in addition, they can be used to develop a large number of applications, including those with a marked social nature. Some examples include early warning systems to detect inappropriate behaviour on social networks such as detection of hate speech and offensive language, cyberbullying, detection of certain eating disorders such as anorexia and even mental health problems such as depression and suicide. During the summer school in Spain participants can learn about all these issues and made some practices with the social robot called Pepper. It is a fully customizable and interactive humanoid robot, capable of identifying non-verbal language, gestures and emotions that also offers visual information through its tablet.

Improving our capacity to deal with diseases. Histological study of the cellular response to cerebral ischemia. Various cell populations in the brain, such as neurons and astrocytes, can suffer alterations after hypoxic (altitude sickness) and ischemic (stroke) type phenomena. Due to the fundamental role of

both cell populations in the brain (transmission of nerve impulses in the case of neurons and structural and functional support in the case of astrocytes), these alterations can affect the functionality of the brain. Therefore, it is hypothesized that both the morphology (shape) and the number of both cell populations may be altered after an experimental model of ischemia/hypoxia. Taking this hypothesis into account, participants can determine the possible alterations at the morphological and quantitative level of neurons and astrocytes against an experimental model of ischemia/hypoxia, through the use of optical microscopy.

The essential is invisible to the eye. Genes, proteins, microorganisms and their role in human reproduction. Infertility is a growing health problem affecting individuals and couples around the world. Despite being a widely studied disease, its complexity means that at present the molecular mechanisms that cause it are not fully understood. In recent years, laboratory experiments using state-of-the-art technologies are generating a multitude of data that must be carefully analyzed to extract information with biological meaning. Through this project, participants can investigate the molecular causes that lead to infertility in humans. To do this, they learn to manage public biological information sources, from which they obtain data that would be later analyzed using bioinformatics tools.

What do wetlands hide? Finding out cryptic biodiversity through digital images: participants learn how to sample aquatic systems, particularly non-visible organisms, achieving skills in their manipulation and preparation to be able to visualize them. They use technology to extract information, make visible and value these components of the aquatic systems.

Is pollination at risk? study of the production and viability of pollen grains: Participants were immersed in a research process acting as true scientists, acquiring competencies and skills of the experimental sciences. After establishing hypotheses to answer a research question, girls calculated the pollen production of several autochthonous species and estimated the average viability of the pollen grains by testing their enzymatic activity.

Colors. This topic offers a variety of interactive activities. interactive activities around the topic of "Colours Uncovered". The theme of colors is easy to make the connection between STEM and arts, support participants in understanding the importance of color in our everyday lives from different perspectives. Small groups of girls can investigate the importance of colours from the perspective of science, mathematics, technology, engineering and the arts, such as the importance of colors in Virtual Reality design, the importance of "colored light" in our well-being, the significance of color in nature.

Creating a product. Creativity, leadership, communication, negotiation and critical-thinking skills are key to strengthen entrepreneurial competence that prepares for teamwork, problem solving and the

decision-making process. Participants of the project can develop own idea and presented an entrepreneurial proposal of it at the end of the GEM week based on what has been working throughout the Camp or from their own initiatives. With the aim of guiding girls in this process, a workshop on the design of ideas and entrepreneurial strategies can bee planned on the first day of the week.

Smart City. By organizing a summer school about smart technologies, participants are exploring how to live more comfortably by involvement of technology, why is can the combination of STEM and business bring innovation to the world and also become active themselves. There are several smart house generations to discover: wireless technologies (I), artificial intelligence (II), robots (III), Smart House components, identifying objects, Smart House control systems. In the next step, an introduction to Arduino programming can be given, followed by learning about "technical brains" (Micro)Controllers, connecting devices, data acquisition, sensors and data processing. Designing a mini project with sparks their curiosity and lets them go deeper into STEM and entrepreneurship.

Science in the investigation and preservation of cultural heritage. The participants can learn what is the scientific support that is necessary to the conservators/restorers and curators by incorporating examinations and analysis on historical materials and their deterioration products. This helps in various aspects such as conservation treatments, profiling the artist's palette, documentation, authentication and dating. Such investigations are carried out on artefacts in order to enrich knowledge on their historical background as well as preserve and maintain them. The activities can focus on how science helps preservation and restoration of works of art. Students worked on an investigation of a historical work of art in order to establish what information lies out of plain sight which can help in the interpretation and preservation of this artefact.

Sustainable development. Sustainability has three main pillars: economic, environmental, and social. The sustainable development goals are universal call to action to end poverty, protect the planet and improve the lives and prospects of everyone, everywhere. For this reason, sustainable development is part of the education of most countries around the world. A summer school can focus on presenting the role of science and research in fulfilling the economic, environmental, and social goals of sustainable development. It can include outdoor STEM activities, the use of information and communication technology for simulations and modelling of processes in the landscape and group work, students' projects, based on the principles of inquiry-based learning. Knowledge can be gained that help the participants realize the role of the individual and his conscious steps in the sustainability of life in their surroundings, region and on the planet. The topics that the girls address in their projects should teach them to understand the context of human activities with respect to the environment, the protection of plant and animal species and to consider and process information in a scientific context. The topics can involve: environmental goals of sustainable development and the role of Geographical Information Systems (GIS) in the implementation of these goals at the global and local level, 3D applications of GIS,

interactive educational trail with ICT support focused on discovering of animals' world, discovering Landscape from a mathematical point of view and an interactive simulation game aimed at finding a compromise between socio-economic and environmental activities of people at the global and local level.

