ICSE
International Centre for STEM Education

GEM
Empower Girls to Embrace their Digital and Entrepreneurial Potential

Final Report on the Organization of European GEM Summer Camps

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GEM Empower Girls to Embrace their Digital and Entrepreneurial Potential

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GEM Empower Girls to Embrace their Digital and Entrepreneurial Potential

Report on activities carried out during the European GEM summer camps and recommendations for further action

Introduction

As its name implies, the GEM project set out to empower girls to embrace their STEM, digital and entrepreneurial potential. One of the main activities of the project were the GEM summer camps, intended as an educational opportunity through which girls can enjoy STEM as they learn about STEM and through STEM together with other girls. The purpose behind the summer camps was to inspire girls by giving them a positive experience of STEM and helping them realise their potential in STEM, digital and entrepreneurial fields.

Ten higher education institutions organised the summer camps in the countries participating in the project, namely Cyprus, Czech Republic, Germany, Greece, Lithuania, Malta, Netherlands, Slovakia, Spain and Sweden twice, first in 2021 and then in 2022. The first round of summer camps involved piloting of various activities and a report was prepared focusing on the planning and activities carried out in the summer camps held in 2021, lessons that were learnt and recommendations for modifications emerging as a result of evaluations carried out at a national level. On the basis of this piloting, the programmes were modified and a second run of the summer camps was organised in 2022.

This report is intended to give an account of the main activities of the summer camps. The first part of this report focuses on the planning and activities carried out in the summer camps, lessons that were learnt and recommendations for stake holders interested in advancing the issue further to successfully organize similar activities. This part of the report gives an overview of the summer camps and of overall lessons learnt as a consortium. The second part of this report consists of a set of case studies focusing on the events carried out and including details such as the organization, content, tasks used and an evaluation of the implementation and its effects. This part of the report contains a rich description of contexts, plans and activities and their evaluation.

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Part 1: Overall report on the activities carried out as part of the European GEM summer camps

1.1 Aims

GEM aimed to achieve a number of overall learning outcomes. These were then translated into specific learning outcomes for the context and students involved in each country and linked to specific learning activities.

The general desired learning outcomes were:

- Girls will have increased interest in STEM/digital disciplines
- Girls will become aware of their own potential
- Girls will be enabled to perform successfully in STEM/digital disciplines
- Girls will be encouraged to study or pursue careers in STEM/digital sectors
- Girls will have the confidence to consider leadership positions in STEM/digital sectors
- Girls will have an enhanced employability with regards to STEM/digital labour markets
- Girls will want to know more about STEM
- Girls will want to be involved in STEM

1.2 Pedagogical approach

The consortium developed the pedagogical approach for the GEM summer camps. Inquiry-based learning was the main pedagogical stance adopted. Activities were offered in which girls could engage and explore topics or problems motivated by their curiosity. Real-life problems and tasks that are relevant for society were assigned. Such authentic contexts and problems are known to trigger curiosity, enhance student motivation (Hugerat et al., 2018) and stimulate ownership of the question and the method employed. Moreover the use of real-life contexts and the blurring of boundaries between science in school and science in everyday life were seen to make the subject more accessible to minority groups (Wilson et al., 2015), foster positive attitudes towards science and reduce the gender gap in science education (Bennett, 2016). Examples of such contexts and problems included dealing with environment-related and pollution-related issues in a valley; student projects involving innovative ways of transforming tourism into sustainable tourism; and mini projects using Arduino to solve a real-life problem among others. The inquiry activities involved students asking questions and devising methods to answer the questions. This approach stimulates ownership of the questions and of the inquiry itself. Students can see the usefulness of the activity and its applicability in real life while being involved in authentic STEM practices. In order for this approach to be fruitful it was deemed necessary to provide the right educational environment by nurturing a culture of belonging, fostering social connectivity among all the participants and developing a learning culture where girls feel comfortable to learn with others, where making mistakes is allowed, and where they learn from their mistakes. Female role models also played an important part. Female STEM professionals were invited to talk about their work, their life, experiences and hobbies. This was intended to introduce the participants to different STEM-related careers but also present female role models with whom girls can identify themselves. These role models were intended to show that it is possible to be a female STEM professional and be successful in one's profession while having a social life.

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1.3 Students targeted

The project aimed to involve girls between 12 and 18 years old. Different countries focused on different age groups, some working with younger students while other countries focused on older students. This depended on the educational context involved, such as the age when the girls could opt to study STEM related subjects or points when the summer camp might be able to influence their career choice. Table 1 gives a summary of the number of girls involved in each participating country during the two rounds of summer camps and the age of the students. During the 2021 summer camp, in a number of countries, COVID restrictions meant that they were unable to host 50 girls or so at one go and that meant that the number of participants was reduced to the maximum number allowed. Some partners were able to organise more than one summer camp, increasing the number of participants. During the 2022 summer camp, in most countries, the restrictions had been removed and organisers were able to involve larger groups of girls. Over 800 girls participated in the GEM summer camps over the two years.

Table 1: Girls participating in the summer camps

Country	Age	Participants 2021	Participants 2022	Total
Cyprus	12-14	20	27	47
Czech Republic	12-16	50	51	101
Germany	12-18	25	15	40
Greece	13-15	68	70	138
Lithuania	12-14	66	36	102
Malta	11-12	35	65	100
Netherlands	14-16	27	20	47
Slovakia	10-18	15	63	78
Spain	13-18	64	59	123
Sweden	12-15	18 (out of 47*)	7 (out of 17*)	25 (out of 64)

* The event was attended by both boys and girls

1.4 Summer Camp Learning Plans

Each partner developed a summer camp learning plan for the specific needs of the students. These learning plans were based on guidelines developed for the GEM project (WP2). The learning plans were based on the key concepts developed by the GEM consortium and the specific details were designed with the help of the National GEM Teams who gave their advice and feedback on appropriateness of materials for the girls involved and outcomes desired. The plans varied in length and in content but in most countries they involved 5-day summer camps with an average of 5.5 hours per day. All are examples of educational approaches to encourage girls to participate in STEM. Some of the summer camps focused on a particular theme such as colour, designing digital escape rooms, lab technology and every-day life consumption and mini-projects exploring solutions for safety and comfort using Arduino. Other learning plans included a number of stand-alone activities targeting different desired outcomes. All summer camps involved hands-on activities, workshops or

laboratory work through which girls could solve problems, try out ideas, design and collaborate on the given tasks.

In 2021, despite the pandemic, most of the summer camps involved participants attending physically on university campus or on other sites. In Germany the summer camp involved female scientists who delivered lectures online to students who were physically present on campus. In Malta and Greece, the organisers were constrained to carry out all the activities online due to public health restrictions. However, the plan was successfully converted into an online form which still involved students in hands-on activities and workshops in groups.

By summer 2022 pandemic restrictions had been lifted in most countries. In most countries it was possible to hold summer camps that were completely face to face on University campus. The Greek team opted to have another online summer camp in 2022. The summer camps included various trips and outdoor activities. Some of these summer camps involved collaboration with entities or organisations that are already involved in STEM related events and STEM communication or that already organise summer camps or events dedicated to STEM. Their knowledge and experience were combined with that of the organisers of the summer camps to give a positive and fruitful experience to the participants.

Ice-breaker and team building activities were used to help participants introduce each other and get to know each other and these were greatly enjoyed by those present whether attending online or in person.

The learning plans for the summer camps included meetings with female STEM professionals who spoke about their careers, challenges encountered and solutions found. They also spoke about their life in general and their hobbies. This brought science and scientists closer to the girls, presenting the professionals as normal women who have opted for a STEM career. It also showed girls that it is possible for a woman to succeed in STEM. In Spain, participants could go a step further since girls were able to work with and be immersed in the work of a female scientist for four afternoons.

Gender stereotypes were also targeted in other ways. For example, some activities included interactive sessions that dealt specifically with stereotypes related to STEM and gender stereotypes in particular. Women's contributions to STEM fields were also show-cased.

The learning plans included science content learning such as electromagnetism, human power or DNA; mathematics such as mathematics in architectural structures; computational thinking and programming skills; problem-solving; hands-on practical skills and entrepreneurship among others. In all of these summer camps a lot of learning was taking place while participants were enjoying themselves doing fascinating things such as blowing a bubble as big as a person or exploring magnetic fields using magnets that appeared to float in air; designing and 3-d printing their own escape box or using Arduino and sensors to develop solutions for every-day problems. Through the summer camps students were also able to develop soft skills such as working with others and

presentation skills. During several of the summer camps STEM became STEAM (science, technology, engineering, arts and mathematics – Yakman & Lee, 2012) as the artistic aspect and creativity were encouraged and developed. For example, designing escape rooms involved a strong artistic aspect which included developing a story line among other things.

Entrepreneurship was targeted in various ways. For example, workshops involved girls in considering being their own boss and reflecting about having leadership positions. Another activity engaged girls in planning how to turn one of their hobbies into a business. Another way of targeting entrepreneurship was by integrating it with other summer camp activities. For example students were given a problem for which they were required to produce a solution and create a product. The girls were then required to pitch the product to an audience.

Over the two years, various digital tools were used for communication such as the OWL-system, ZOOM, Microsoft Teams or for coding such as Scratch, Arduino, Micro:bits and Blockly games. Students also used applications when working on presentations, data analysis and so on. All of these helped develop further students' digital skills and empowered them to feel ready to participate in and contribute to our increasingly digital society.

Girls participating in some of the summer camps were able to take home something to remind them of this event such as an escape box, t-shirt, kit for experiments with magnets, a book about women and their STEM-related contribution to society or a kit which enabled them to continue experimenting with coding after the summer camps.

Details of these Learning Plans, the activities involved and their evaluation are available in the country case studies.

1.5 Recruitment

Recruitment of participants in the various countries involved a variety of strategies and campaigns. All partners had a summer camp support site with details about the summer camp and joining the summer camp. These sites consisted mainly of a page on the higher education institutions' web site. A popular form of advertising was through social media using catchy messages. Below is a list of strategies and tools used by the various organisers.

- Summer camp support site
- Social media (FB, Instagram, Twitter, LinkedIn)
- Information on Faculty or departmental web page
- Newsletter of the University, Faculty or Centre
- Personal contacts with schools and STEM teachers
- Personal contacts with associations
- Contacts through student-teachers during school placements
- Emails
- Meetings (e.g. with schools, with students, with parents)

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- Newspaper through a press-release
- Radio and TV (regional or national)
- Special occasions such as events for girls
- Advertising during local conferences, seminars and university activities
- Digital leaflets and posters
- Printed posters put up in schools, University etc.
- Education Departments or delegations
- Teacher Centres
- Foundations for Science and Technology

Students generally applied through online registration forms. Paper forms were also provided to schools in some countries to ensure that anyone can apply and not only those who are able to register online.

In some countries, the number of applications was greater than the number of places they could offer. In these cases, selection was necessary. Countries generally opted for selection on a first-come-first served basis which was facilitated by online registration which included a time stamp. This seemed to be the fairest and the most resource-saving thing to do.

As these few examples show, there are many possible methods of recruitment and selection. Reflections about these methods are included in the sections related to evaluation and recommendations.

1.6 Mentors

A very interesting characteristic of the GEM project was the involvement of GEM mentors in the summer camps. The partners taking part in this project took up the idea and developed it further. Some countries involved female experts as mentors by involving them in the design of the activities or by assigning groups of students to join their research work for the duration of the summer camp. Other partners involved young female mentors with a STEM-related background as adult group leaders and session leaders. In this way a mentor would follow a small group of students for the duration of the summer camp. These mentors were often prepared for their roles through special training sessions in which the aims of the summer camp, the activities and pedagogy to be employed were explained. Some partners involved experienced teachers and females involved in non-formal learning events.

1.7 Challenges encountered

The main challenge encountered when implementing the summer camps in 2021 was the COVID-19 pandemic. This affected the number of students participating, the activities that could be organised and also made the logistics more complex. Some of the challenges caused by the pandemic are listed below:

- A number of countries tried to delay the summer camps as much as possible with the hope that the situation improves.

- A number of partners decided on whether to have an on-site or an online/hybrid summer camp very close to start of the summer camp, mostly the week before. This made planning difficult and very hectic in the last few days before the start of the summer camp.
- One partner (MT), was not given permission by the health authorities to go ahead with the on-site summer camp despite planning and including safety and sanitization measures. They changed to an online summer camp losing some of the students who had registered for the summer camp.
- Other partners, while having the possibility to organise an on-site summer camp, had a restriction in the number of girls they could accept for the event with the maximum being 20 or 25 students. Some partners were able to run the summer camp twice so that all the students could participate but for some partners this was not possible.
- Some activities had to be abandoned due to COVID restrictions such as a project presentation event to which parents are invited. Partners who still managed to organise such an event found the activity to be very successful.

Some challenges were specific to the country involved, for example weather conditions such as very high summer temperatures that limit the possibility for outdoor activities.

Having many girls interested in participating may appear like a positive point but this proved to be a challenge when the number of applications was greater than the number of places available. This situation was made worse by COVID restrictions in 2021 resulting in a smaller number of allowed participants. Selecting girls who would participate in a fair and transparent way was a challenge. Accepting students on a first come first served basis was adopted by a number of partners. In some countries attracting a good number of girls was a challenge.

A common challenge was including girls from all socio-economic backgrounds. The educational nature and timing of the summer schools (during school holidays) together with the venue (University campuses) resulted in a rather homogeneous group of girls participating, that is, girls who either themselves or their parents already have some interest in STEM. Although we do not have data about their socio-economic backgrounds, it is likely that many participants come from similar backgrounds. Girls from poorer educational backgrounds might have to overcome an extra hurdle to participate in an event that is organized by a higher education institution. In this respect, schools are in a better position to encourage girls to consider STEM because girls from all backgrounds attend school, and this encouragement should preferably start when they are still in primary level.

One particular partner (SK) implemented the summer camp through an already established summer camp related to physics which is usually open to boys and girls. In 2021 this was organized for girls only as part of the GEM project. Several boys and their parents complained. One possible solution to this challenge is to organize two parallel summer camps one for girls and the other for boys and girls as was normally the practice.

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Having participants with a wide age range (e.g. 12-16) may present a challenge. This may be solved by grouping the students into smaller sets with a smaller age range (e.g. 12-14; 15-16).

The distance of certain venues from the main campus was also a challenge.

Ensuring that the activities reflect the interests of the students may be a challenge. One of the partners found it necessary to adapt and re-design activities on a daily basis during the first round of summer camps, to reflect the interest of the group of participants and make them more relevant to the girls.

Another challenge encountered was financial in nature. Engaging mentors, buying materials, providing lunches and paying for trips meant that some partners needed to look for sponsors to cover all the expenses.

1.8 Evaluation of the activities of the summer camps

The GEM project adopted a plan-do-check-act approach, so part of the planning and implementation involved having an evaluation phase. Due to the different educational and national contexts in which partners operate and the variety of activities involved in the summer camps it was necessary to analyse systematically the different design aspects and their impact. Those would permit reflection on the feedback obtained, adaptation of learning plans and making recommendations for future summer camps whether they are GEM summer camps or other summer camps organised by policy makers or other stake holders. The evaluation was based on the experience of all the participants, girls, educators and the organizers themselves.

The impact of each summer camp and its activities on the participants was explored using a pre-post survey design. A literature review was carried out to identify previously validated instruments that can be used to explore participants' characteristics and attitudes such as students' interest in science and scientific careers and perceived relevance of science education. These were used to develop an instrument for use in the GEM project. This includes items developed by Knezek and Christensen (2010), PISA (2006) and the Modified Attitude towards Science Inventory (Weinburgh & Steele, 2000). Following review and extensive discussions within the consortium it was agreed to prepare a short and simple version of the instrument that can satisfy the need of the evaluation without burdening students with lengthy questionnaires which would be contrary to the aim of the summer camp. The pre-questionnaire was intended to determine the characteristics, views and perceptions of the participants while the post-questionnaire was intended to provide feedback about the summer camps and their impact on students. The post-questionnaire included a number of open questions to give students the opportunity to elaborate on their views and experiences.

The pre-questionnaire was divided into three sections. The first section collected information about the age of the students, the STEM-related subjects studied at school and their career aspirations. The second section looked at participants' thoughts about STEM-related school subjects. The items were based on the STEM semantics survey developed by Knezek and Christensen (Tyler-Wood,

Knezek & Christensen, 2010). The third section investigated girls' feelings about STEM subjects and about studying STEM through eight Likert scale items. Items 1-4 were items from the PISA (2006) study while items 5-8 were from the Modified Attitude towards Science Inventory (mATSI). The items chosen were adapted to focus on STEM and not only on science. Items 1 and 2 explored the students' enjoyment in learning STEM; items 3 and 4 their instrumental motivation to learn STEM; item 6 targeted their self-concept of STEM; while items 5, 7 and 8 explored their views about the value of STEM in society.

The post-questionnaire too was divided into three sections. The first section consisted of a series of statements that targeted the desired outcomes of the summer camp. Students were required to mark their level of agreement with each statement on a five-point Likert scale. The second section consisted of the same items that appeared in Section 3 of the pre-questionnaire. It was intended to explore any changes in views and thoughts as a result of the summer camp. The third section of the post-questionnaire was intended to provide feedback about the regional activity.

A short reflective questionnaire was prepared to obtain feedback from educators leading sessions with the students. A template with questions and instructions, to be filled by partners helped the development of a case study report for each country. Copies of these instruments may be found as Appendices to this report. An analysis of the key characteristics and outcomes is given in the following sub-sections. The quantitative data presented is based on an analysis carried out by Oliver Straser from University of Education in Freiburg, Germany (PHFR).

1.8.1 Characteristics of the students attending the summer camp

The students who attended the summer camps tended to have quite positive attitudes about STEM. The students ticked a number in a STEM semantic survey making part of the questionnaire, to indicate how they feel about the STEM subjects that they learn at school with 1 representing 'means nothing' and 7 representing 'means a lot'. Table 2 summarises their thoughts about STEM subjects.

Table 2: Participants' thoughts about STEM subjects

		SCIENCE	MATH.	BIOLOGY	CHEMISTRY	PHYSICS
Mean		5.67	5.59	5.57	5.09	5.11
To me science means nothing	1	1.47%	2.30%	3.10%	6.19%	7.93%
	2	1.47%	3.55%	2.00%	5.73%	3.30%
	3	5.03%	5.22%	6.87%	6.42%	6.61%
	4	12.16%	9.39%	9.76%	12.61%	13.22%
	5	19.08%	17.75%	17.07%	20.87%	18.06%
	6	21.59%	24.84%	23.73%	19.72%	22.47%
To me science means a lot	7	39.20%	36.95%	37.47%	28.44%	28.41%

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The mean scores were between 5.09 and 5.67. The physical sciences had slightly lower means compared to the other STEM subjects, however overall most participants had a positive attitude towards STEM. Around 11% of the participants neither liked nor disliked STEM subjects, while for another 13.5% STEM means nothing or very little. Table 3 on the other hand summarised the students' responses related to how interesting they find the school subjects ranging from 1 (boring) to 7 (interesting).

Table 3: Participants' level of interest in STEM

		SCIENCE	MATH.	BIOLOGY	CHEMISTRY	PHYSICS
Mean		**5.68**	**5.24**	**5.39**	**5.33**	**5.02**
To me science is boring	1	2.30%	5.22%	5.92%	6.75%	9.21%
	2	3.34%	4.59%	5.29%	4.14%	6.21%
	3	4.18%	8.14%	4.23%	4.36%	7.49%
	4	9.19%	11.90%	10.15%	13.51%	11.56%
	5	15.03%	16.70%	15.64%	13.51%	13.49%
	6	26.72%	20.46%	20.51%	20.70%	20.13%
To me science is interesting	7	39.25%	32.99%	38.27%	37.04%	31.91%

The mean score for science learnt in an integrated form is the highest score observed. However most participants expressed a relatively high interest in the STEM subjects. This is understandable as the summer camp was a voluntary activity and in most countries it took place during the students' summer holidays so it is no surprise that it mostly attracted girls who show a moderate to high interest in science. In fact, when asked why they applied for the summer camps most students did so out of their own personal interest in STEM as shown in Figure 1.

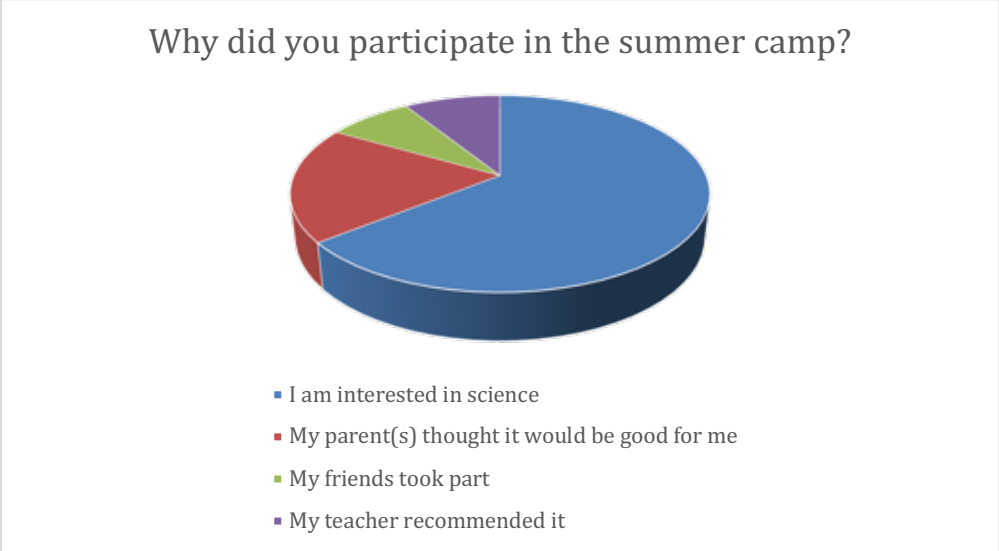

Figure 1 Motivation to attend the summer camp

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But does the students' interest in STEM correspond to an interest in further studies in STEM? This issue was tackled by another item in the pre-questionnaire. The responses to this item are summarised in Table 4.

Table 4: Participants' interest in continuing studies in STEM

Continuing studies in STEM is . . .			Continuing studies in STEM is . . .	
ordinary	1	3.35%	unappealing 1	2.31%
	2	1.89%	2	1.47%
	3	4.61%	3	4.82%
	4	12.37%	4	13.21%
	5	20.34%	5	16.35%
	6	27.04%	6	27.88%
fascinating	7	30.40%	appealing 7	33.96%
Mean		5.48	**Mean**	5.60

The responses summarised in Table 4 show that before the summer camp almost 25% of the participants did not feel fascinated by the possibility of further studies in STEM nor did they find the prospect appealing.

1.8.2 Girls' feelings about STEM subjects before and after the summer camps

A set of questions were included in both the pre-and post-questionnaires. These questions investigated girls' feelings about STEM subjects and about studying STEM. The questions explored student enjoyment in learning STEM, their instrumental motivation to learn STEM subjects, their self-concept of STEM and their views about the value of STEM in society. Table 5 shows the means of the responses given by the participants on a five-point Likert scale where 1 corresponded to 'strongly disagree' while 5 corresponded to 'strongly agree'.

Table 5: Means of the pre- and post- responses related to students' feelings about STEM and STEM learning

Statement	Mean pre-questionnaire	Mean post-questionnaire
A. I am interested in learning about STEM	4.14	4.44
B. I enjoyed learning STEM topics	3.96	4.47
C. Making an effort in my STEM subject(s) is worth it because this will help me in the work I want to do later on	4.04	4.22
D. What I learn in my STEM subject(s) is worthwhile for me because I need this for what I want to study later on	3.91	4.11
E. STEM is useful in helping to solve the problems of everyday life.	3.76	4.15
F. STEM is easy for me	3.45	3.64
G. STEM is helpful in understanding today's world	4.06	4.31
H. It is important to know STEM in order to get a good job	3.74	3.89

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The means show that overall, student responses ranged from a neutral position (3, neither agree nor disagree) to an agreement with the statement (4) before the summer camp. Their enjoyment in learning STEM (statements A and B) showed a mean of around 4 corresponding to agreement. The statements linked to their feelings about the value of STEM in society had means ranging between 3.45 and 3.76. The lowest mean (3.45) was observed for the statement linked to their self-concept of STEM indicating that for a number of participants STEM is not easy. The means of the statements linked to instrumental motivation to learn STEM were 3.91 and 4.04.

When asked to record their feelings about STEM subjects following the summer camp all the means increased to show a more positive disposition. Figure 2 shows a comparison between the means scored per statement in the pre- and post- analysis.

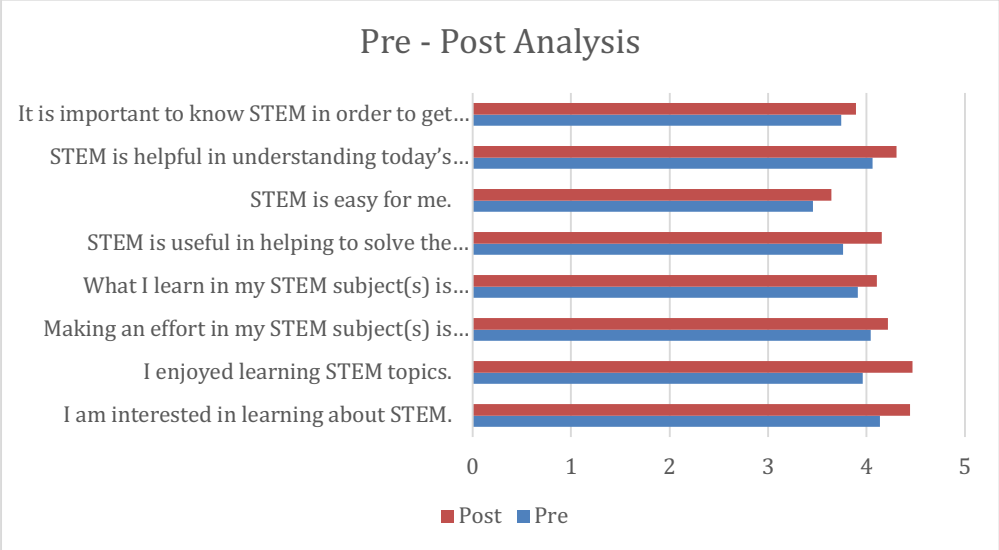

Figure 2: Pre- Post- analysis of responses related to students' feelings about STEM and STEM learning

A t-test analysis, based on 400 matched pre- and post- questionnaires, showed that the differences between the pre- and post- responses were statistically significant. Cohen's d value for the size of the effect were low to medium with the greatest effects (d = 0.504 and d = 0.445) obtained for statements B (I enjoyed learning STEM topics) and F (STEM is easy for me) respectively. Other relatively high effects were observed in relation to their interest in STEM (A), the instrumental motivation to learn STEM subjects (C) and the value of STEM in society (G). These statements are all linked to outcomes targeted by the summer camps. Although Cohen's d values are not very high, one has to keep in mind that the participants started the summer camp with a relatively positive attitude towards science hence the modest increases.

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A set of questions in the post-summer camp questionnaire targeted the desired learning outcomes identified by the consortium for the summer camps. Students were required to self-assess and indicate their level of agreement with a list of success criteria. The percentage of participants choosing each category are shown in Table 6 with 1 representing 'strongly disagree' and 5 representing 'strongly agree'.

Table 6: Student self-assessment

	I can mention ICT-related uses and applications	I am aware of gender stereotypes	I am aware of the relevance of digital technologies in my life	I am ready to engage in science	I am ready to engage in ICT	I can imagine myself working in a science-related job	I can imagine myself working in an ICT-related job
1	2.66%	3.02%	1.52%	2.83%	4.72%	2.65%	7.09%
2	2.47%	1.51%	1.14%	2.08%	8.49%	3.98%	11.22%
3	12.55%	8.30%	7.39%	15.47%	21.70%	16.67%	28.74%
4	54.56%	30.00%	41.67%	37.36%	40.19%	32.39%	31.89%
5	27.76%	57.17%	48.30%	42.26%	24.91%	44.32%	21.06%
Mean	4.02	4.37	4.34	4.14	3.72	4.12	3.49

Around 80% of the students agreed or strongly agreed with most statements. The lowest levels of agreement were for statements related to their readiness to engage with ICT or an ICT-related career (65 and 53% respectively). This trend is evident in the mean score for each statement, also given in Table 6.

In most countries more than half the students participated because they were interested in science. This is expected as the summer camp was voluntary and likely to attract girls who were already interested in science. The high interest and positive attitudes of participants before the start of the summer camp meant that increase in interest and change in attitudes in many countries was modest (Figure 2) however students still reported a change in their views about science which were broadened as their knowledge deepened (Figure 3). A more substantial change was often observed for their awareness of the applicability of STEM in everyday life. This showed that one of the strengths of these summer camps was the way STEM was presented through real-life contexts using hands-on activities. Their meetings with females in STEM professions also helped students learn about how science was being used to solve real-life problems such as developing a vaccine for COVID-19 (ES) or use of electromagnetism in diagnosis and treatment of medical conditions (MT), among others.

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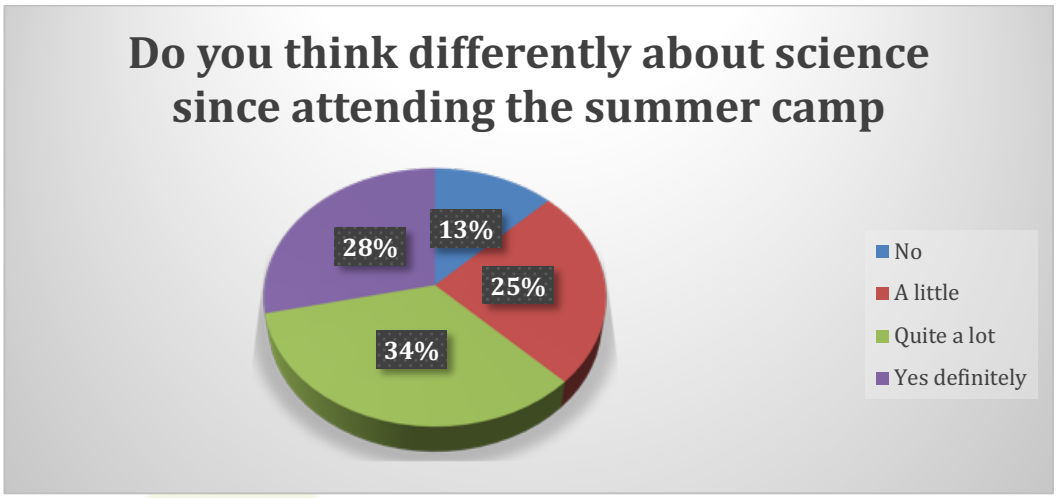

Figure 3: Changes in how the participants see science

1.8.3 Which advertising methods attracted students to participate?

Figure 4 shows that most of the girls heard about the summer camps from their schools or their teachers. Parents and friends were also influential. It appears that personal contact was the most effective method for recruitment since having someone encouraging them to attend, influenced girls' decision to participate. In this respect it may be helpful to involve schools and teachers who may encourage girls who are less likely to come forward and apply because they are not very good at STEM subjects or because they have never considered a STEM-related career. In this way the summer camps would be able to reach girls who would benefit from these events more than girls who are already very keen on science.

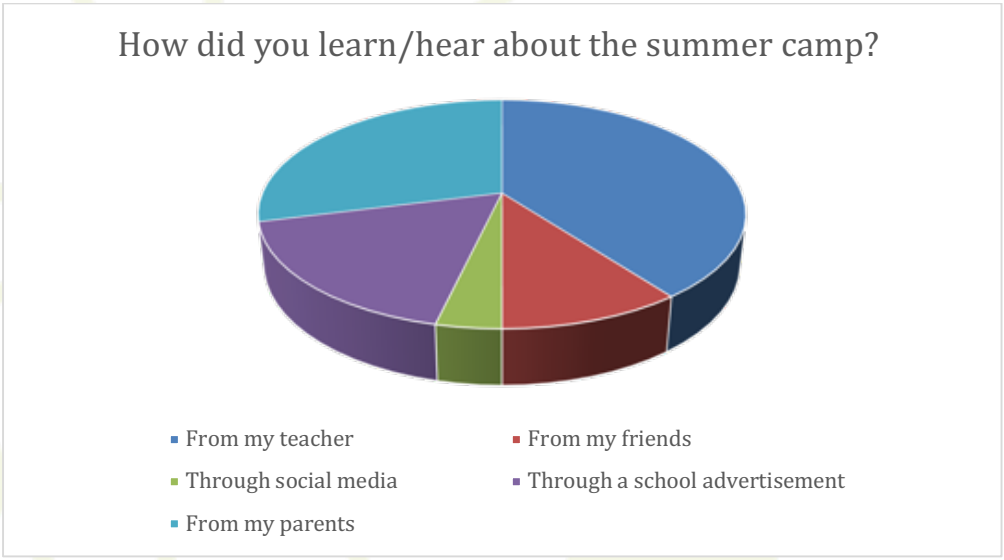

Figure 4: Advertising methods that attracted the participants

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1.8.4 Feedback related to the summer camps

All summer camps reported very high enjoyment of the activities involved. Figure 5 summarises the students' response about enjoyment of the activities. Their response to this statement corresponds to their response to the question about whether they enjoyed learning STEM during the summer camp, discussed in Section 1.8.2.

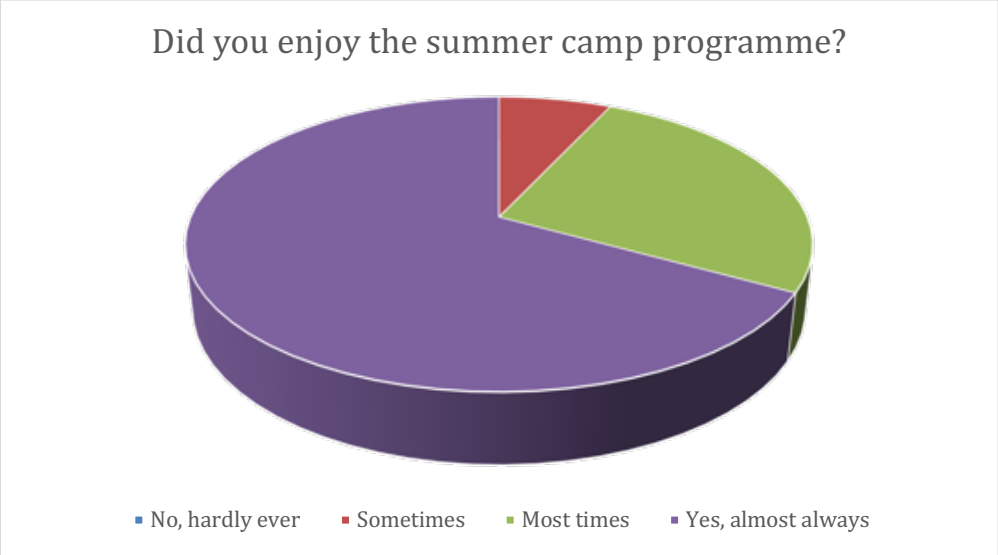

Figure 5: Feedback related to enjoyment of the programme

Students also reported feeling comfortable during the events which would have contributed to their enjoyment. This was one of the aims of the summer camp: providing a comfortable and non-threatening environment in which the girls can work. Figure 6 summarises their responses related to this point. It is evident that the summer camps managed to achieve this aim as most students felt comfortable and at ease during the summer camps.