Discovering technology in hands-on activities. Several days of actie discovery and trying-out can be organized by combining programming, 3D modelling, 3D printing and use of laser cutters as well as several maker moments with electronics as well as programming robots. It is motivational for participants to first see possible prototypes they can try to make but that their interest and curiosity will make them later develop their own products based on their own ideas. Before actively producing products themselves, participants are learning how to solder and becoming first simple task assignments in working with Microbit, an introduction to Tinkercad, 3D-Printing, the laser cutter. Then the participants are good to start working on their own very own projects, accompanied by young mentors who can support the process and overcome difficulties. The participants can get encouraged to create complex products where they use knowledge from several different new technologies they learned during the week.

Designing and building a 3D-printed escape room. By organizing a summer school on this topic, participants are experiencing two topics: 3D printing and escape room design. In the last couple of years 3D printing has developed its technologies to the next level and is offering various applications that were not thinkable earlier in the day. There are companies that are producing prosthetic limbs & body parts, art objects, even homes and foods with the help of 3D printing. It has also emerged as a wonderful tool in STEM education. Without much prior knowledge, learners can apply their theoretical STE(A)M-knowledge and solve real-world problems. 3D printing is both a very simple and a very complex technology. Nowadays, the use of a 3D printer does not involve high costs or a very long training period anymore but a target-oriented application requires the user to have an interdisciplinary understanding of the technology used. Also, in the entertainment sector, actual escape rooms or online, escape games and action events are gaining on popularity. Having to solve challenging riddles embedded in an exciting story, alone or in a group, really offers an entertaining experience and is currently a beloved activity.

Bringing these two aspects together and making the girls work creatively themselves while learning so much about the STEM subjects and their real-life applications, proved to be a great way to inspire girls to involve them in the STEM activities.

1.B Pedagogical formats of activities

- Create gender-neutral and safe learning environment in which girls feel confident to try things out and push their "comfort zone" to make progress are a precondition for successful female performances (Sammet et al., 2016). Again, attention for a feeling of belonging is important (to girls) (Blickenstaff, 2005; Rainey et al., 2018) which means that summer camp mentors need to introduce activities with explicit attention for success experiences, allowing for mistakes and promoting ownership. Our pilots showed also the importance of ice-breaking and team building activities and games to help students to get to know each other.
- Combat stereotypes and involve female role models with careers in STEM sectors (COM, 2007). Girls need to see female role models in the workplace that look like them. They need to receive the message that women can work in STEM careers and be successful and fulfilled in their work life while still having a personal life, meeting friends and having hobbies such as sports and music (Boston & Cimpian, 2018). They need to receive this message repeatedly (Milgram, 2011). Provide for instance a historic and a modern review of female STEM role models (Bielefeld, 2019), or visit workplaces involving female scientists.

Example - A GEM activity from Sweden, Summer 2022

Meeting a female Saab engineer

www.fi.uu.nl/toepassingen/29139

At the Swedish company SAAB (saab.com) people from different disciplines are working together on different challenges. In this specific example this female engineer gave a clear insight in how people are working together in order to achieve high and qualified results. This means that the students were given an example of an interesting future where STEM knowledge was used in collaborative ways. This 'meet the professional' can be a strong incentive for young people to get a clear view for their future career.

- Use (young) female lecturers and mentors as there is a positive and significant association between the proportion of female teachers in a high school and the likelihood that a female student will choose a STEM-related major (Stearns et al., 2016). Our pilots show that it is recommended that mentors leading group work attend training sessions prior to the summer camps in which they can be briefed about pedagogies and STEM-related content (more about that under the section "mentors").

- Active engagement in inquiry-based and hands-on lab activities apparently were shown beneficial for girls (Patrick et al., 2009; Sadler et al., 2007). For example, by letting them build large artificial, moving animals you can create a fusion of art and technology – with curiosity, imagination, and play with a hands-on construction materials (Thuneberg et al., 2018). Girls working in groups and supported by an adult leader (mentor) proved to be very successful during the GEM pilots. Groups of around four students worked very well (either allowing students to work with their friends or with different students).
- Provide low-floor (and high ceiling) learning opportunities for girls to encourage a sense of achievement, experience success and build self-confidence. Introduce a growth mindset, i.e. the belief that skills can be improved through effort and commitment (Boaler, 2016).

Example - A GEM activity from the Czech Republic, Summer 2022

Four classical elements for inquiry learning with simple experiments

www.fi.uu.nl/toepassingen/29137

Classical elements typically refer to water, earth, fire and air. For this GEM learning unit several experiments that include one or more of the four elements are collected, for use in the classroom but also in other situations (home, workshop, etc.). Examples: Air - Little Balloon in Bottle, How much space does air need?; Vitamin Rocket. Water - Lava Lamp, Water as glue, Water is not like water. Fire - Who turn off first?, Fire extinguisher, Does the iron burn?. Earth - Acids are dangerous, On the trail of markers, Dry feet to the treasure.