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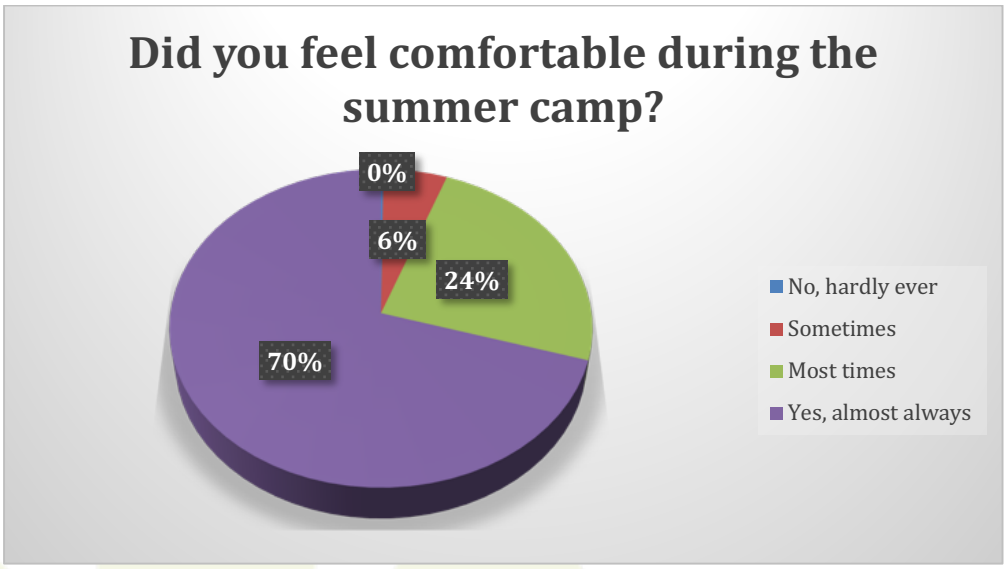

Figure 6: The environment during the summer camp

Another item in the questionnaire required students to indicate whether they would recommend this summer camp to other girls. The responses are summarised in Figure 7. Students indicated that they are likely to recommend the summer camp, in fact 96% of the students indicated that they are likely to do so.

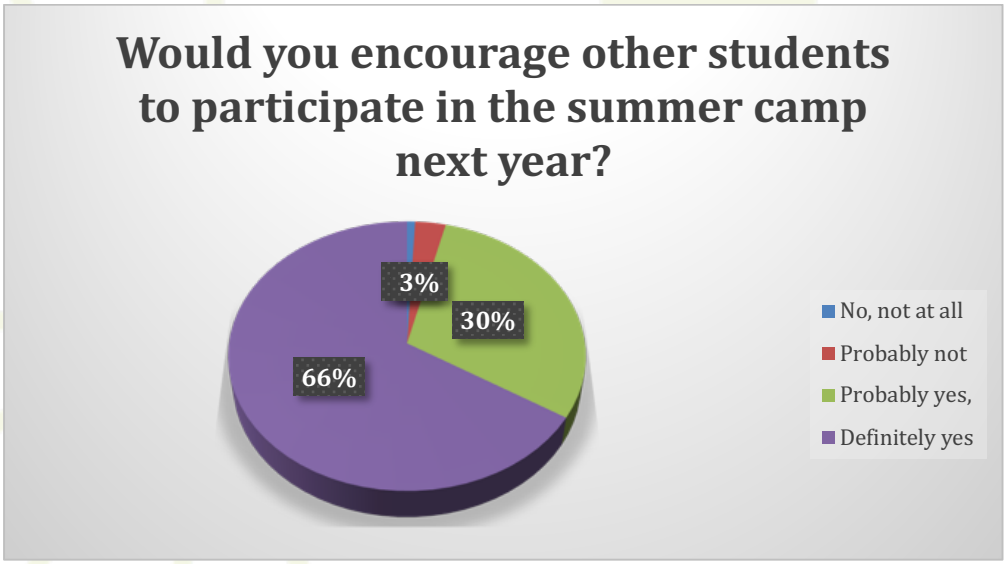

Figure 7: Encouraging other girls to participate

The questionnaire also encouraged participants to write their reasons for their choice of statements and to provide further feedback through open questions. The students provided a lot of feedback,

some of this specific to a particular camp or activity which the organisers can use for future summer camps.

A number of students suggested longer summer camps and shorter breaks so that they would have more time doing science:

> "*I would like a longer one, maybe a week camp would be great*!" (CZ)

> "*Those breaks are unnecessarily long, we lose time to explore something else*." (CZ)

> "*I wish it lasted more days*!" (GR)

Participants also stated that they would encourage other students to attend and reported a change in their views and attitudes related to STEM:

> "*Before the summer camp, I couldn't connect much with STEM. My friend persuaded me to take part in the summer school and it was so much fun. I would like to do my student internship at ICSE next year*." (DE)

> "*Yes I did because after this camp I found that science can be very fun and interesting*". (MT)

Some students stated that they would apply again the following year if this opportunity was again available. This shows that the various types of summer camps such as in-person or online, the activities included (such as working with scientists, meeting and talking with female scientists, hands-on tasks and experiments, creating and building something together such as an escape room) were well planned and appropriate for the age groups involved. Students reported learning new STEM-related content, learning about STEM-related careers, entrepreneurship and gender stereotypes:

> "*It strengthened my desire to become a respected person in a given field where there are mostly men!*" (CZ)

> "*I realised that women have a wide variety of jobs in STEM and that it is not male related at all.*" (MT)

> "*Being a scientist seems like a dream to fulfill and the woman can do anything she dreams of*." (ES)

The extent of achievement of the various outcomes was impressive. It varied from country to country and each partner has identified particular strengths of their model of the summer camp and

events, as well as taking note of areas that needed to be reinforced. These specific points are available in the country case studies presented in Part 2 of this report.

Students appreciated the challenge in some of the tasks such as creating their own riddles and coding:

> "*What I liked most was that we could make up our own riddles. Maths riddles are particularly exciting*". (DE)

> *"I liked creating the project the most, it was a lot of fun when you find out that the project you made works and can be useful for others, and I also really enjoyed collaborating and working in groups"*. (LT)

> "*It was a lot of fun and exciting … it is possible to develop imagination and thinking here*". (LT)

The participants also appreciated activities that were linked to real-life contexts:

> "*I really enjoyed working in the biology lab and I got excited because I learned about my blood type by doing the experiment myself*" (CY).

The girls also appreciated the contact with female scientists especially when they were able to shadow them during their work:

> "*This is a different way of learning science than in school, it is practical, you enter a laboratory, you meet people who are dedicated to this and especially the point of doing it yourself and doing a real research*". (ES)

> "*Great chance for students far from the capital to meet such interesting females. Very inspiring.*" (GR)

This last comment showed how an online event may prove to be successful and may even be advantageous as students who live too far from the university organising the event may still participate and benefit from the experience.

1.9 Lessons learnt and recommendations

Several lessons were learnt through the experience of the two rounds of summer camps held in 2021 and 2022. These included lessons of a more general nature as well as specific lessons related to activities or events held. In this section recommendations of a more general nature are described. Other recommendations that are more specific to a particular summer camp or activity can be found

in the case studies. These recommendations are based on the feedback given by students, educators and parents as well as observations and reflections of the project consortium.

1.9.1 STEM SUMMER CAMPS CAN REACH ALL GIRLS

- Attracting girls who are not very interested in science

While a sizeable number of girls who participated were not very interested in STEM or STEM-related careers when they joined the summer camp, it is recommended that where possible more students of this type should be involved. Girls who do not have a STEM background (such as high interest in science, high achievers or parents in STEM-related professions) should be invited and encouraged to participate. Teachers and schools may be able to help by encouraging such students or their parents to register for the summer camp. Organisers may include this as a selection criterion when selecting participants. Furthermore since schools are already in touch with students with a range of interests in STEM and diverse achievement levels, they are in a very good position to influence girls. Schools may benefit from the activities organised in the various GEM summer camps and draw from the ideas based on the cost free GEM summer school organization guidelines that are available on the GEM website. These may be adapted for use with students. The in-school activities may include informal meetings with STEM professionals, discussions related to gender stereotypes in STEM as well as hands-on educational activities. The ages of the students catered for by the GEM summer camps were set by the EC at 12-18 years. However we recommend that school activities targeting girls should start at an even younger age and continue throughout their years at school. Schools may benefit from seminars or workshops on aspects targeted by the GEM summer camps.

- Helping girls who are somewhat interested in science

One of the observations made was that generally girls who participated in the summer camps tended to be already interested in STEM. A good number were not interested in a STEM career before the summer camp but claimed that they would consider it at the end of the summer camp. It would be interesting to know how many students would eventually opt to further their studies in STEM related areas and take up STEM-related careers. This information is not available and could not be collected so soon after the event. The evidence seems to suggest that summer camps are an ideal activity for girls who are somewhat interested in STEM but do not necessarily feel inclined towards a STEM career. Events like the summer camps may act as the final encouraging push in the direction of STEM careers. They are also a very good tool for higher education institutions to attract future students.

- Attracting participants

Ideally planning should start several months before the actual camp to allow tackling of all the logistics and to permit a good advertising campaign. It would allow parents to make arrangements about vacations and other commitments such as planning activities for their daughters during school holidays. When organising events such as summer camps, getting students from underprivileged socio-economic backgrounds to participate may not be easy. We recommend visits to schools from such areas and reserving some places for girls from these backgrounds. When

preparing the dissemination materials it is advised to consider teachers and parents as target groups of the dissemination measures, since the majority of girls did not apply on their own, but were encouraged by them.

1.9.2 ORGANIZING SUMMER CAMPS IN A COLLABORATIVE WAY IS BENEFICIAL FOR THE SUCCESS OF THE SUMMER CAMPS

- Involving experienced persons, existing networks and events

The summer camps have shown that using the expertise of persons who are already involved in organising summer camps can enhance the students' experience. These persons may be involved in the planning but may also organise a session/s. It is important to inform these experts about the aims of the summer camps. Similarly, any existing networks or activities for girls may be used.

- Mentors and role models

Several partners reported the benefit of having students working in small groups while being supported by a female mentor who could lead the work involved. In some countries, the mentors were involved in planning and designing the activities. Some mentors were asked to attend training sessions. It is recommended that mentors leading work in groups attend workshops/training sessions prior to the summer camps in which the organisers can brief them about the pedagogies that would be employed and how they can support and scaffold student learning. The STEM-related content can also be introduced. The role of the mentors is considered crucial to the success of the program as they helped provide a supporting environment where girls feel safe and able to work in an inclusive and welcoming environment. Mentors were also able to encourage girls to persist when faced with challenges and difficulties, emphasising the importance of grit and determination and showing girls that failure is a normal part of the learning process.

Visits to workplaces involving female scientists who can act as role models and who can show that it is possible to be female and a STEM professional while at the same time have a normal social life are also recommended as ways of tackling gender stereotypes. It is important to show female professionals in an approachable way, so that girls can identify themselves with these role models. Besides speaking about their careers, role models may also speak about the challenges they have encountered and how they managed to overcome gender stereotypes.

1.9.3 INCLUDING THE GIRLS' SOCIAL SURROUNDINGS MAXIMIZES THE IMPACT

- Parents

Since the girls were minors, parents were involved in the registration process and were required to give their consent for data collection, photography etc. In fact a considerable number of participants said that they applied because their parents encouraged them to apply. We recommend that when advertising STEM summer schools, parents are included as a target group. Due to COVID-19

restrictions, in most countries it was difficult to involve parents in a meeting, therefore some countries organised an online information meeting for parents. An event where students present their projects or the work carried out during the summer camp to an audience that includes their parents is highly recommended. This can be an occasion to target stereotypes that parents themselves may have or may be followed up by sending parents further links and online materials.

- Shaping boys' attitudes too

One of the discussions that often came up in meetings related to the project were whether it is best to organise the summer camps only for girls or whether both boys and girls should be included. There are pros and cons for both types of summer camps. What is definitely needed are opportunities to shape boys' attitudes on girls in STEM too. This may be done by showcasing girls' teams' success in STEM-related investigations and projects. When facing criticism about organizing a "girls-only" event, it proved to be a good practice to indicate and communicate all the other STEM events in the region, that are organized for boys, since project partners made extensive networking activities and knew about the STEM activities on offer. The girls who participated in the summer school were also encouraged to tell about their summer schools experiences in class, show the products they had developed through programming, engineering or researching. This way the whole class gets involved and the impact is extended.

1.9.4 IT IS INSPIRING TO SHOW THE VARIETY OF STEM ACTIVITES AND THEIR CONNECTIONS TO AUTHENTIC REAL LIFE PROBLEMS

- The activities

The activities that may be included vary according to the students involved. The project partners and the national GEM teams organized activities involving inquiry based learning and real-life problems in a supportive learning environment and linking the topics chosen to the world of work and involving female role models in STEM. The case studies have shown that activities that resemble school STEM activities (including report writing and listening to a talk) should be avoided or kept to a minimum. On the other hand, activities that actively involve students such as laboratory-based activities, hands-on activities, coding, planning, designing and discussing were all motivating and beneficial. The fun factor and the wow factor are also important. Ideally students should be introduced to various STEM fields including relatively new STEM fields. Activities linked to real-life contexts and to the interests and lives of young people were particularly successful.

The activities should provide opportunities for learning experiences that make girls feel that STEM learning is accessible and to persist when faced with challenges. This requires the right type of activity, scaffolding and support.

Involving students in presenting their projects to an audience will also help develop students' presentation and communication skills.

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Tackling gender stereotypes and entrepreneurship directly is also recommended. This may include specific discussions related to stereotypes, students learning about women in STEM including examples from history and the present day. Meeting role models is another way of tackling gender stereotypes. Entrepreneurship may be developed by designing the summer camp around a problem or competition that will help participants develop these skills. A product may be developed as part of the summer camp which students are then required to 'sell'.

- Location and duration of a summer school

The length of the summer camp and of each day should also be considered. While a number of partners reported that students asked for longer summer camps and more activities, one particular partner received feedback that the day was too long and that some students were tired towards the end of the end. Striking a balance between types of activities and length of each summer camp day requires some trials and adjustments. For example an event in the form of a summer school during school holidays for girls who are already interested to some extent in STEM may be one or two weeks long. This type of summer school may be a suitable holiday activity for these students while their parents work. On the other hand shorter events may be more suitable for girls with lower levels of interest. The organizers should consider the best options by weighing costs against the added value of the activities and the length of the event.

Since it is expected that a summer school offers a variety of activities for entertainment and social interactions, it is very much appreciated, if the learning also takes place outside a class room. Outdoor events are recommended, such as learning about laws of physics while being in a climbing arena or learning about optics in a laser tag room, or going to the mountains at night to watch stars and learn about astronomy and so on.

- Learning Environment

The use of activities such as ice breaker activities and games helped students to get to know each other. These activities may also be linked to STEM. This time for exchange between students, making friends and socialising is an important part of the process. This together with other efforts to provide a supportive and non-threatening environment are very important.

- Group work and collaborative work

Girls working in groups and supported by an adult leader (mentor) proved to be very successful. Groups of around four students worked very well. Grouping of students may be carried out in different ways. In some examples reported in the case studies, allowing students to work with their friends encouraged students to participate and in most cases helped students. In one particular case in the first round of summer camps, students were distracted when working with their friends and worked better when working with different students.

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1.9.5 EMBEDDING THE SUMMER CAMPS IN THE REGIONAL AND NATIONAL STEM EVENTS SCENE HELPS MAINTAIN STEM INTEREST

- Follow-up events

A positive outcome of the summer camps was the fact that many girls enjoyed the summer camp experience so much that they declared that they wished to apply again. We recommend follow-up events for these girls to sustain and support their interest in science – this can be done by informing the participants and their parents about the other STEM events that are organized by the same institution or other institutions in the region.

1.9.6 FURTHER APPLICATIONS OF THE GEM SUMMER CAMP PILOTING EXPERIENCES

- Workshops/summer school for teachers

Based on the feedback gained through the networking activities, teachers may benefit from workshops related to stereotypes, entrepreneurship and pedagogies and activities that may support girls in their STEM classrooms. Our Lithuanian colleagues are already ahead of this and based on the GEM summer school experiences, the knowledge gained in connection to gender and STEM, a 40-hour professional development course was developed and will be launched by April 2023.

- STEM Summer schools as an outreach event of higher education institutions

During the piloting several higher education institutions recognized the benefits of organizing a STEM summer camp for girls, in order to attract future students. The organization of the GEM summer camps was done in a collaborative way: higher education institutions offered rooms and staff, STEM female professionals participated on a voluntary basis without remuneration and in some cases there was sponsorship by private companies besides the EU grant that was used to cover the expenses involved. Local institutions, non-governmental institutions and initiatives connected to STEM and gender equality were good collaboration partners in establishing the organizational team of the summer camps. These structures will be maintained in some countries and they will continue organizing STEM summer schools, setting an example also for other higher education institutions.

1.9.7 BECAUSE OF THE COMMON INTEREST IN ATTRACTING MORE GIRLS TO STEM STUDIES AND CAREERS, SHARED FINANCING OF THE SUMMER SCHOOLS IS IMAGINABLE

Apart from the higher education institutions and local institutions, non-governmental institutions and initiatives connected to STEM and gender equality who might be interested in supporting the organization of summer schools mentioned in Section 1.9.6, we would like to highlight two other possible support groups:

- Parents

Since it is in the interest of parents for their children to find promising jobs in the future and since they may also be in need of (educational) leisure time activities for their children in the summer holidays, many parents would be ready to pay a participation fee for the STEM summer school. This however may only include girls and parents who are already interested in STEM subjects or a future STEM career to a certain extent and excludes girls who are unable to pay the fee.

- Business

Additional support may be obtained from local companies that can offer their employees as role models and guided visits of the premises of the company for world of work connections. Big companies who are willing to get involved in education and who already have staff and financial capacities for this purpose, may help when searching for funds.

1.10 Conclusion

The first part of this report gave an overview of the GEM summer camps organised in the 10 countries involved in this project, evaluating several aspects of the planning and implementation. This is followed by a series of case studies focusing on specific summer camps.

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Part 2: Country case studies – Summer Camps 2022

In the following sections case studies describing and evaluating the summer camps held in the different countries are presented.

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GEM Summer Camp 2022 – [Cyprus]

1. The Context

(Provide some background information on the educational context including for example ages of compulsory education, subjects taught (especially whether STEM, entrepreneurship and ICT are compulsory), age when students make subject choices, if any etc.)

The educational system in Cyprus is centralized with all schools in Cyprus (ages 4-18) monitored by the Ministry of Education and Culture which decides on the curricula and the books that will be taught in each age year. The compulsory education covers ages five to sixteen, and for those ages education is free in all public schools. The main teaching language in public schools in Greek. There is also the option for private schools for which the parents have to pay tuition fees, and these are usually schools in which the main teaching language is English. For the primary school (ages 6-12) the curricula includes mainly the following subjects: Greek Language, Mathematics, History, Religious Education, Health Education, Science, Sports, Music and Environmental Education. In the secondary education (12-15) the students again focus on general knowledge in various subjects similar to primary education, but science is divided in Chemistry, Biology and Physics, and ICT is added as a new subject. In the high school (15-18) the students choose a specialization (Classic studies, STEM, Finance) or a technical direction. Students who wish to follow STEM careers have to choose the STEM specialization which focuses mainly on Mathematics, Physics, Chemistry and a choice between Biology, Advanced ICT and Architectural Drawing.

2. Recruitment

(Provide information about the advertising and recruitment campaign, what worked and what was less successful. Describe activities, tools, materials used in the advertising strategy.)

Because of the covid-19 restrictions our group had to wait until last minute before deciding on whether the summer school 2022 would be held on-line or as a face to face event, and also to be able to decide on the number of students we could accommodate in the classroms. Given the good conditions at the beginning of the summer in Cyprus, we decided to hold the summer school as a face to face event at the University of Nicosia campus mainly, with some visits to other premises as well. The summer school was scheduled for the week after the end of the school year, June 27th until July 1st 2022.

The local team prepared a letter introducing the summer school and providing all details (dates, program, link to form for people interested). The letter was circulated to personal contacts, all university faculty and staff, on a facebook page for teachers and parents and was also advertised in an online newspaper (paideia-news) that is popular with teachers and parents. The letter with the details and the schedule is included in Appendix I in greek. The letter included a link for parents to register their children to the summer school. We decided that if we had more participants than we could recruit we would use a first come first serve approach and this was possible because the online registration form has a date and time stamp.

The initial registration was very successful with more than 40 girls registering for the summer school, but we were informed by the University that we could not have more that 27 girls at the University classrooms. Therefore, we selected the first 27 girls who registered and informed their parents. The consent form to photograph activities and record parts of the summer school was included in the initial form submitted by the parents.

3. Summer camp support site

(Provide brief information and link to the summer camp support site.)

A summer camp support site was prepared and this included information about the project, the team and the daily schedule.

http://www.girls4stemcyprus.com/pilambdaetarhoomicronphiomicronrho943epsilonsigmaf.html

Link to the summer camp support site:

http://www.girls4stemcyprus.com/pilambdaetarhoomicronphiomicronrho943epsilonsigmaf.html

4. The Plan

(Give a description of the ideas behind the learning plan; people supporting the plan such as any companies e.g. ICT or software companies. You may include copies of adverts, posters etc. Describe your plans. What did it involve? (How many days and how many hours in each day? Where were the sessions held? What kind of activities have you planned? Did you organise trips? Who was involved? What is the agenda?)

The learning plan for this years' summer school was modified based on observations and comments from the first year. As a team we reflected on the process from Year 1 and noticed the following: (a) there was a need for a more integrated learning and a problem that would tie together all activities, (b) the emphasis on technology and entrepreneurial skills was not highlighted in the previous year. Therefore, the second summer school was modified to account for these two issues. We decided to use a problem as the guiding for all days, and we also placed an emphasis on design thinking process.

The target group for this year were 12-14 year old students and the duration was five day, 6-hours per day. Four of the days took place at the University of Nicosia, in different labs and Departments, and one of the days was a visit at the Athalassa National Park. The detailed plan is presented below. The activities were interactive and required the students to work in small groups, collaborate and create various artefacts. People from the Department of Education, Department of Human Biology, the National Environmental Center of Cyprus and various companies were involved.

(a) Pedagogy

(Include a description of the pedagogy employed in the activities, giving examples.)

The emphasis was on using the design thinking process as a way to solve different problems that were presented in the activities. Specifically, the main problem that was presented to the students was: How can you improve scientists' well-being at work by using colors? In order to be able to address the problem the students had to first familiarize with different scientists and their working spaces. This involved visiting different labs at the university (i.e. VR lab, biology lab), outside the university (i.e. environmental center), and meeting scientists working in different companies (i.e. interface design engineer, a space craft engineer) and discussing with them about their work life and everyday life. At a later stages they had to brainstorm about different solutions, chose the most appropriate solution using specific criteria (if it is feasible in terms of making a prototype and cost), prepare their product and pitch it to the audience. Therefore, the pedagogy was mostly problem-based learning, using aspects of design thinking process.

(b) Focus on entrepreneurship

(How was the focus on entrepreneurship achieved?)

Our focus on entrepreneurship had to steps:

(a) On Day 5 we invited two female role models working in private companies (interface designer and software designer) to visit the students and do the following: (a) present aspects of their work, especially the entrepreneurial aspect, and (b) act as judges for the products prepared by each of the group.
(b) Students were asked as part of the design thinking process to prototype a product and pitch it. Pitching involved creating a logo and identity for their product and company, and presenting their product in 5 minutes using creating ways. During the process of preparing for the pitching of the product they received feedback and comments from the female role models.

(c) Technology

(How was technology incorporated to enhance girls' digital competences?)

Insert text here

- They engaged with AR and VR technologies in the special lab on Day 1
- They engaged with programming and robotics on Days 2 and 3 (Lego WeDo)

5. The learning plan for the summer camp

(Include a copy of your learning plan.)

Day 1: **Introduction and the science of colours**

9-10: Introduction to the summer school and ice breaking activities

- Draw a STEM person activity and share it with the rest

10-11.15 am: Break

11.15 – 12.15 pm: Virtual Reality and Colors (visit at the VR lab of UNIC and emerging in VR and AR with the guidance of Dr Chris Christou)

12.15 - 1 pm: Discussing with female role models – Meeting an astrophysicist (Dr Stella Manoli)

1.pm - 1.30 pm: Lunch Break

1.30pm – 3 pm: The science of colors and materials

- The students will work in groups in the science lab mentored by a female scientist to understand the science behind iridescent colors.
- Students will experiment with materials to create their own iridescent colors.

Day 2: Colors in the environment – Visit to National Part and environmental center

9-10: Introduction to the activity, field study and tools

- Students will be introduced to the problem: what is the role of colors in the environment and where can you spot iridescent colors in the National Park.
- Students will be introduced to field study rules and the technological tools that they will use during the field study.

10-11.15 am: Break

11.15 – 1.00 pm: Group Work

- Field study
- Presentation of findings and discussion of findings with female scientists

1.pm - 1.30 pm: Lunch Break

1.30pm – 3 pm: Designing a sustainable school – activity using LEGO we do II

Day 3: Using colors in the lab and the mathematics of colors

9-10: Introduction to lab work and lab rules

- Students will visit the Human Biology and Technology labs at the University of Nicosia and will learn about basic rules and the technologies and tools that are available for them to use (i.e. 3D printer, stop motion animation, lab equipment). How do we use colors in lab work? Using indicators and change color as a way to see changes
- Introducing the role of women in STEM through an interactive presentation of history of STEM
- The role of mathematics in STEM

- Interview with a female scientist (Dr Vicky Nicolaidou, Immunologist)

10-11.15 am: Break

11.15 – 1.00 pm: Learning how to program – workshop on programming LEGO we do 11 using light and color as the problem (Dr. Efi Nisoforou and Eftychia Xerou)

1.pm - 1.30 pm: Lunch Break

1.30pm – 3 pm: Time for cinema! Movie screening of a movie about women in STEM

Day 4: The role of technology and the process of designing and promoting products

9.00-11am.: Working with technological tools and how they can help

11.00-1pm: Group work on design thinking and promoting products

1.00-1.30μ.μ.: Lunch break

1.30-3.30μ.μ.: Working in groups to produce a product related to colors

Day 5: Entrepreneurial skills in STEM

9.00pm- 11am: During the last day the students will work in their groups in order to prepare the final project.

11am - 1pm: Meeting female role models (Christina Vasiliou, Interface Designer/ Eleni Michailidou/ Software Designer)

1.00-1.30pm: Lunch Break

1.30 – 4.30pm: Presentation of final project and Evaluation by Female Role models

6. Learning Outcomes

(List the learning outcomes targeted.)

Learning Activities	STEM/ICT subject knowledge	Knowledge of inspiring role models and their meaning	Knowledge about the STEM/digital world of work	Entrepreneurial mind-sets	Transversal skills
Draw a STEM person	X	X	X		
Giant bubbles	X				X
The science of colors and materials	X		X		X
Visit to National Park	X	X	X		X
Using colors in the lab	X	X	X	X	X
The role of designing and promoting products	X	X	X	X	X
Final presentation	X			X	

7. Mentors

(Describe the involvement of mentors, how they were recruited, the number, their STEM backgrounds, how they were trained/prepared for the summer camp.)

Some of the mentors were also involved in the first summer school. Those involved in the first summer school reflected on their activities from Year 1 and modified them. Those involved for the first time were informed about the target audience and purpose of the summer school before attending.

Maria Evagorou	Associate Professor in Science Education focusing on inquiry based learning
Efi Nisiforou	Lecturer on Technologies, her work focusing on using technological tools (i.e. eye tracking) to identify users' needs.
Myrtani Pieri	Associate Professor, her research focuses on gastointestical track physiology. She also holds a diploma on entrepreneurship
Maria Nicolaou	Theoretical physicist
Liza Pitri	Artist, work focusing on materials and color
Vicky Nicolaidou	Assistant Professor, hew work focuses on autoimmunity
Stella Hadjiachilleos	Environmentalist, work focusing on sustainable development
Stella Manoli	Astrophysicist, work on designing products and solutions for spaceships
Agni Stylianou	Associate Professor on Learning Sciences, work focusing on multiple perspectives
Eftychia Xerou	Expert on robotics
Chris Christou	Associate Professor in Multimedia, expert on AR and VR technologies
Christina Vasiliou	Interface Designer and entrepreneur, works at a national bank in Cyprus as an interface designer for bank apps
Eleni Michailidou	Software Designer, works at a private company

8. Evaluation data collection

(Describe the preparation related to data collection such as obtaining permissions, consents.)

During the application process the parents were asked to indicate whether they provide consent for data collection, including recording of some sessions, photos and responding to questionnaires. All parents provided the written consent for data collection for research purposes and for the use of photos for research purposes.

9. Challenges encountered

(Describe challenges encountered and how these were tackled.)

There is a lot of interest for the summer camp events and we have seen this in both years and it was challenging choosing only some of the students. Unfortunately, the interactivity of the activities which meant working closely with students and in smaller groups meant that we needed a big group to be able to work with more students.

An additional challenge was the practicality of arranging the meals everyday.

Finally, we had challenges in achieving representation from different socio-economical groups of population, mostly because going to the University requires a parent driving to the campus.

10. Evaluation of the summer camp

(a) Quantitative

(In this section provide a quantitative evaluation of the summer camp, reporting changes related to how they perceive STEM, if any).

(i) Pre-summer camp

Who are the students participating in the summer camp? Number of participants, ages, subjects studied, career aspirations.

What are their attitudes towards science and STEM?

27 students aged 12-14 year old participated in the summer camp. Students were asked what kind of careers they would follow and only nine of the 27 students reported careers related to science, four students stated that they do not know yet, and the remaining students chose careers not related to science (i.e. piano player, lawyer, interior designer). Students were asked to complete a pre and a post-test in order to identify their attitudes towards STEM. The questions were on a 5-point Likert scale with 1 being the least favorable response and 5 being the most favourable response. The results are presented in Table 1 below.

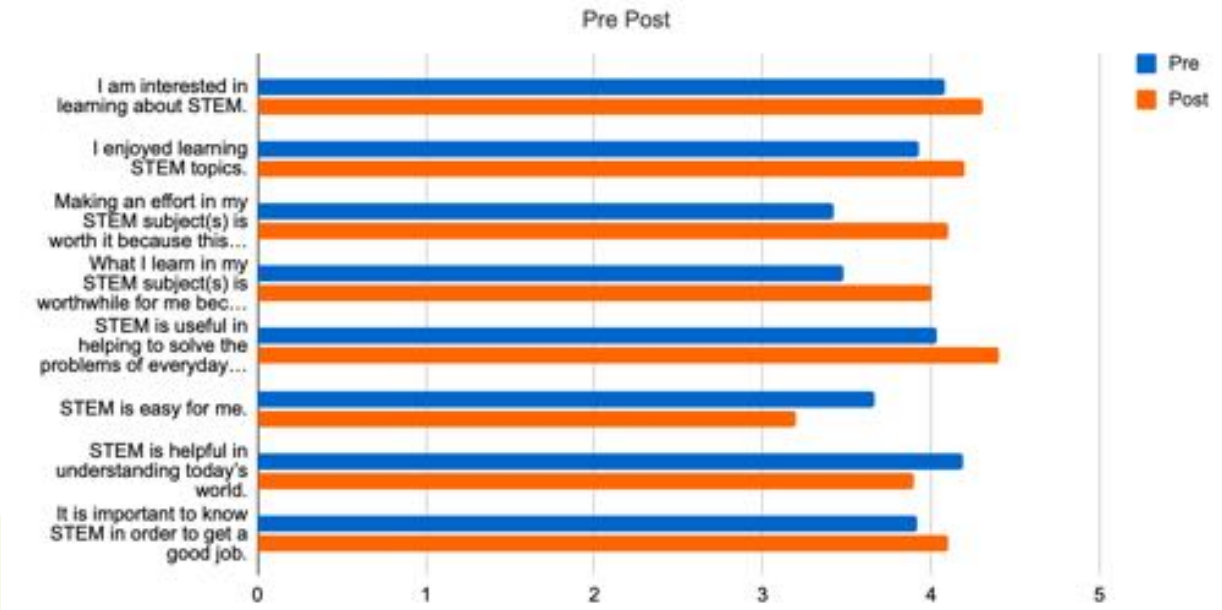
Table 1. Students interest in STEM before and after the summer school

Statement	Average in Pre-test	Average in Post-test
I am interested in learning about STEM.	4.1	4.3

I enjoyed learning STEM topics.	3.9	4.2
Making an effort in my STEM subject(s) is worth it because this will help me in the work I want to do later on.	3.4	4.1
What I learn in my STEM subject(s) is worthwhile for me because I need this for what I want to study later on.	3.5	4
STEM is useful in helping to solve the problems of everyday life.	4	4.4
STEM is easy for me.	3.7	3.2
STEM is helpful in understanding today's world.	4.2	3.9
It is important to know STEM in order to get a good job.	3.9	4.1

Graph 1 below presents a comparison between students' attitudes towards STEM before and after the summer school.

Graph 1. Comparison of students' attitudes towards STEM



As evident by the results in the Graph, students' attitudes towards STEM improved in all statements, with the statement having the most increase linked to students' understand of the role of STEM in their everyday lives.

(b) Qualitative

(In this section provide a qualitative evaluation of the summer camp, emphasizing good practices that worked and practices that could be improved. Include quotations from the students' and educators' feedback and other observations and comments collected. Include information related to specific activities or events.)

The students commented very positively on the fact that they worked in groups most of the time, and they also enjoyed the different types of activities that included visiting labs (VR lab, biology lab) and working with scientists, but also outdoor activities and watching movies. What we received as feedback from the first summer school was that the students had the need to work in a more informal and relaxed environment, something that will not remind them of school settings. Therefore, this year's summer school focused on a balance between learning and having fun.
Some quotes from the students below:

"I really enjoyed the virtual reality games on the first day because it was my first experience with something like this. I also liked the day at the park because I like being outside"

"I really enjoyed working in the biology lab and I got excited because I learned about my blood type by doing the experiment myself"

"My favourite activity was working on the product that we had to prototype and I enjoyed it because we worked as a group and had fun at the same time"

"I was really excited and happy about gaining new skills and knowledge but I got frustrated when our prototype was not working and we had to build it again"

11. Lessons learnt

(Include a description of what you have learnt from the organization of summer camps for girls. This may refer to content, organization and other matters.)

During the two years of organizing the summer camp we have learned the following as a local team:
- The summer camp has to be designed around a driving problem that the students will have to solve during the week
- An important aspect is the "wow" factor, the excitement of the students. This has pushed us towards designing activities that foster the enthusiasm of students to engage them in the process (i.e. VR activity, blood test activity)
- Atudents need a framework to help them work around a problem. Specifically, students need support to be able to understand different aspects of a problem (i.e. social, financial, environmental) and to be able to reflect on possible consequences of solutions they propose. To support the students during the second summer school we used the design thinking framework as a way to guide their work.
- A summer school is an out of school activity in which the students expect to have fun as well. Activities that combine fun with learning are more suitable.
- The logistics of preparing a summer school (organizing and advertising, organizing catering etc) take a lot of time and need to be carefully planned.

12. Recommendations related to the organization of out of school events for girls

(Include any recommendations such as recommendations for policy makers)

Combine playful character with learning
Focus on a problem that the students will work on to provide solutions
Make connections to their everyday life
Make use of technology they already use in the lives.

13. Photos and other evidence

GEM Summer Camp 2022 – CZECHIA

1. The Context

(Provide some background information on the educational context including for example ages of compulsory education, subjects taught (especially whether STEM, entrepreneurship and ICT are compulsory), age when students make subject choices, if any etc.)