- Girls require a special culture of feedback, e.g. in case of 'failure' refer to a lack of effort instead of competence, and give girls opportunities to experience success and have it recognized (Jahnke-Klein, 2001). Consequently, invite for contributions and allow mistakes, promote feelings of ownership and empowerment among the participating girls (Boaler & Dweck, 2016). Take a positive and constructive attitude towards failures and let them be experienced as valuable learning opportunities (Boston & Cimpian, 2018). Such activities contribute to a culture of feedback that reaches girls, let them overcome feelings of uncertainty, and create a culture of belonging.
- Consider girls' institutionally narrated identities in school practice often oriented on finding the right answers. For stimulating girls to pursue science careers avoid old-school lecturing practices and engage them in authentic science practices (in middle school) (Tan et al., 2013).

Example - A GEM activity from Malta, Summer 2022

Electro-magnetic fields

In this activity girls get a basic understanding of non-contact forces and magnetic fields. They experiment with different materials and watch a video that visualizes the interaction of fields with molecules and to show the resultant friction and heating effects.

www.fi.uu.nl/toepassingen/29126

2. Practical guidelines

In these guidelines the experience from higher education institutions from 10 countries piloting GEM summer schools is combined. The advice given must be adapted to national contexts and the infrastructure of the organizing institution. The report on piloting and evaluation of European GEM summer camps 2021 shows the rich variety and local choices in each of the participating countries. For more information you can read these reports or explore and contact local organizing teams. Include links to the local GEM support websites[3].

Building an Organizers Team

If you want to organize a STEM summer school as well, consider the cooperation potential on regional and national level. As reducing the gender gaps in STEM professions is also a major concern of many actors, an outstandingly mutual benefit arises from supporting the activities, so it is important, to do the research, use exiting contacts to collaborate.

Higher education institutions. Higher education institution is an important collaborator in organizing STEM out of school activities as they are interested in attracting future students and have rich up-to-date knowledge. They can provide rooms and materials for the summer schools, usually the cafeteria at the higher education institutions is a good and resource saving way to organize meals. If it is a higher education institution that prepares future teachers, due to their STEM background and pedagogy skills the ongoing students can be involved as mentors and support the girls during the summer school as volunteers or paid cost-friendly staff. If you have time enough, consider developing a course that prepares the students for working in out-of-school activities and take care of the official ECTS recognition. There might be also university staff that is interested in getting more involved with the organization as the setting offers research possibilities. Involve the different departments to teach one topic in an integrated way.

[3] The website of the German GEM support site: https://icse.ph-freiburg.de/gem/gem2021/
The website of the Spanish GEM support site: https://gem-esp.eu/
The website of the GEM support site in Lithuania: https://www.fsf.vu.lt/mokslas/projektai/tarptautiniai-projektai/europos-komisijos-programos?layout=edit&id=2937=empower-girls-to-embrace-their-digital-and-entrepreneurial-potential-gem
The website of the Swedish GEM support site: https://upptech.se/komteks-fritidskurser/teknikkollo-2021-pa-upptech.html
The GEM support site in Malta: https://www.um.edu.mt/educ/ourresearch/gem
The website of the Greek GEM support site: http://scholar.uoa.gr/gpsych/GEMSummerCamp2021
The GEM support site in Cyprus: http://www.girls4stemcyprus.com/
The Dutch GEM support site: https://elbd.sites.uu.nl/2019/12/06/gem/

Schools. Schools are the perfect collaborators in organizing summer schools, since they have the access to girls from all socio-economic backgrounds and all STEM motivation levels, they have the pedagogical staff in place and also rooms. Schools can also organize GEM summer schools as after school activities or be implemented during the project weeks.

Initiatives, projects, NGOs, institutions, networks connected to girls and STEM. Everyone that is sharing the same aim of involving more girls in STEM can share their expertise, be involved as summer camp staff, help gaining participants, overtake separate tasks in the organization.

Companies, business representatives. It is beneficial to approach business representatives that are related to your chosen summer school topic to make better connections between the content and real-life applications, it serves the participants as a close job experience and inspires considering a STEM career. Business can offer role models to tell about their careers, job responsibilities and work-life balance issues during a summer school session. You can jointly go into preparing separate learning units and let the business role model lead the session. Local companies can also offer a guided excursion to their premisses or rooms for parts of the summer school.

Parents. Summer schools are offering a great combination of learning activities as well as entertainment. Since legal guardians of the girls are often searching for leisure time activities for the school free time while they work, they also are often ready to pay a participation fee. Therefore, the time and place the summer school should be considered in accordance with the needs of parents as well. Parents are also great to involve for supervising girls during some leisure time activities or even can serve a pool to find an inspiring STEM role model for one of the sessions.

Municipalities. Often also political actors are interested in raising the STEM skills of the society and improve their innovation potential. We strongly advice to inform the respective responsible persons about the summer school and ask for support.

Duration

The length of the summer camp and of each day needs to be well considered and fit your aims, time and money resources. We experienced a variation of two - day camps with 8 working hours a day, over 4 days with 5 working hours up to five 5, with 7 working hours a day. On average the summer schools were running 5 days, 5,5 hours. There are pros and cons for all format decisions which we would like to present in the table below. Regardless of the duration of the summer camp, consider place for social interactions and entertainment as it takes place in the school free time. Small breaks for girls to unofficially talk to mentors, to spend time together, play team building games or enjoy entertainment possibilities. It is easy and fun to organize entertainment around STEM subjects.

Striking a balance between types of activities and length of each summer camp day requires trials and adjustments in your national context.

Field of Decision	<3 days	>4 days	Over night	Only during the day/until lunch
Finances	Is manageable with limited resources	Costs are growing every day	3 meals a day, drinks, supervision of girls 24/7 necessary.	Only snacks and lunch. Possible, that also teachers accompany girls
Content	More emphasis on learning possible.	Good mix of leisure time and learning activities possible	Learning capacity might decrease due to not enough sleep at night, (group dynamics and social interactions), on the other hand social aspect and belonging to group, fun side of STEM is dominant, which is also beneficial	Active learning in the new environment (summer school premises) is mixed with time home in the old surroundings, interactions with familiar social interactions
Participants	Girls that are moderately interested in STEM are more likely to apply, since it is not taking up all of their holiday. Possible to reach more girls and interest them in STEM with the same amount of available resources.	Parents can work and can count on their girls being supervised, entertained and gaining new knowledge	Possible for 12 – 18 year-old girls. Either way, legal guardians consent is necessary. A person in organizers team has to be available for communication with parents.	
Working atmosphere		Increasing familiarity between the participants with the time spent together. Possible to develop a stronger sense of belonging to the science community, building friendships.	Experiencing all phases of the day together brings the group together. Mentors have to be skilled in dealing with the group dynamics and individual challenges of the girls	
	Meeting girls with similar interests. Possible to foster belonging to the group by creating whatsapp groups or follow up events			
Staff	Less staff necessary. Possible to be organized by several persons only	A variety of staff members necessary	The same person cannot supervise girls 24/7.	
		Staff has to meet some organizational issues at home if they have children on their own: also they need supervision, which in not available during holidays	A god staff management plan, including shifts and responsibilities necessary.	

Involving Mentors

An important part of the summer camps was involvement of female role models which sometimes were also involved as mentors. As mentioned in the activity example in the section 1.B Pedagogical formats of activities, female STEM entrepreneurs were invited to give talks about their career choices, everyday job responsibilities. In order to explicitly address the need for role models you can involve a 'Girl of the day'. This girl is a woman/girl that is invited in the Summer School to give a short presentation about her work, with a special emphasis on the STEM characteristics of her work. This gives the participants a role model, and a dedicated view of the kind of work and 'the daily practice'. She can also mentor during the activities of that day.

As our experinece show, it is important, that these role models are relatable, open and have good communication skills. It was most beneficial to involve the real life entreprenuers in leading learning session and guiding girls through STEM tasks, as itmaximizes the time spent with them and develop a deeper level of communication opose to a plain lecture.

But also STEM students or female researchers in STEM also fits perfectly the role. Mentors should be guiding the girls thourg summer school, support them in dealing with the assigned tasks, look after the well being of each girl and be there to answer any questions, preferably, 1 mentor per 5-6 girls' group.

Unless the mentors are already highly experineced in working with teenage girls and are familiar with the STEM topic that you have chose for your summer school, we suggest you are organizing a training session or a day for them to become familiar pedagogies used, summer school tasks and phases where participants will require support, special activities that all of the mentors should lead and talk though the time schedule and staff assignments.

It is also imaginable to split the task of mentoring the girls in STEM related activities (involve STEM students) and guiding girls in the group dynamic developments and help with organizational matters of the day (a youth worker, a social worker or similarly educated professional). A gender studies specialist is also welcome to give input on the specific pedagogies while working with the girls.

Recruitment of participants

Consider a variety of strategies and campaigns to recruit your participants including the use of spreading catchy messages through social media. Based on our experience, a minority of the participants applied themselves. Instead, the communication took place with teachers and parents, so it is advised to consider teachers and parents as (indirect) target groups of your dissemination measures.

Additional to spreading information though social media, existing mailing lists and personal contacts, it is recommended link yourself with persons who are sitting at a contact point to teachers and parents (such as school district supervisors) and to set up a summer camp support site with details about the camp and

registration links for joining. The list below shows a variety of strategies and tools that can be selected and tuned to local situations.

- Disseminate the Summer camp support site among schools and teachers in your region
- Use channels available on social media (FB, Instagram, Twitter, LinkedIn)
- Advertise the camp through newsletters of your university, for teachers or from teacher associations
- Try to reach newspapers, radio and tv through a press-release
- Advertise the camp at local teacher conferences, seminars and university activities with (digital) leaflets and posters

In case more girls are interested than can be accepted, consider:

- Accept students on a first come first served basis.
- Give priority to girls with no STEM background (e.g. girls whose parents do not work in STEM fields).
- Try to diversify girls' profiles (e.g. trying not to take more than four girls from the same school).
- Having participants with a wide age range (e.g. 12-18 years) may present a challenge. This may be solved by grouping the students into smaller sets with a smaller age range (e.g. 12-15; 15-18).

Choosing of participants mostly followed first come first serve approach because setting the criteria to reject a girls' participation were very problematic and this approach seemed like the fairest way to set participants for all sides, additionally it is the most time saving way to get participants.

A very convenient way of organzing the application is to organize it online.

The application process of a summer camp can be built by the following steps:

1. Create an electronic invitation for the summer camp to spread across your mailing lists and important persons with connections to your target groups. The invitation should include easy to understand information about summer school and benefits of participating in it: include a summary of the scope and the content of the summer camp, the learning plan, legal guardians' consent for participation ready to be signed, a flyer for putting up in schools and out of school setting, where pupils are following their hobbies.
2. Send the invitation and accompanying documents through the identified dissemination channels to identified target groups (i.e. schools or organisations). Also consider person groups, that can forward the invitation to parents or directly to girls.