Education in Czechia is compulsory from ages six to fifteen years. Compulsory education covers five years of primary education followed by four years of lower secondary education. Education is free in all state schools, children can be educated by parent's decision also in private schools. The Czech school system is organised by two level system: Framework Educational Program (FEP) as guidelines for School Educational Programs (SEP) as own school product. In FEP are listed only so-called educational areas and their educational fields, which can be applied as school subjects. In area of STEM the educational areas are Maths and its applications, Man and Nature (Physics, Chemistry, Biology and Geography), Man and Health, Man and His World, Man and World of the Work and Informatics. During the primary level students study integrated science and ICT and during lower secondary level separated subjects are usually applied, physics, biology, and geography in all four grades, chemistry usually in last two grades.

2. Recruitment

(Provide information about the advertising and recruitment campaign, what worked and what was less successful. Describe activities, tools, materials used in the advertising strategy.)

We planned the summer camp for the year 2022 similarly like in year before, it means that we decided the main topic must be connected with the professional and research orientation of our Department of Chemistry and Chemistry Education. We decided to focus on everyday life consumptions and their consequences with STEM mostly with laboratory activities. In year 2022 we add also lecture oriented on gender stereotypes in science.

The recruitments we organised mainly through Facebook group "Teachers of Science (Učitelé přírodovědných předmětů) and through workshops with teachers and future teachers connected with our department. We have a limitation for capacity of our labs, and we decided to organise parallel sessions combined lectures and lab activities. The summer school was situated on the last week before holidays of the secondary students, in June 23-24. The content of the summer school we discussed with our National GEM Team (NGT) and advisory group made from teachers, policy makers and others.

We prepared information posters for summer school (see Appendix 1), and these were publish in FB group and distributed in print form to schools in Prague and close environment. The project was here introduced, and students were invited to register by on-line (QR code) together with confirmation of their parents. This recruitment campaign was successful and for the event 51 girls applied to join the summer camp. After the initial registration, parents were informed about conditions and asked to fill and to sign consent forms for data collection, photography etc.

3. Summer camp support site

(Provide brief information and link to the summer camp support site.)

A summer camp support site was prepared. This consisted of information about the project and summer camp on the website of the Faculty of Education of the Charles University Link to the summer camp support site.

Link to the summer camp support site:

https://pages.pedf.cuni.cz/kch/vyzkum/resene-projekty/gem/

4. The Plan

(Give a description of the ideas behind the learning plan; people supporting the plan such as any companies e.g. ICT or software companies. You may include copies of adverts, posters etc. Describe your plans. What did it involve? (How many days and how many hours in each day? Where were the sessions held? What kind of activities have you planned? Did you organise trips? Who was involved? What is the agenda?)

The plan was to organise event for around 50 girls aged 12 – 16 years at the Department of Chemistry and Chemistry Education Faculty of Education Charles university in Prague. The students worked during lectures in whole group and for workshops and labs they were divided to two or three groups by their decision. The plan was to have a series of activities related to different STEM areas. Each activity was led mostly by a female who worked in the elected area. The programme included lectures, workshops and labs, and ice-breaker activities, games and refreshing breaks. Two days were selected for the summer camp (23. – 24. June 2022). This was one week before a summer holidays. Each day started at 9.00 and end by 17.00. The parents brought the children to the faculty every morning and picked them up again after the activities.
Refreshing breaks and lunches were provided each day – for this reason parents were asked to notify the organisers in case of any food allergies or special dietary requirements.
The end of last day was dedicated to certificates delivering.

(a) Pedagogy

(Include a description of the pedagogy employed in the activities, giving examples.)

The pedagogy used during summer school was oriented to students' activity and engagement supporting their internal motivation. Most parts of the program were situated in the lab to hand-on activities of students. Also lectures were based on interactions and discussion among lecturers and participants. Students were engaged in the thinking process and IBL during common solving of the task. As typical example we can show connection the lecture about gender stereotypes in science and practical activities in lab leaded by female lecturers. From one side ethically oriented lecture Hunting and animal trade and form other side lab activities about basic science principles were similarly positive evaluated.

(b) Focus on entrepreneurship

(How was the focus on entrepreneurship achieved?)

Female lecturers used in their approach many aspects as to focus on entrepreneurship and used the key words related to this area. They shared experience related to their career. It was visible mainly in the lecture oriented to current state of microscopy technologies leaded by very experienced and successful female expert. Entrepreneurship aspects were included also on organising of group-work and presentation of the own results.

(c) Technology

(How was technology incorporated to enhance girls' digital competences?)

Sessions with using of sensors in the lab focussed mostly on students working with technology, especially with digital technology. In these sessions students were asked to use sensors for monitoring of different processes and create their own outputs. These activities allowed participants to experience technology in direct and practical examples. It was also contribution to their computational thinking skills.

5. The learning plan for the summer camp

(Include a copy of your learning plan.)

The Charles University through its Faculty of Education organized summer camps for girls, the first in 2021 and the second in 2022. They will participate in teams in activities linked to real life problems in which they apply their knowledge of different STEM areas and learn new concepts in a hands-on, collaborative environment. The summer camps also included meeting and working with women involved in STEM-related careers.

Summer Camp Learning Plan

Title of Summer Camp:
Lab Technology and Everyday Life Consumption

Target Group (age, school type):
Students who have the age from 12 to 16.

Venue:
The Charles University, Faculty of Education, Department of Chemistry and Chemistry Education, Street M. Rettigove 4, Prague.

Transportation to the venue:
The meeting point is inside the building of Faculty of Education, 2nd floor, Room 202.

Subsistence:
A refreshing break in all half-day and lunches will be provided (lunches by catering company, selection from its offer).

Contact person for girls and their guardians:
Students will be led by a mentor who will accompany them throughout the summer camp. She will be their contact person in all time. Among other things the mentor will make sure that the group works safely, keeping to social distancing rules, sanitizing tables and any equipment used. The mentor will be in close contacts with all lecturers, too.

Format of the activities:
The two-day science camp of the GEM project took place one week before of the summer holidays, i.e., 23 - 24 June 2022. Fifty-one girls aged 12-16, who are interested in science and technology, completed a diverse program every day from 9:00 to 17:00. The program consisted of:

- lectures on on gender stereotypes in science (M. Babcová, M.A. and G. Langhammerová, M.A.), How can coloured gold improve microscopy? (assoc. prof. V. Petráková), Hunting and animal trade (Karel Vojíř, Ph.D. and A. Nejedlý, M.A.) and Chemistry and Art (assoc. prof. Š. Kučková),
- workshops with the topics We measure with a computer in the chemistry lab (K. Chroustová, Ph.D.) and Natural Science Principles in Simple Experiments with Substances of Daily Consumption (prof. M. Bílek),
- laboratory work with the topics How Substances around us are separated in a Chemical Laboratory (K. Chroustová, Ph.D.) and Colours in a Chemical Laboratory (Ing. T. Smirnova).

The professional part of the program was supplemented by discussions with women-lecturers who are experiencing their working careers in the world of science and university education, about their lives and careers. Detailed schedule is in the Appendix 2.

6. Learning Outcomes

(List the learning outcomes targeted.)

The general learning outcomes of the GEM summer school were taken as the overall learning outcomes of the GEM project. Then each activity had a series of learning outcomes derived from the general learning outcomes. The general learning outcomes were – girls will have increased interest in STEM/digital disciplines, become aware of their own potential, be enabled to perform successfully in STEM/digital disciplines, be encouraged to study or pursue careers in STEM/digital sectors, have the confidence to consider leadership positions in STEM/digital sectors, have an enhanced employability with regards to STEM/digital labour markets, want to know more about STEM and want to be involved in STEM.

7. Mentors

(Describe the involvement of mentors, how they were recruited, the number, their STEM backgrounds, how they were trained/prepared for the summer camp.)

Mentor and lecturers for the summer schools were recruited from the academic staff of organisers and their co-workers from other academic institutions (Czech Academy of Science and University f Chemistry and Technology in Prague). Mostly females were invited – see Appendix 3. With lecturers and mentor were organised individual meetings oriented to content of their sessions. The sessions were about the GEM project, about the learning plan and about how to lead groups during the GEM summer camps and how to communicate with participants and their parents.

8. Evaluation data collection

(Describe the preparation related to data collection such as obtaining permissions, consents.)

The evaluation was planned via the pre- and post- student questionnaires and a questionnaire for the mentors and educators. The questionnaires were translated to Czech language.
All students and parents were informed that participation is voluntary and that when filling in the questionnaire, students will be asked not to write their names on it, and they may choose not to complete it. Furthermore, the questionnaires will be coded, so that even the identity of the school will be anonymised. All raw data will be securely stored, and the data obtained will be solely used for the compilation of this research.
The pre-questionnaire was given to students as the first activity of the summer school, while the post-questionnaire was the last activity. Mentor and lecturers were also asked to fill in a questionnaire giving their views and feedback after the summer camp.

9. Challenges encountered

(Describe challenges encountered and how these were tackled.)

The summer school attracted planed number of students finally not only from Prague and its close surroundings but from different places of Czechia. Applications were counted and closed in level of 50 participants.
From side of financial costs, we counted with our limits, and it was possible to ensure refreshment and lunches for all participants. Mentors were motivated for cooperation in very small financial conditions, lab equipment and material were supported for organising department.
For continuing after project duration we will thing about support from institution and/or from sponsors.
Next challenge is to ensure protective aids for students (lab coats and lab glasses) in appropriate sizes.

10. Other

Success of our summer schools in 2022, and in 2021, too, is challenge for a continuing with these activities in the coming years. This has prompted the organisers to meet up with interested stakeholders and sponsors to identify ways and means for a support. The using of gained know-how is good aspect.

(In this section you may include other relevant points not included above.)

11. Evaluation of the summer camp

(a) Quantitative

(In this section provide a quantitative evaluation of the summer camp, reporting changes related to how they perceive STEM, if any).

(i) Pre-summer camp

Who are the students participating in the summer camp? Number of participants, ages, subjects studied, career aspirations.

What are their attitudes towards science and STEM?

Evaluation of the summer camp is based on the pre-post study conducted as part of the GEM Summer School. The summer school took place from 23 to 24 July 2022. A total of 51 girls in age 12 - 16 participated, with an average age of 12,85. At the beginning and end, the pre/post questionnaires were each completed.
The girls had a comparatively positive attitude towards the STEM subjects, as can easily be seen in the elected position on 7-point scale from insignificant/boring (position 1) to significant/exciting (position 7).
In the dichotomy insignificant/significant they elected positions from 5 to 7:
- science: 76,2 %,
- mathematics: 66,1 %,
- biology: 65,4 %,
- physics: 60 %,
- chemistry: 54,0 %.

In the dichotomy boring/exciting they elected positions from 5 to 7:
- biology: 79,5 %,
- science: 78,1 %,
- chemistry: 55,8 %.
- mathematics: 44,0 %,
- physics: 43,2 %.

Although they find most subjects interesting, they do not yet rate their importance as highly. In particular, the importance of physics and chemistry is considered comparatively low by the girls, which may also be due to the fact that they have had no or very few lessons in these subjects. Highest evaluation of the science can be caused by good experience from primary education where it is integrated subject.
Their positive attitude is reflected in their study and career choices.
Interestingly, most girls were encouraged to attend summer school by their parents and/or teachers, and social media plays in their decision a minor role.

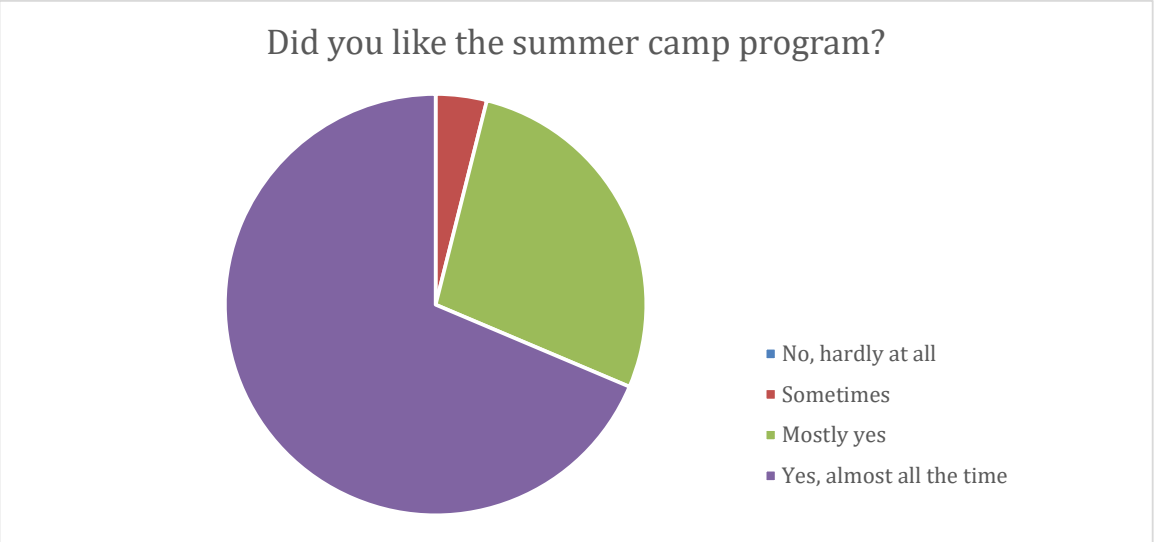
(ii) Post-summer camp

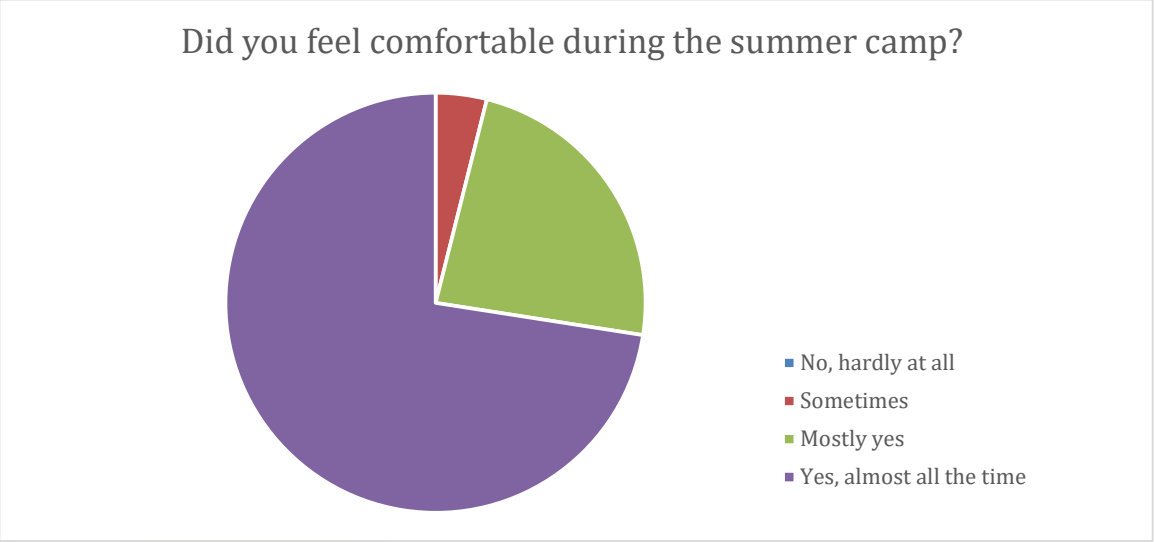
Did their views and attitudes change after participating in the summer camp?

What do students have to say about their experience in the summer camp? Activities preferred or least preferred.

Educators' views.

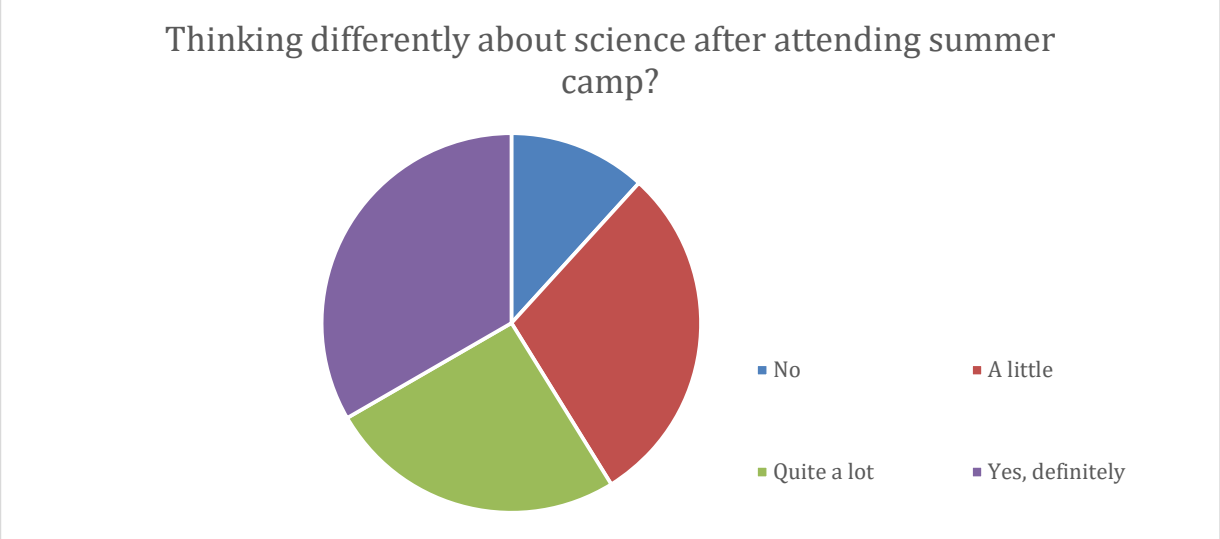
The summer school was extremely well received (see next two graphs). None of the students stated that she did not like the summer school and 68,6 % of the girls enjoyed the summer school all the time.