3. A link of the application for participation to the summer camp and a link to the event's homepage should be inserted in form of a code to scan with a mobile device. An example, using an online tool for event registration: https://eveeno.com/290929825.

Consider what is the information you need to obtain from the girls already in the application process. Do they require any specific knowledge? Age? Be clear, that you also need the contact information from parents, if participation is required each day for specific learning results, what materials do they have to bring along?

For example, you can ask for the following details in the application process:

- personal and contact information
- name of the school they go to
- how did they find out about the summer school
- if they can bring their own laptop or tablet along (any other devices that are necessary)
- if they have a special diet or allergies
- motivation for participating
- STEM grades
- include a filled-out guardian consent on participation and making images obligatory.

4. After the application deadline is closed, list the participants and crucial information. During the summer school you will need a list of them and contact information for checking attendance as well as possible emergencies.

5. Welcome the participants by sending them program and certain organizational issues in advance. Name a contact if parents or girls need any additional information. You may also kindly ask parents to notify you in advance, if the participation is not possible after all, so that a participant from the waiting list can take the place.

Consider inviting parents to an informational event to answer all of the questions at once.

Resources and budget needed for the activities.

The resources needed highly depend of the type of activities that you organize. Since these activities vary from designing escape rooms, using 3D printers, doing lab work, designing tessellations no general remark can be made. To illustrate it with an example, at one partner university a sufficient number of 3D printers were available already, only the printing material had to be bought, whereas another institution, that really wants to try out this topic, needs to by everything anew and also educate a supervisor of the printers, so to give the necessary support during the summer school activities.

Considering the big diversity across the European countries, we can also only make an attempt of suggesting the budget necessary for organizing a summer school. For example, similar number of the summer school participants in Sweden and in Lithuania were having hands-on activities where they had to develop some devices with Arduino, based on the knowledge gained. In Lithuania the supplies for one summer school costed 1800 Euro, while in Sweden 2492 Euro were used. To follow the budget in the same countries, for lunch and snacks in Lithuania 400 Euro were necessary for 3 days, while lunch and snacks for students in Sweden for 4 days costed 1918 Euro.

The budget necessary also depends on the length of the summer school, local circumstances in matters of available staff and possibilities to outsource some tasks, ready materials, and available resources.

For example, as a higher education employee you most likely can organize meetings and the whole summer school on the university campus cost-free. Using the university campus leaves some budget aside for entertainment activities outside it. In our experience, partners connected the elements of fun and entertainment in connection to the subject they were covering during the summer school:

Country	DE	SK	SK	ESP	CY	MT	NL	LT
Topic of the summer school	Developing 3D printed escape rooms	Optics	Role of science in sustainable development: economical, environmental, social	STEM: astronomy, robotics, biodiversity, artificial intelligence and society etc.	Colours from an integrated STEM perspective	STEM. Magnets, entrepreneurship, environment, health, coding	Each day with different topic: trees, eyes, paper	Building models with arduino for more comfortable life
Location additional to the university campus	the city (playing the escape game)	Laser arena (learning about optics)	ZOO (Learning about sustainable environment)	Mountains (learning astronomy and watching starts), excursion to national museum	National Park (Learning about colours)	Valley (learning about investigation, data collection n and analysis), science centre	Climbing hall (learning about physics)	Botanical garden, JUNG smart home centre, Teachers Lead Tech Centre (learning about real life applications of programming and engineering)

Going to these locations require transportation and the costs of it can be solved in several ways:

1. parents are bringing the girls to the location on their own or building driving groups - a disadvantage is, that girls coming from poor socio-economic families might get excluded. An advantage is outsourcing this task to parents and having less organization matters to take care of as organizers.
2. reimbursing public transportation costs for girls – a cost friendly way, as the girls usually own a ticket to use the local public transportation system. Administrative load of the task is however a disadvantage. Depending on your institution you might have to collect the tickets as a proof, have to take care of having change for actually giving the money to girls, and you still have to supervise the participants on the way.
3. organizing a bus to go there jointly – renting the bus and paying for the gas might be costly. You might approach companies that are sharing the topic of your summer school and approach them for financial support.

A very rough estimate of a four-day summer camp could be that you need € 7500 euro for organizing a summer camp and ask a participation fee of € 300 including accommodation, meals and resources for the activities (with an estimation of 25 participants). However, these cost categories and the indicated amounts are very location-dependent, can vary largely among various countries, therefore we advice to undertake a very careful planning of the resources in advance:

Meeting rooms	€ 1.000,- (including drinks)
Overnight accommodation	€ 2.500,- (€ 40 euro per night; 3 nights and 25 participants)
Meals	€ 2.000,- (€ 20 euro per day; 4 days and 25 participants)
Resources	€ 1.000,- (depending on your activities)
Personnel costs	€ 1.000,- (student assistants / mentors)

Follow up

Last day of the summer school is offering a great chance to let the girls present what they have learnt of developed during the summer school alone or in groups, make them prepare posters and other visualization materials to create an exhibition. It is a great event to take care of a bigger visibility of it, by inviting all relevant levels, starting from parents, over directors of the coordinating institutions and collaborators, to media.

We suggest sharing with the girls and their parents other local and national possibilities to keep being involved in STEM, such as mentors programs, events, career advising apps that are available in the

national context as well as encourage girls to bring the prototypes and developed products to the regular school class and tell about their summer school experience to their classmates and teachers.

Roadmap for organization

Organizing a summer camp for girls requires measures for preparing the camp as well as a schedule for the camp itself. The preparation as well as the day-to-day program can be visualized in a roadmap. This roadmap supports institutions that plan to organize such a summer camp and provides a variety of possible adaptions for usability within our project partners. In general, the organization of a summer camp will follow six steps:

Step 1:	Choose topic, do the research on relevant stakeholders on regional and national level, build the organizing team, set up a financial and technical plan for the summer camp, and decide how to involve mentors. If needed, feel free to consult the organizers of previous GEM summer schools (see contacts on national support websites that are listed on page 13).
Step 2:	Developing a concept with involvement of STEM partners and representatives from the World of Work (e.g. participation of a Girl of the Day representing the WoW) to ensure fostering entrepreneurship among the girls. Checking if the resources and expertise (e.g. camp trainers) is given (including role models). Finalizing budget and decision on participation fee.
Step 3:	Organizing transportation/hotels, laboratories and rooms. (Caution, in some institutions the reservation of rooms need to take place a year in advance/a semester in advance). Order and organize necessary materials (including certificates, give away gifts). Prepare day-to-day program(s) in a detailed way. Which person form the organizers team is available on which day, specific tasks and that this person still need to get organized, replacement plan, if someone gets ill. Inform local authorities and create a press release in save-the-date form. Organize a person to take fotos along the summer school
Step 4:	Setting up a homepage with application system, preparing the content: describing the summer school activities in catchy way, describing mentors, asking mentors and role models to do promotional videos for social media. Promoting the Summer Camp at schools, ministry of education, partners, social media channels (see list above), invite press, radio and TV to attend the scummer school in especially exciting sessions. Train/inform the mentors and other involved staff on content and pedagogical guidelines.
Step 5:	Run the Summer Camp (if possible: update others, parents, etc. through posts on social media). Make sure to develop a list of all the persons involved, list of participants and their contact details, when are they available to mentor the girls, who is going to lunch with the girls and who is staying in the class to clean up, who and at what time is greeting the role models that are arriving just for several sessions and show them around/help prepare for their session. Checking if the meals prepared in accordance to the allergies list, who is picking up and preparing snacks and drinks, preparing the room for the next day, plan a meeting of mentors and lecturers to discuss the day and undertake any changes to the following plan if necessary.
Step 6:	Evaluation of the Summer Camp, reporting in social, public, and professional channels. Try to sustain the initiative by connecting to organisations that are also active in this field. Do your best to make follow ups of the summer school by informing girls about other STEM possibilities or another round of evaluation to see, if the impact has prolonged.

An example roadmap for organizing a camp together with your team is provided in Figure 1 below:

	RoadMap Girls Empowered - Version 2020	Target - Activity in Autumn 2020
	Action	**Details**
2020 April	(Virtual) Meeting with the NGT	Finding the date for Autumn 2020 (maybe not a camp, but a day)
May	Design a Flyer (pdf) for communication	
	Mail to all national institutes involved	Save the date mail
	Start website	
June	First (virtual) meeting with all 'camp-trainers'	Setting up the program
	Mail to all national institutes involved	Invitation with possibility to enroll
	Working on the details of the program	All camp-trainers involved are designing elements of the program
July	Second (virtual?) meeting with all 'camp-trainers'	
	Finalizing the program with all details	
	Update website	
September	Third meeting 'camp-trainers'	Getting through all details. Final remarks. Check of materials
October	Activity	

Figure 1: Example roadmap for organizing a GEM summer camp in the Netherlands

Figure 2 below is a screenshot of a part of a tentative day-to-day program for a summer camp in Spain.