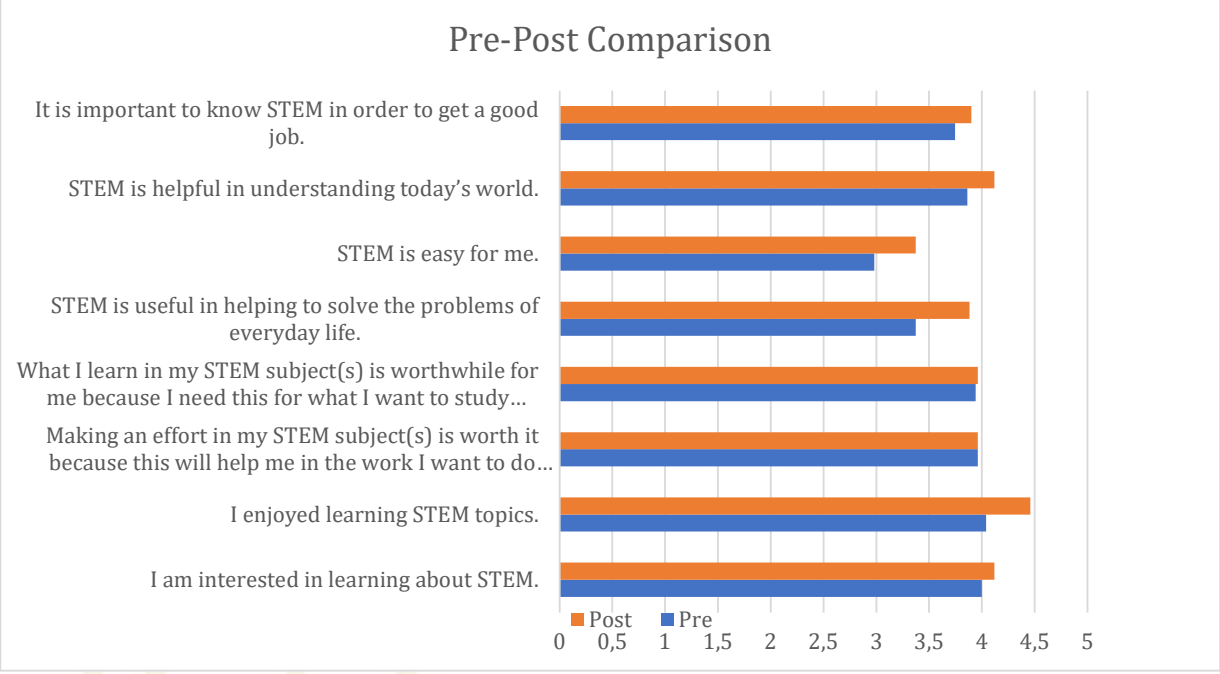


This is also reflected in the fact that almost all the girls (96 %) would recommend the summer school to their friends.

The impact of summer school was visible, as it is presented in next graph. More like 58 % of girls is thinking differently about science after attending summer camp, and only 12 % not.



Finally, the girls' opinions about STEM were improved. The results are not statistically significant because the data set was too small but show positive trends (see next graph).



(b) Qualitative

(In this section provide a qualitative evaluation of the summer camp, emphasizing good practices that worked and practices that could be improved. Include quotations from the students' and educators' feedback and other observations and comments collected. Include information related to specific activities or events.)

Qualitative evaluation was a part of the questionnaire, too. But also our (organisers and lecturers) observations show that the summer school was a complete success from the students' point of view. Most of the students felt comfortable throughout and would recommend the summer school to others. They evaluated very good also preparing and organising sides of the summer school.

"The program and the camp were great. Thank you for allowing me to participate in such an event. I'm sure you guys had a lot to do with it."

"The program was great. Don't take my comments about the destination of the camp too critically. I enjoyed the whole thing, I just didn't learn that much new stuff. Which is fine because repetition is the mother of wisdom."

When asked why they would recommend the summer school to others, they said that they simply enjoyed learning here and that girls should generally be promoted more in the STEM field.

"I think they can learn something new here!"

"Because it's useful for life and most of all it's fun."

A little bit criticism was that the age range was too broad.

"Definitely yes, especially if the friends are younger or not as knowledgeable in the sciences."

Most of the girls said that there was really nothing to improve from their point of view. In particular, the topics Colours in Lab, and also all lab activities were very well received. Some topics were evaluated controversially, a part of students like it very well and part not (e.g. Chemistry and Art or Lecture on endangered animals and poaching).

Finally we have to say that the community and the atmosphere were described as very positive, which was also reflected in the particularly committed working attitude of the participants and some of their parents.

Positive evaluation was expressed by mentors and lecturers, too.

"The girls were already well versed in the issue of gender inequality and stereotypes, they were very communicative and discussed with us as the two lecturers. I think that this also motivated them positively towards each other, firstly to see that they did not have to be shy to express themselves and join the discussion and secondly to see the support among themselves."

"Girls need to have more opportunities for STEM activities. During the activity, the participants showed great interest in the topic and asked questions and inquired about other sources of information. Therefore, it can be assumed that the activity fostered their interest, and they want to gain more knowledge in the field."

"Everything was great, the organization of the event, the audience, and the atmosphere. Thank you very much for the invitation!"

"Given the summer conditions and the concentration of participants, consideration could be given to including outdoor activities related to STEM."

12. Lessons learnt

(Include a description of what you have learnt from the organization of summer camps for girls. This may refer to content, organization and other matters.)

1. Hands-on activities: Girls are more motivated in hands-on activities than passively listening to speakers or presentations.
2. Experienced role models: Girls very good evaluated to see women as lecturers and leaders of lab activities. They had many questions related on their careers.
3. A supportive environment: Girls need to feel safe and to be in an inclusive and welcoming environment. The role of the mentors is therefore crucial to the success of the program.
4. Fun: Enjoyable and engaging activities are important, relations to everyday life and girl's interest is very welcome.
5. Persistence: To persist in the face of challenges and difficulties needs emphasising the importance of grit and determination and showing girls that failure is a normal part of the learning process.

13. Recommendations related to the organization of out of school events for girls

(Include any recommendations such as recommendations for policy makers)

There is a need for more events like the GEM school so that girls can have more opportunities to explore and be exposed to STEM. These events need to be well-advertised and easily accessible so that as many girls as possible can participate.
It is important to gain continued support for this kind of events (institutions, sponsors).
It is important to offer a diverse range of activities at STEM-related events so that girls can find something that interests them and that they can see themselves pursuing in the future.

14. Photos and other evidence

(Include here)

ICSE

GEM Empower Girls to Embrace their Digital and Entrepreneurial Potential

Čtvrtek 23. 6. 2022

9.00 Přivítání na Pedagogické fakultě Univerzity Karlovy (Dr. K. Chroustová, mentorka letního tábora) – před místností R216

9.05 – 9.30 Organizační záležitosti (dotazník, nabídka pro volbu jídla k obědu) – R216

9.30 – 10.30 **Přednáška o genderových stereotypech ve vědě** (Mgr. Markéta Brabcová, Mgr. et Mgr. Gabriela Langhammerová, R216)

10.30 – 10.50 Přestávka s občerstvením – R216

10.50 – 12.20
Skupina I: **Chemie a umění** (doc. Š. Kučková, R216)
Skupina II: **Barvy v chemické laboratoři** (Ing. T. Smirnova, R206D)
Skupina III: **Měříme s počítačem v chemické laboratoři** (Dr. K. Chroustová, R206A)

12.20 – 13.25 Oběd (jídlo dle dopolední individuální volby) – R216

13.25 – 14.55
Skupina I: **Barvy v chemické laboratoři** (Ing. T. Smirnova, R206D)
Skupina II: **Měříme s počítačem v chemické laboratoři** (Dr. K. Chroustová, R206A)
Skupina III: **Chemie a umění** (doc. Š. Kučková, R216)

14.55 – 15.15 Přestávka s občerstvením – R216

15.15 – 16.45
Skupina I: **Měříme s počítačem v chemické laboratoři** (Dr. K. Chroustová, R206A)
Skupina II: **Chemie a umění** (doc. Š. Kučková, R216)
Skupina III: **Barvy v chemické laboratoři** (Ing. T. Smirnova, R206D)

16.45 – 17.00 Zakončení prvního dne (doc. Š. Kučková, Ing. T. Smirnova, Dr. Chroustová, R216)

ICSE International Centre for STEM Education

GEM Empower Girls to Embrace their Digital and Entrepreneurial Potential

ICSE

GEM Empower Girls to Embrace their Digital and Entrepreneurial Potential

Pátek 24. 6. 2022

9.00 Přivítání na Pedagogické fakultě Univerzity Karlovy (Dr. K. Chroustová) – před místností R216

9.00 – 9.10 Organizační záležitosti (nabídka pro volbu jídla k obědu) – R216

9.10 – 10.40 **Jak může barevné zlato vylepšit mikroskopii?** (doc. V. Petráková, R216)

10.40 – 11.00 Přestávka s občerstvením – R216

11.00 – 12.30 **Lov a obchod se zvířaty** (Dr. K. Vojíř, Mgr. A. Nejedlý, R216)

12.30 – 13.25 Oběd (jídlo dle dopolední individuální volby) – R216

13.25 – 14.40
Skupina I: **Přírodovědné principy v jednoduchých pokusech s látkami každodenní spotřeby** (prof. M. Bílek, R206A)
Skupina II: **Jak se oddělují látky kolem nás v chemické laboratoři** (Dr. K. Chroustová, R206D)

14.40 – 15.00 Přestávka s občerstvením – R216

15.00 – 16.15
Skupina I: **Jak se oddělují látky kolem nás v chemické laboratoři** (Dr. Chroustová, R206D)
Skupina II: **Přírodovědné principy v jednoduchých pokusech s látkami každodenní spotřeby** (prof. M. Bílek, R206A)

16.15 – 17.00 Zakončení letního tábora (dotazník, předání certifikátů, Dr. Chroustová, prof. Bílek, R216)

European Commission

Appendix 3

I dívky umí STEM!

Laboratorní technologie a produkty každodenního života

Katedra chemie a didaktiky chemie

Pedagogická fakulta Univerzity Karlovy

M. Rettigové 4, 2. patro

23. – 24. 6. 2022

Lektorský tým

ICSE
GEM Empower Girls to Embrace their Digital and Entrepreneurial Potential

Mgr. Markéta Brabcová a Mgr. et Mgr. Gabriela Langhammerová

Markéta Brabcová a Gabriela Langhammerová jsou z oddělení Národní kontaktní centrum - Gender a věda Sociologického ústavu AV ČR. Zabývají se problematikou institucionální změny ve vědeckých a výzkumných organizacích, a také strukturálními překážkami ve vědě a výzkumu, se kterými se potýkají zejména ženy – vědkyně během své kariéry. Markéta vystudovala práva a dokončuje genderová studia, Gabriela vystudovala teologii, filosofii a genderová studia, dokončuje doktorské studium.

„Ženy a dívky do vědy patří!"

doc. Mgr. Ing. Štěpánka Kučková, Ph.D.

Štěpánka Kučková vystudovala analytickou chemii na Přírodovědecké fakultě UK a biochemii na VŠCHT v Praze. V současné době působí na obou vysokých školách, ale na UK se nyní věnuje přípravě budoucích učitelů. Z vědeckého hlediska se zabývá převážně analýzou uměleckých objektů a proteomickými analýzami krevní plazmy pacientů s onkologickými a neurodegenerativními onemocněními. Doma ji vždy po návratu vítají dva mainští mývalí kocouři.

„Život je krátký, dělej, co tě baví!"

RNDr. Kateřina Chroustová, Ph.D.

Kateřina Chroustová vystudovala učitelství chemie a matematiky pro střední školy a následně didaktiku chemie na Přírodovědecké fakultě UHK. V současné době pracuje na Pedagogické fakultě UK, kde se podílí na výuce budoucích učitelů chemie. Její vědecké působení se zaměřuje na témata z didaktiky chemie, zejména na oblast digitálních technologií či experimentálních činností ve výuce chemie. Ve volném čase chodí do divadla a ráda si zpívá.

„Nikdy není pozdě s čímkoliv začít!"

ICSE
GEM Empower Girls to Embrace their Digital and Entrepreneurial Potential

Ing. Tatiana Smirnova

Tatiana Smirnova vystudovala Vysokou školu chemicko-technologickou v Praze v oboru Biochemie.
Již od bakalářského studia se věnuje analýze proteinů s využitím různých analytických metod. V současné době pokračuje ve svém vzdělávání v doktorském studiu také na Vysoké škole chemicko-technologické v Praze. Současně je odbornou asistentkou na Katedře chemie a didaktiky chemie Pedagogické fakulty Univerzity Karlovy, kde vede cvičení a laboratoře z analytické chemie.

„Pokud něco chceš, tak to určitě půjde udělat!"

doc. Ing. Vladimíra Petráková Ph.D.

Vladimíra Petráková se narodila v roce 1985. Vyrůstala v Kladně, kde vystudovala Fakultu biomedicínského inženýrství ČVUT. Ve své doktorské práci se zabývala výzkumem luminiscenčních center v diamantu pro biomedicínské aplikace. Tři roky strávila díky Humboldtově stipendiu na Svobodné univerzitě v Berlíně, kde od nanodiamantů přešla ke studiu nanočástic zlata. Od roku 2019 působí v Ústavu fyzikální chemie J. Heyrovského Akademie věd ČR, kde díky prestižní grantové podpoře zakládá vlastní výzkumnou skupinu. Zabývá se tím, jak pomocí plasmonických nanočástic vylepšit superrozlišovací mikroskopii. Je jednou ze zakladatelek organizace Czexpats in Science, která sdružuje české vědce v zahraničí. Má čtyři děti, dceři je šestnáct, synům deset, osm a nejmladšímu dva roky.

„Nevzdávejte věci dopředu!"

PhDr. Karel Vojíř, Ph.D.

Karel Vojíř vystudoval učitelství biologie a chemie na pedagogické fakultě Univerzity Karlovy. Doktorát následně získal na Přírodovědecké fakultě Univerzity Karlovy. V současné době působí na katedře biologie a environmentálních studií Pedagogické fakulty Univerzity Karlovy, kde se podílí na přípravě budoucích učitelů. Výzkumně se zaměřuje především na kurikulum přírodních věd, aktivizační metody ve výuce a dovednosti budoucích učitelů přírodovědných předmětů.

„Kdo hledá, nalézá."

ICSE International Centre for STEM Education

GEM Empower Girls to Embrace their Digital and Entrepreneurial Potential

ICSE

GEM Empower Girls to Embrace their Digital and Entrepreneurial Potential

Mgr. Adam Nejedlý

Adam Nejedlý vystudoval učitelství biologie a tělesné výchovy. V současné době pokračuje ve svém studiu v rámci doktorského studia zaměřeného na didaktiku biologie na Pedagogické fakultě Univerzity Karlovy. Výzkumně se zaměřuje především na vědecké dovednosti žáků i budoucích učitelů. Zároveň působí jako učitel na Základní Škole Davle.

„Učíme se pro život."

Jana Fiřtová

Jana Fiřtová vystudovala potravinářskou průmyslovku a působila jako mistrová v cukrářské výrobě. Potom přešla na Katedru chemie a didaktiky chemie Pedagogické fakulty UK a je zodpovědná za laboratoře, přípravu laboratorních činností a další podobné aktivity.

„Holky, nebojte se laboratoře, chemie je krásná!"

prof. PhDr. Martin Bílek, Ph.D.

Martin Bílek vystudoval učitelství chemie a fyziky pro základní a střední školy a věnuje se celou svoji akademickou kariéru vzdělávání učitelů přírodovědných a technických předmětů zejména chemie. Zastupuje Univerzitu Karlovu v konsorciu ICSE, založeném na Pedagogické univerzitě v německém Freiburgu, které je hlavním koordinátorem projektu GEM. Na Webu konsorcia ICSE (icse.eu) je řada informací k podpoře výuky přírodovědných a technických předmětů, včetně dalších projektů, návodů k řešení problémů apod.

„Děvčata, nebojte se chemie, je všude kolem nás, a nebude nám škodit, když budeme vědět, co znamená a jak ji používat!"

European Commission

GEM Summer Camp 2022 – Germany

1. The Context

Germany is a Federal Republic and the responsibility for the education system is divided between the Federation and the federal states. The scope of the Federal Government's responsibilities in the field of education is defined in the Basic Law (*Grundgesetz*). Unless the Basic Law awards legislative powers to the Federation, the federal states have the right to legislate. Within the education system, this applies to the school sector, the higher education sector, adult education and continuing education. Administration of the education system in these areas is almost exclusively a matter for the Länder.

Following the primary school stage, after grade 4 (in some federal states after grade 6), an early division into the educational pathways of secondary education, which are the following: *Hauptschule*, *Realschule* and *Gymnasium*. These three types of schools differ in the amount of theoretical and practical knowledge, if the pupils then have access to higher education or if it is excluded and the school graduates are continuing learning in vocational schools (and other differences). Nevertheless, most German schools allow students to transfer within the system and attend a school whose final examination will give them a university entrance qualification. This means that higher study institutions in Germany are open to all German students within the German education system. Vocational education and training take place in the dual System, it means it is carried out in two places of learning: at the workplace and in a vocational school (Berufsschule).

In Germany, school attendance is compulsory from age 6. Usually, pupils are at school until the age of 18.

In the area of STEM education, German secondary schools do not provide cross-curricular schooling on the one hand and do not anchor individual STEM subjects on the other. The disciplines of engineering and computer science are not or only rudimentarily included in the educational plans of the federal states. Interdisciplinary lesson planning between several teachers takes place only rarely. The German learning and school structure, in which teachers conduct and organize lessons, leaves little room for interdisciplinary exchange between colleagues.