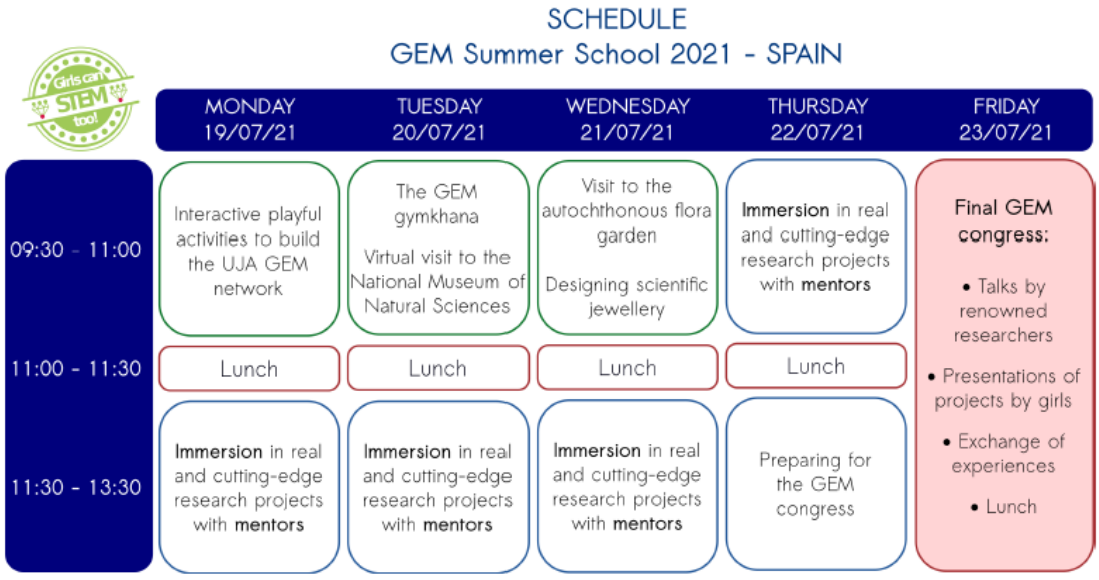

Figure 2: Example of a weeks' program for a summer camp in Spain

Note, during the session that is called "Immersion in real and cutting-edge research projects with mentors" girls chose a group with a specific topic to do during the summer school. For example, to investigate the cellular response to cerebral ischemia and determine the possible alterations at the

morphological and quantitative level of neurons and astrocytes against an experimental model of ischemia/hypoxia, through the use of optical microscopy.

For the organization, a day-level plan is facilitating an easier management:

	Where	Content	Preparatory steps that should be accomplished by the / ToDo is highlighted
7:30	Preparing the room KG5 007, setting tables and table for the snacks	Berit und Dita are turning on computers and entering the passwords, opening the online pre-questionnaires Building up the printing station with key word Distribution of USB Sticks and note-books	
8:00	Meeting point on the stares from the building KG5	Dita is meeting up with the representative from EU direct, parents and girls	Parents and girls are informed about the meeting point, the parents' consents are in place for each girl, check if everyone agrees with photo taking, list of participants and contact information is available. list of mentors and their contact information as well
8:15 – 9:00	welcome	Laura: welcome from ICSE and PHFR Dita: about the project on national ad international level Frau Lipphardt: welcome from EU connect and the EU level of cooperations Oliver: Introduction PPT Filling out the questionnaires	Mentors are sending their pictures and 2 truths and 1 lie about themselves. PPTS are finalized and saved on the server + on a USB stick
9:00 – 9:45	Testing the Escape Activities	(All leaders of the escape boxes are there, all mentors, all girls) Normal Escape Room: Rahel Digital Escape Rooms: Henning 3D-Printed Box: Laura Wooden Box: Verena	Boxes have to be ready until 8:00 at their assigned positions. Careful: time that is needed to crack the codes for each box varies. Mentors therefore need to follow the prepared time plan and improvise if any time is left. If it takes some time to get to the next box, talk about the tasks and alternative tasks and solutions. Dita will keep the time management. Sabine is preparing snacks for the pause.
9:45 – 10:00	Pause	Preparing the two tables outside the computer room. Bring the glasses, plates and spoons from the kitchen, Oliver brings drinks, Dita rings fruits, currently in the kitchen as well. Sabine will bring buns from the bakery and prepare the break.	
10:00– 11:30	Testing the Escape Activities	(All leaders oft he escape boxes are there, all mentors, all girls)	Leaning after the break and preparing the next break: Sabine

		Normal Escape Room: Rahel Digital Escape Rooms: Henning 3D-Printed Box: Laura Wooden Box: Verena	
11:30 – 11:45	Pause	The same	
11:45 – 12:30	Summary: what is the structure of the Escape Rooms, how are they built? What about the codes?	Rahel	Rahel: do not forget the transition to the 3D printing and materials, since later Frau Helmer from the GLSSOMER company will be there and will talk about the new method of 3D printing glass. You can also show the objects you have printed before (they are currently in the printing room).
12:30 – 13:00	Entrepreneur Dorothea Helmer	online	Dita starts the zo meeting room at 12 :15 while the lecture is going and takes care of the technical issues: Preprepared link: https://ph-freiburg-de.zoom.us/j/61413678168?pwd=VWkxV1ZMSEw0U2pRd3VQZkh2aklEUT9
13:00 – 14:00	Lunch	Mentors are accompanying girls to the café	Mentors make sure, that the staff at the café knows about the coupon system and what should the lunch consist of. Please leave the bottles from soft drinks there – otherwise we have to pay for the bottles ourselves! Organizers stay and prepare the room for the next day. Organizers and mentors meet up to discuss the day. Did the girls achieve the day goals? Do we have to make arrangements for tomorrow? Any chnagenecessary in the plan because of the individual needs of the girls?

Figure 3: Example of a day plan in a summer school in Germany

3. Do's and don'ts

The practical guidelines for organizing summer camps for girls are summarized in a list of DO's and DON'Ts:

DO

- The summer schools should allow for time for group building especially if girls come from different schools are involved.
- Create inquiry-based activities during which girls can do science, explore and be creative in contexts where science makes a societal difference or relates to social scientific issue (Patrick et al., 2009; Sadler et al., 2007; Thuneberg et al., 2018). Prepare final sessions for exchanging findings or an exhibition of results.
- Do include female role models (also as lecturers) but take care to not make it seem like something outstanding, more that it is/should be common, that woman work in those fields. Consider small breaks for girls unofficially talk to mentors and representants of the world of work, a kind of Q&A's.
- In advertising emphasize social aspects of the event and opportunities for girls to work together (e.g. call it a girls club).
- If there are limitations to organize a live summer school (e.g. because of COVID) we recommended to organize a reduced program online. We have good examples of how to organize activities online (see GEM website).
- Invest in setting up a community (e.g. create a WhatsApp-group).
- Encourage two or more girls from the same class/school (makes it 'low floor' and also is helpful for transportation).
- Emphasize the importance of STEM for society and responsible citizenship ('21st century skills').
- Emphasize social aspects, be part of a community, including meetings with role models ('21st century skills').
- Take care that parents know the program and can support.
- Include female role models and organize meet & greets
- Invite girls and women to tell about the kind of work they do and how they use STEM skills.

Don't

- Don't emphasize that you need to be high achieving in STEM.
- Don't forget time for ice breakers at the start, meetings with mentors during, and sharing findings at the end of the summer camp.
- Don't use too sophisticated words (in interaction, in communication).

4. Suggestions for activities

As stated in the introduction the first general objective of this proposed GEM project *is to inspire and enable Europe's girls to tap their STEM, digital and entrepreneurial potential.*

The first round of summer camps for girls in 2021 has brought a load of inspirational activities, positive experiences with STEM content, especially ICT, learning from inspiring (female) role models and developing an entrepreneurial mindset and transversal skills.
Inquiry based learning is used through most of the activities. This ensures attention for transversal skills throughout the activities. Characteristics of these activities are for instance that they are 'meaningful for others' and are linked to real life and to the STEM/digital world of work in the students' own region. For more characteristics see the section on Theoretical starting points.

Below we list activities that can be implemented in summer camps. All activities are exemplary and can be changed and adapted in the design-process of setting up the summer camp program. In the appendix we add a list with sources and tools that will help in (re)designing these activities. When adapting it is important to make sure the activities contribute to at least one of the aims: STEM-content, ICT/coding, role models, world of work, entrepreneurial mindset. Although the aims are general to the project, activities contributing to those aims may differ from country to country.

List of suggested activities
Activities related to ICT/Coding/programming[4]
Unplugged activities related to 'ideas behind coding'
Programming for example little robots, lego mindstorms, tools, drones or Arduino's to do specific tasks, or program a computer game using scratch or Python
Programming and using devices/sensors for measuring in everyday life (related to STEM areas)
Explore and create digital tools and programs to promote health and wellbeing.
Debate ethical issues related to the digital world: privacy, hacking, etc.
Activities related to STEM
Lab & technological work (e.g. using sensors, 3D-printing) on processes, products and experiments related to everyday life (food, cosmetics, water, weather) and girls' main interest.
Covid-19 related topics (e.g. how viruses work, epidemic models, sampling and data visualization, informing and changing behavior of the general public, the role of science/scientists) https://epiclearning.web.unc.edu/covid/

[4] See also: https://www.coding4girls.eu/

Outdoor STEM activities with apps on digital devices for example: - Math 'tours' in the city https://mathcitymap.eu/en/ - Environmental research about types of soil, wild birds, mice on fields, water, the weather https://icse.eu/up-in-the-sky-exploring-space-with-a-weather-balloon/
Activities related to role models
Explore the contributions of women to science and their 'lives' (both from history and current days). For example, by inviting young female scientists or representatives of the world of work to speak about their personal stories (e.g. Girl of the Day).
Activities related to the world of work and entrepreneurial mindset
Engaging groups of girls with activities that might be divided and explored through different lenses from STEM subjects and workplace professionals.
Study urban architecture, by a lecture on: How to make a town friendly for citizens? Architecture as a participatory activity and a vehicle to shape and improve our society taking into account sustainability issues.
Activities in collaboration with existing science and technology centers/museums and with industry/small business

Besides the examples listed above and the Case Studies from GEM 2021 (see the Report on piloting and evaluating European GEM summer camps, December 2021) we encourage to make use of resources from other EU projects in which one or more of the partners participated, such as Mascil, MaSDiv and IncluSMe (see https://icse.eu/international-projects/).

One of the products is a collection of the 'strongest ideas' of the GEM Summer Camps in an online repository. This will be arranged in the tradition we already have in the ICSE consortium: https://www.fisme.science.uu.nl/publicaties/subsets/icse_en/ .

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6. Appendix

type	category	Title/topic	url	
source	coding	code.org	Code.org	
source	coding	Code Kingdoms	https://codekingdoms.com	NL
tool	coding	cubelets	http://www.modrobotics.com	NL
tool	coding	scratch	scratch.mit.edu	NL
tool	coding	simsketch	http://modeldrawing.eu/our-software/simsketch/	NL
tool	coding	ozobot	ozobot.com	NL
source	empower	female stem role models	https://blog.mimio.com/female-stem-role-models-increasing-girls-in-stem-fields	MT
source	ibl	everyday life consumption		CZ
source	ibl	inclusme	inclusme-project.eu	SK
source	ibl	urban architecture	https://en.wikipedia.org/wiki/Urban_design	SK
tool	coding	arduino	arduino.cc	DE
source	ibl	science musea	https://herakleidon-art.gr/	GR
tool	coding	lego mindstorms	mindstorms.com	NL
tool	coding	python	python.org	DE
source	coding	lego league	firstlegoleague.com	NL
tool	coding	blockly	blockly.games	NL
tool	coding	javascript	developer.oracle.com/javascript	NL
tool	coding	swift	swift.org	NL
source	coding	cs-unplugged	csunplugged.org	NL
source	coding	legowedo	https://education.lego.com/nl-nl/lessons/wedo-2-science	NL
source	ibl	augmented/virtual reality		NL