Integrated STE(A)M education is not yet structurally anchored in the German education system, but for more than 14 years, STEM education has been a central issue in Germany at civil society and political level. The Federal Ministry of Education and Research published the STEM Action Plan in 2019 and defined four fields of action: STEM education for children and young people, STEM professionals, opportunities for girls and women in STEM, and STEM in society. There are several STEM networks in Germany that are active in preparing new initiatives for STEM education and training and support

educational institutions such as kindergartens and schools in exploring and discovering the world of mathematics, IT, science and technology with children and young people.[1]

2. Recruitment

In order to recruit girls for the summer school, first of all we contacted all of the schools in Freiburg. We contacted all 4 responsible supervisory school authorities in the city and nearest surroundings and asked them to spread information about our summer school. They contacted the directors and teachers at the school, which in turn gave this information to their pupils during their lessons. The information they received was aims, activities and input of the summer school, why is it beneficial to participate in the summer school, information on the application process, poster of the summer school for girls as well as a letter to the parents. In the letter to parents, we clarified organizational issues and asked parents for their consent for participation of girls in the summer school, their consent to the surveys before and after the summer school as well as making and publishing pictures of the participants.

Two weeks before the summer school we sent a reminder email to the schools directly. We included again all the accompanying documents and stated, that the application process is still open.

We also used advertisement option on Instagram to reach girls and on linkedin to reach teachers, as we posted a poster of the summer school and linked it to the summer school support site.

Additionally to that, project managers working in ICSE on other projects contacted directly persons involved in the previous projects, teachers as well as parents of girls in the corresponding age and invited them to apply for the summer school.

3. Summer camp support site

The summer camp support site contains detailed information on the purpose of the summer school, workshop content and learning outcomes, introduction of role models and application process, access to the registration form for the GEM Summer School in *eveeno*, information about the GEM project, “Contact us” section, data privacy information.

Link to the summer camp support site: https://icse.ph-freiburg.de/gem/gem2022/

4. The Plan

The aim of this summer school was to create a STEM-Escape Box, i.e. a portable Escape Room with STEM-content. In order to be able to accomplish this task, students needed to understand how Escape Rooms are constructed and how puzzles can be designed. Additionally to that they learnt the basics of the programming language JavaScript and learnt to incorporate digital puzzles into the box, e.g. integrated by a QR code. To construct the Escape Box, the students learnt how to use 3D design software and later create it with a 3D printer. The aim was not only to shed light on the technical and scientific side of

[1] STE(A)M Education in Germany (steamonedu.eu), Germany - Overview | Eurydice (europa.eu), Education in Europe - Statistics & Facts | Statista

creating Escape Rooms, but also to look at artistic aspects, such as developing a story to go with the Escape activity.

Since it was the core of the summer school to introduce the possibilities of the STEM field and engage in hands - on activities, we prepared lectures with as much as needed and as little input as possible for the girls to be able to work for themselves and learn by doing.

The summer school took place on the premises of University of Education Freiburg. Because of the summer school topic, it was necessary to have a room that is equipped with computers, has enough space to locate the 3D Printers (with the possibility to leave them in this room unattended in case the objects have to get printed overnight). We needed a lot of space to locate the ready-made escape boxes and space for the girls to try them out. Also, it was very practical that we were able to organize the meals for girls in the cafeteria for students for reasonable prices.

We organized the summer school for 5 days. Based on the experience from organizing the previous summer school we arranged it this time around the weekend. It was a necessary step to take so that we can print the escape box details and the girls can test each other's escape boxes on the last summer school day. Another reason for this decision was to thusly have some extra time to react to small programming mistakes and still get the results on time. This way the girls could experience the pleasure in completing the task on their own and also present the escape boxes at their schools before the summer break. Something that we learnt from the year before was to set a framework for the size of the escape boxes: this time we proposed to design them approximately 10 x 10 cm big. This way we were sure, that the printing will succeed in completing the boxes on time.

Each day girls had lectures and workshops from 8 to 13 o'clock. On two days there were extra activities in the afternoon. One afternoon the girls and their mentors went to the city centre to take part in a city challenge and were sensitized to yet another entrepreneurial aspect. On the other afternoon, at the end of the summer school they were taking part in a materials market and also invited their friends and family to join them. The materials market provided insights in STEM professions in Freiburg, presented by local businesses which was appreciated by the participants very much.

Another crucial part was to show female role models in STEM throughout the summer school. Meeting and hearing an inspiring female professional talk about her career choices and her work can open the minds of the students so that they can envision a future as STEM professionals and hopefully inspire them to become what they want. Even if it is not certain what career choice they will meet in the end, it does open the room for additional choices and makes the females in STEM more present and approachable which in turn will have an effect on the society eventually. The girls heard about how useful STEM is for the society and individual persons by hearing about an innovative 3D glass-printing technics and therefore reducing plastic waste. They also heard about developing a start-up in STEM fields and about the challenges they experienced and countermeasures to stereotypical mistreats in professional life. They encouraged girls hey to seek entrepreneurial potentials and not be afraid to make mistakes. The speakers also shared their personal and professional experiences, discussing challenges they have encountered and how did they overcome gender stereotypes.

(a)Pedagogy

Girls started the summer school by trying out the escape rooms themselves and grasping the structures behind them. Following this light and entertaining introduction, the whole summer school was divided into three parts:

1. workshops
2. open work phases
3. career talks

Throughout the workshops the emphasis was put on the active participation of the girls: after providing the basic theoretical knowledge girls were led to the main phase of the workshop, the free working phases i.e. input was kept as small as necessary to give as much space as possible to interact in groups by working on their personal escape boxes. Usually, the workshops ended with open questions that encouraged further work and setting own questions (under the supervision of the mentors). The students had to ask themselves whether and how they could incorporate what they had learned into the Escape Boxes and so to learn in an inquiry-based way.

In 3D printing as in many other educational practices our dominant approaches were: situated learning, experiential learning, critical making, concepts from constructionism and self-directed learning.

(a) Focus on entrepreneurship

There are a couple of characteristics that belong to the entrepreneurial mindset that were also developed during the summer school activities:

Opportunity recognition: girls were introduced to the real applications of STEM technology knowledge and how are they used to make profit: where is 3D printing used, what can you make out this technology. Participation in Escape City challenge and hearing about the entrepreneurial side of building a business through role models was also contributing to developing this skill.

Critical thinking: the girls' groups received one joint task, namely, to design and develop a functioning, story-telling escape box that contains STEM riddles. It was the girls themselves that were making the decisions on the task division between the group's members, how much time might be necessary, what is the correct sequence of going the tasks (designing the objects for the box, making the number of compartments to fit the number of riddles and the story of the escape box etc). They had to determine the ways of integrating the knowledge they received in the beginning of workshop, recognise own mistakes, and improve the solutions. Mentors supported them by giving hints, if the intended solution is realistic in the maintaining summer school hours. This means that the girls also had to demonstrate and learn flexibility and adaptability – to continue working and get to a solution despite a step back in the process.

Communication and collaboration: girls were divided in groups and worked together on one project=one box. This required them to apply the existing communication and collaboration skills but it also pushed them to grow in their skill level.

Comfort with risks: by inventing the form of the escape box girls were taking some risks on the chances the compartments of the escape boxes are going to function.

Creativity and innovation: girls had to come up with a creative idea on the problem (design a box) and they had to invent a new box which showed what they have learnt in a creative way.

(b) Technology

Girls used computers to 3d-design escape boxes and program digital riddles for escape games. Especially the girls learned how to use the software tinkercad, GeoGebra and basics of the computer language JavaScript.

5. The learning plan for the summer camp

Wednesday, 20. July	
8:15 – 9:00	Welcome
9:00 – 9:45	Testing escape activities
9:45 – 10:00	Pause
10:00– 11:30	Testing escape activities
11:30 – 11:45	Pause
11:45 – 12:30	Summary: how are the escape rooms built?
12:30 – 13:00	Personal lecture and discussion with **Dorothea Helmer** from Glassomer
13:00 – 14:00	Lunch
Thursday, 21. July	
8:15 – 9:00	3D-printing and 3D-design. Basics.
9:00 – 9:45	Working on a very own escape box
9:45 – 10:00	Pause
10:00– 10:45	Workshop 1: Escape Design
10:45– 11:30	Working on a very own escape box
11:30 – 11:45	Pause
11:45 – 12:30	Workshop 2: Storytelling
12:30 – 13:15	Working on a very own escape box
13:00 – 14:00	Lunch
14:00 -16:00	Frexit City Challenge
Friday, 22. July	
8:15 – 9:00	Designing escape box with the 3D-printer
9:00 – 9:45	Working on a very own escape box
9:45 – 10:00	Pause
10:00– 10:45	Workshop 3: programming I
10:45– 11:30	Working on a very own escape box

11:30 – 11:45	Pause
11:45 – 12:45	Working on a very own escape box
12:45 – 13:15	Personal lecture and discussion with **Isabel Hörder** from Jugendarbeit im Jugendhilfswerk Freiburg e.V.
13:00 – 14:00	Lunch

Monday, 25. July

8:15 – 9:00	Workshop 4: programming II
9:00 – 9:45	Working on a very own escape box
9:45 – 10:00	Pause
10:00– 11:00	Workshop 5: Escape Design II
11:00 – 11:30	Personal lecture and discussion with **Nicola Gepperth** from ExperiNauten
11:30 – 11:45	Pause
11:45 – 12:30	Finalising escape box
12:30 – 13:15	Female empowerment session
13:00 – 14:00	Lunch

Tuesday, 26. July

8:15 – 9:00	Workshop: Outlook 3D-Druck
9:00 – 9:45	Presenting and testing the escape boxes I
9:45 – 10:00	Pause
10:00– 11:30	Presenting and testing the escape boxes II
11:30 – 11:45	Pause
11:45 – 12:15	Personal lecture and discussion with **Lisa Ihde:** software-designer, book author, lecturer, design-thinking-coach, gender referee and mentor.
12:15 – 12:45	Evaluation, Certificates for Participation

13:00 – 14:30	**Materials Market** THE possibility for gaining authentic STEM world of work. Local entrepreneurs are showing their work and sharing with you their professional insights. Join the materials market with your family and friends.

6. Learning Outcomes

The main learning outcome was to understand how escape activities are designed and how STEM-sciences are involved in the conceptualisation. Further learnings outcomes include basics of programming, 3D-Design, the creation of augmented reality applications and storytelling. Furthermore, the girls are sensitized to typical STEM stereotypes.

Learning outcomes attributed to 3D printing include critical thinking, creativity, design thinking, and collaboration.

7. Mentors

We invited female STEM professionals to participate in the summer school and share their personal and professional experiences. We invited a:

1. Founder of the new technology that allows to 3D print glass that currently is the best on the market, grounder of a company, scientist, project manager
2. Media educator working with youngsters on ICT subjects from a local NGO
3. Scientist and science communication specialist, educator, entrepreneur
4. ICT graduate, Forbes »30 Under 30« face, mentor for programming workshops for youngsters, a lecturer, book publisher, winner of Hackathon.

Besides speaking about their careers, speakers also shared challenges they have encountered and how did they overcome gender stereotypes, because it is important to show female professionals in an approachable way, in a way, so that girls can identify themselves with these role models. They told about making choices, solving problems in the way of founding their companies, thus sensitizing girls for seeking entrepreneurial potentials and not being afraid of taping them.

Beyond these female speakers, we invited another 5 women: young female STEM mentors to accompany girls during the summers school, especially the working phases and a session on “female empowerment”. Before the summer camp we organized a half day long preparation session on 3 D printing, GEM project aims

and objectives, how to work with the girls as a mentor and how to lead the empowerment session. Different ideas for activities were provided.

After each summer school day mentors got together to discuss the day, check up on working progress in other groups, bring up questions from girls and discuss the organizational issues for the next day.

8. Evaluation data collection

The questionnaires were digitalized with the software Limesurvey. In Germany it is not necessary to collect permission from a governmental institution if you want to do research in out of school activities, but since the girls were under 18, the parents were asked to fill out the form that their daughters are allowed to fill out the surveys. The completion of the survey was voluntary.

9. Challenges encountered

- Since the summer school was positioned in a timeframe, where also schools were organizing projects for their pupils, not as many girls participated in our summer school as we could have allowed to enrol. At the time we found out that these projects are running parallel, we could not move our summer school anymore.
- Several questionnaires were filled out only partially.

10. Other

-

11. Evaluation of the summer camp

(a) Quantitative

(i) Pre-summer camp

In this section we present and interpret the results of the pre-post study conducted as part of the GEM Summer School.

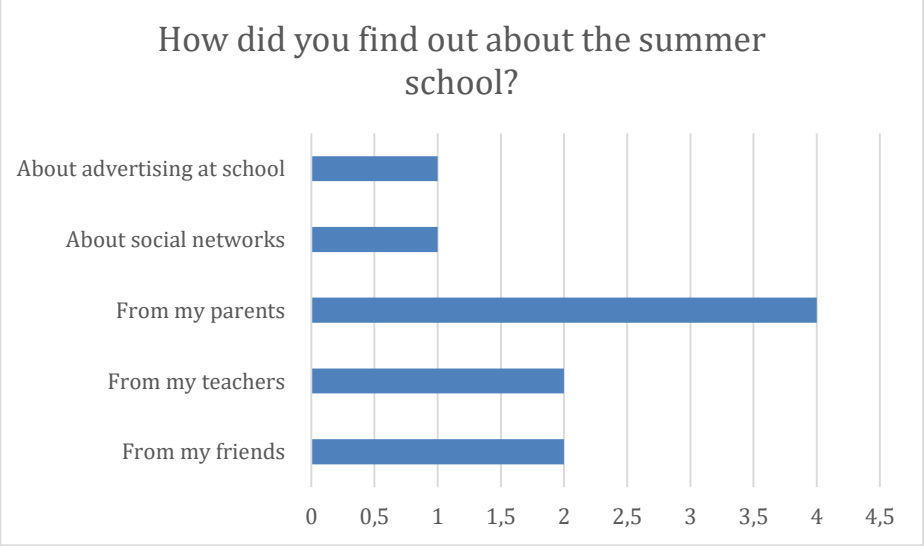
The summer school took place from 20 to 26th of July 2022. A total of 15 schoolgirls participated, with an average age of 13. At the beginning and end, the pre/post questionnaires were each completed digitally (14 pre and 10 post).

The girls had a comparatively positive attitude towards the STEM subjects, as can easily be seen in the following table. Although they find most subjects interesting, they do not yet rate their importance as highly. In particular, the importance of physics and chemistry is considered comparatively low by the girls, which may also be due to the fact that they have had no or very few lessons in these subjects (approximately 50% of the students didn't have physics or chemistry before).

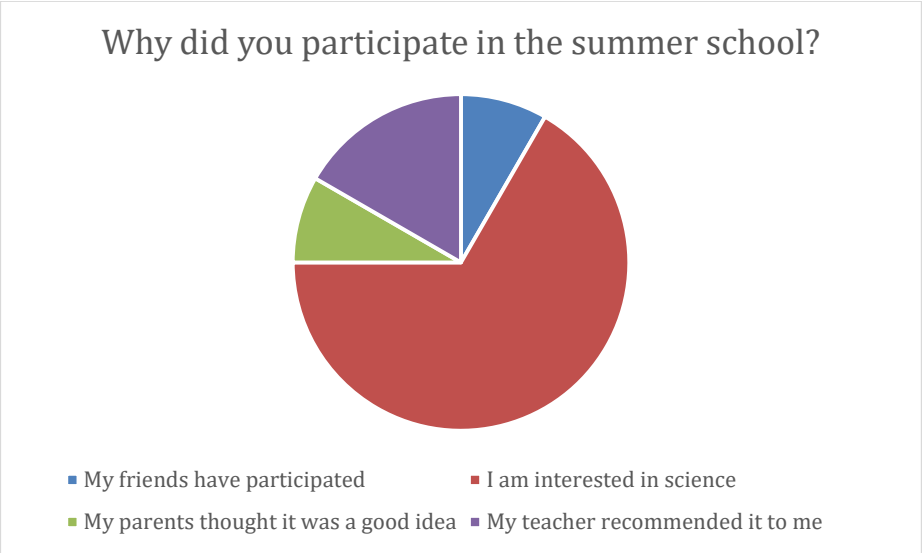
Scale from 1 to 7	Science	Mathematics	Biology	Physics	Chemistry
Insignificant 1 Significant 7	5,928571429	4,142857	3,5	2,35714286	3,142857
Boring 1 Exciting 7	5,714286	5,64286	5,5	5,428571	5,5

Their positive attitude is reflected in their career choices, if they already have one. 75% of the female students already have career aspirations, all of which are in the STEM field, with a few exceptions such as fashion designer.

Interestingly, most girls were encouraged to attend summer school by their parents, teachers and friends, and social media plays a minor role. However, we do not know how teachers and parents were informed about the summer school.

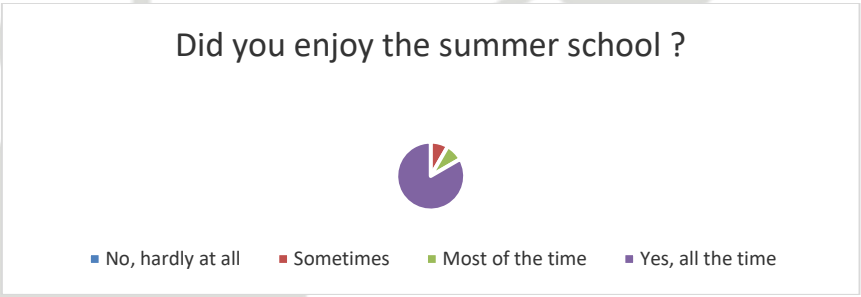


However, from the girls' point of view, the reasons for participation were mainly their own interest in science and less the opinion of their parents and teachers. This is consistent with the previously observed attitudes towards science.

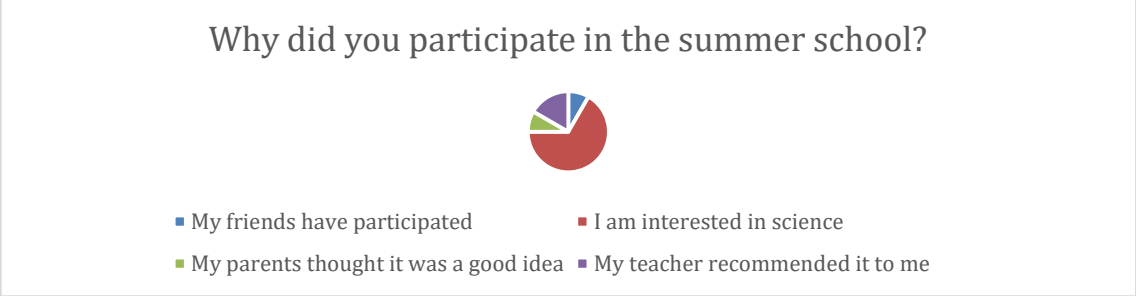


(ii) Post-summer camp

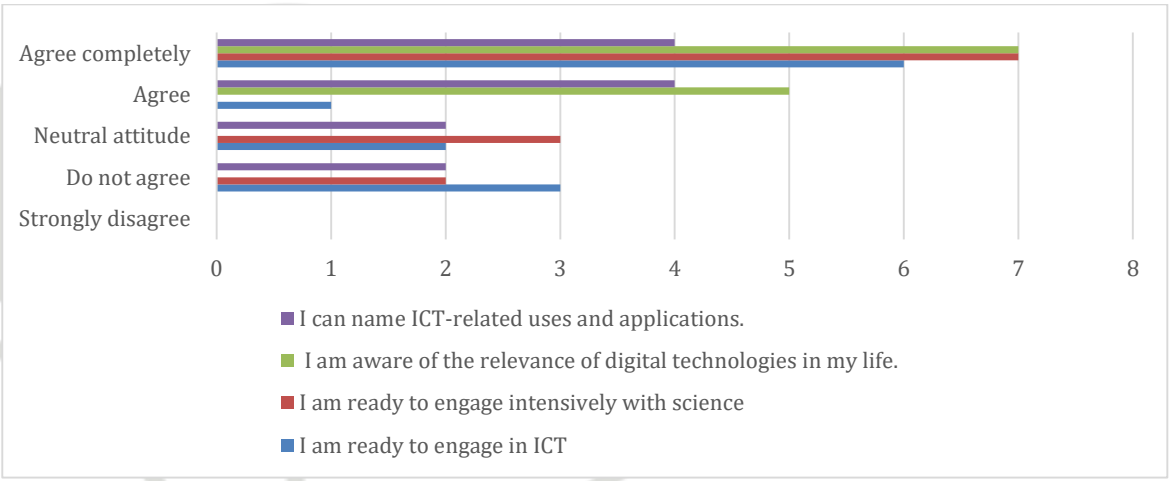
The summer school was extremely well received. None of the students stated that she did not like the summer school and 77% of the girls enjoyed the summer school all the time.



This is also reflected in the fact that almost all the girls would recommend the summer school to their friends.

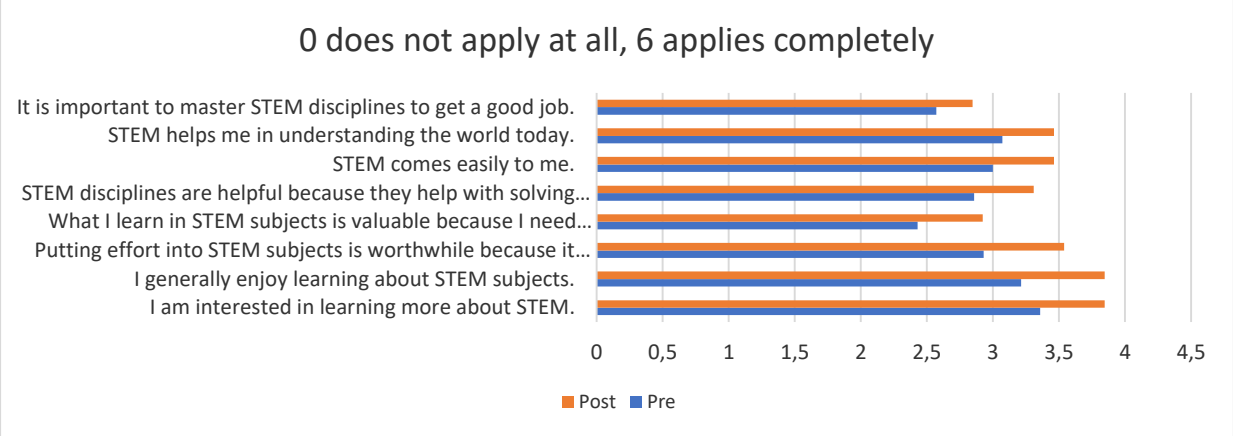


The girls have a pretty good self-concept in science and ICT, as the following graph shows.



However, the summer school didn't change their attitude towards science a lot. About 65% of the girls said that their attitudes towards science had not changed at all or only slightly as a result of the summer school, but this may also be due to the fact that they already had a very positive attitude towards science in the first place.

Interestingly, the girls' opinions about STEM sciences could be improved. However, it should be said that these results are not statistically significant because the data set is too small. However, when combining the data set of the first summer school with the data set of the second summer school, statistically significant effects can be observed in all areas (medium to strong). Research shows that these effects are short-lived, but more can hardly be achieved in such a short period of time.



(a) Qualitative

Qualitative data was collected as part of the questionnaire. In addition, a Master's student recorded and analysed the behaviour of the participants with the help of an observation sheet.

As we have already seen, the summer school was a complete success from the students' point of view. Most of the students felt comfortable throughout and would recommend the summer school to others.

"Because I think it was a cool and very informative experience".

When asked why they would recommend the summer school to others, they said that they simply enjoyed learning here and that girls should generally be promoted more in the STEM field.

"Maybe doing age - appropriate tasks when the age range is 12-18"

The main criticism was that the age range was too broad and that either this should be restricted, or the selection of examples should be broader.

"The (career)-lectures did not interest me that much"

Moreover, the career talks were only partially well received. In a direct conversation, students who participated for the second time said that the career talks should be more related to the content of the summer school and less generally related to STEM. Some of the career talks took place in the middle of the day and, from the students' point of view, disrupted the flow of the summer school and should rather have taken place at the beginning or end of the day. One GEM-Mentor proposed that career talks should be more interactive and less in a lecture format.

But in the end, most of the girls said that there was really nothing to improve from their point of view. In particular, the topics of 3D printing and Escape Rooms were very well received. The students paid quite close attention to their boxes during the printing process and all of them proudly held their 3D-printed Escape Boxes in their hands at the end. In addition, the community and the atmosphere were described as very positive, which was also reflected in the particularly committed working attitude of the participants.

12. Lessons learnt

As we have already seen in the qualitative analysis, the following points should be considered when organizing such a summer school: closer age range and careful planning of career talks.

We also changed something from the first to the second summer school, which in retrospect turned out not to be a good decision. The last year mentors commented in the evaluation survey, that it would be a great idea to place the summer school in the project week of the schools. However, during this time, many projects were organized for the pupils within the school and therefore they could not or did not want to participate in our summer school: multiple teachers wrote us that they would love to invite their pupils to take part in this summer school next year.

Also, last year all participants took part in different workshops in different areas (3D printing, digital escape games, normal escape games), keyword: Jigsaw Teaching Technique. This meant that the students were "experts" in their chosen topics and had to interact very closely with each other in the group, if they wanted to develop a box together: they were dependent on each other competencies. This way of organizing a summer school asked for extensive time and financial resources: we had to use multiple rooms and have simultaneous lectures, had larger organizational effort.

This year we tried out a schedule, where all girls learnt all topics and in retrospective, we would rather organize a summer school again, where girls have to choose topics and cooperate with each other more since it was perceived better by everyone involved.

13. Recommendations related to the organization of out of school events for girls

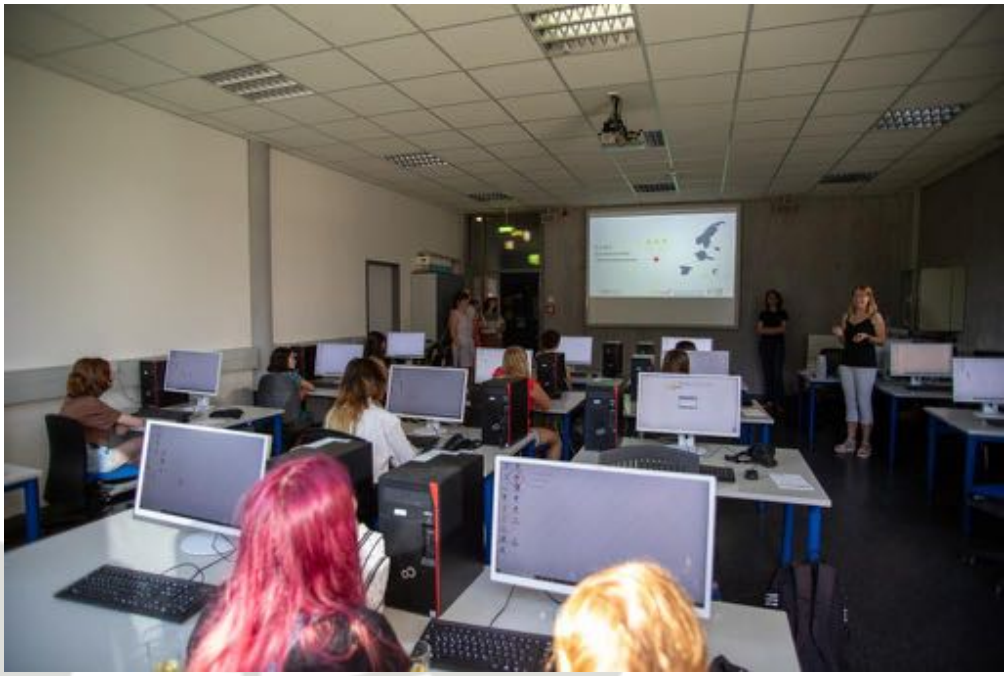
1. if we want to serve such a wide age range, the examples presented should be feasible and challenging for all participants.
2. career talks should be aligned with the content as much as possible.
3. Jigsaw teaching encourages collaboration (but is quite time and personnel-consuming)

14. Photos and other evidence

GEM
Empower Girls to Embrace their Digital and Entrepreneurial Potential
SUMMER CAMP
GIRLS CAN STEM TOO!
Girl Power – Zusammen kreativ sein
Grundlagen des Programmierens
Eigene Escape Boxen designen und 3D-drucken
Escape Aktivitäten mit MINT Bezug
Was?
Verbringe fünf spannende Tage in der MINT-Welt und lerne wie man eine eigene Escape Box kreieren kann!
Wer, wann, wo?
❖Mädchen*
❖12-18 Jahre alt
❖Werktags 20 – 26 Juli, 2022
❖PH Freiburg, Kunzenweg 21, 79117 Freiburg
Wir freuen uns auf deine Anmeldung!
SCAN ME
Über das Projekt:
GEM

ICSE
International Centre for STEM Education

GEM
Empower Girls to Embrace their Digital and Entrepreneurial Potential



European Commission

GEM Empower Girls to Embrace their Digital and Entrepreneurial Potential

GEM STEM Summer Camp 2022 – GREECE

1. The Context

The summer school was addressed only to girls 13-15 years old, meaning girls who attended classes of secondary education during 2021-2022 school year. It was held online for three days from 9.00 to 15.00 approximately every day. The girls were divided in three groups according to their class. A mentor was responsible for each group as regards the educational part of the camp (e.g., activities, structure of sessions, materials, etc.) while another colleague was responsible for the communication with parents/guardians for all organizational issues. The girls were involved in STEM labs based on activities addressing at least two STEM fields. The activities were adapted to diverse levels and profiles including connections to women's contribution to STEM fields and favouring the girls' reflections on their own educational and professional path. With these activities, we aimed to (a) introduce the girls to featured STEM fields and corresponding professional spaces, (b) inform girls about women's contribution to scientific domains, and (c) improve girls' self-confidence in their abilities related to STEM.

2. Recruitment

We used the website of the summer school to provide all information to the potential participants. We used mailing lists of schools and specific teachers of secondary education we had cooperated with in previous projects. We designed an application form via Microsoft forms, and we tried to start the application period as early as possible, relatively to the dates of the summer school.

The application process for our summer camp was comprised by the following steps:

1. Create an electronic invitation for the summer camp (the invitation will include a summary of the scope and the content of the summer camp and all the details of program. Additionally, the interested parties will be forwarded to the website of our summer camp for further information and the application).
2. Invitation will be sent to certain parties (i.e. schools or organisations) for forwarding to mailing lists of parents.
3. A link of the application for participation to the summer camp will be included in the invitation letter (if the applications are more than the available positions of the summer camp, priority will be given to those applied first).
4. After the application deadline is closed, we will have listed the participants.
5. The program and certain guidelines of the process and the venue of the summer camp will be e-mailed to the participating girls.

Additionally, we created an electronic version of a leaflet which accompanied any invitation sent via mail, in order to give more information on the summer school in more illustrative way. A copy of it in Greek follows:

European Commission

3. Summer camp support site

For spreading the information of the organisation of the summer school we used the main site of the scientific responsible at the domain of the University of Athens to host the summer camp support site. By visiting the relevant site someone could find information of the project and the activities. Additionally, we used the site for the application process of the interested girls and to make relevant announcements. Moreover, we used social media to be in touch with the interested parties.

Link to the summer camp support site:
Website: GEM SUMMER CAMP GREECE

4. The Plan

Most of the activities addressed at least two STEM fields, where one of these fields was more dominant than the others. The activities had different formats, such as problems describing real-life situations, games, programming, professional oriented problems, experiential and interactive activities, etc. For instance, one activity concerns girls' engagement in exploring the construction of stairs emphasizing different aspects such as geometrical (e.g., height, length, slope), architectural (e.g., plan view, safety) and engineering ones (e.g., electrical elevator). Another activity concerned girls' engagement in programming through Scratch and game design while a third one concerns girls' involvement in exploring the DNA helix through manipulatives and digital tools. Additionally, there was an escape room as game that gave the girls the opportunity to discover the clues and get knowledge about women in science and an activity through which were trying to get to space and discovered the characteristics of the planets. Moreover, all the activities were followed by reflections on women's role and self-projection of the girls in the related domains (studies, potential professional careers, etc). The STEM labs would be adapted to various levels and profiles (e.g., age, school grade, special

needs & interests) of the participating girls. Apart from the labs there was also the last learning zone during which, lectures by women scientists, video screenings, discussion panel take place. The activities were planned in such way to be amusing, interactive and participating. Certain necessary material was sent to the participants to be able to make simple constructions and be creative while listening also to certain theoretical background of each activity. We managed to have some lectures, panel discussions and mentoring by women from a variety of disciplines, to provide advice to girls as they plan for their future, to get to know "the woman behind the scientist," and to be inspired by their personal stories.

(a) Pedagogy

During the labs we used presentation of subject using mainly powerpoint presentation. Then, the girls would ask questions on the subject since all have understood, the instructor would briefly describe the activity. In most labs the girls were separated in group and get in virtual rooms with an assistant of the lab to help them team work and achieve the objective of the lab.

(b) Focus on entrepreneurship

By inviting female speakers to present their careers in science fields in the labour market

(c) Technology

The girls had to deal with the online format of the summer school. In the summer school plan. The summer school included activities in programming using Scratch, online escape room and Choico.

5. The learning plan for the summer camp

GEM Summer Camp Learning Plan NKUA-2022

Please write a summary of your summer camp. It will be uploaded on the official GEM Project Website: how to get involved in one of the summer camps https://icse.eu/international-projects/gem/

The summer school will be addressed only to girls 13-15 years old, that is girls who attended classes of secondary education during 2021-2022 school year. It will be held online for three days from 9.00 to 15.00 approximately every day. The girls will be divided in three groups according to their class. A mentor will be responsible for each group as regards the educational part of the camp (e.g., activities, structure of sessions, materials, etc.) while another colleague will be responsible for the communication with parents/guardians for all organizational issues. The girls will be involved in STEM labs based on activities addressing at least two STEM fields. The activities will be adapted to diverse levels and profiles including connections to women's contribution to STEM fields and favouring the girls' reflections on their own educational and professional path. With these activities, we aim to (a) introduce the girls to featured STEM fields and corresponding professional spaces, (b) inform girls about women's contribution to scientific domains, and (c) improve girls' self-confidence in their abilities related to STEM.

Summer Camp Learning Plan

Title of your Summer Camp:
Encouraging girls towards STEM fields

Target Group (age, school type):
13-15 years old, lower secondary education

Venue:
Online platform (zoom or webex).

Transportation to the venue / digital access to the Summer Camp:
N/A

Subsistence:
N/A

Contact person for girls and their guardians:
Parents and guardians could contact the scientific responsible of the project concerning all issues of organization or a person of the project team appointed with this role. Mentors will also be available to communicate with girls (one for 20 to 25 girls) as regards their participation in the summer school.

Schedule:
The program is divided into three learning zones. The first two zones will include three STEM laboratories in which all the teams will be involved. The daily program will be organised as following:

Summer School Program 2022

Tuesday 21st June 2022
9:00 am – Welcome to the GEM Summer School 2022

Time	Duration	Activity	
09:30-11:00	1h & 30m	Lab 1	
11:00-11:30	30m	Break	
11:30-13:00	1h & 30m	Lab 2	
13:00-14:00	1h	Lunch break	
14:00-15:00	1h	Lecture and free discussion	

Wednesday 22nd June 2022

Time	Duration	Activity	
09:00-10:30	1h & 30m	Lab 1	

10:30-11:00	30m	Break	
11:00-12:30	1h & 30m	Lab 2	
12:30-13:30	1h	Lunch break	
13:30-15:00	1h & 30m	Discussion panel: "Women in Science and professional arena - Part I"	

Thursday 23rd June 2022

Time	Duration	Activity	
09:00-10:30	1h & 30m	Lab 1	
10:30-11:00	30m	Break	
11:00-12:30	1h & 30m	Discussion panel: "Women in Science and professional arena - Part II"	
12:30-13:30	1h	Closing of summer school - evaluation	

Pre-questionnaire regarding STEM thoughts of the students will be completed electronically on the first day of the summer school during the introductory session and the evaluation of the summer school using post-questionnaire will be completed electronically by the students during the closing session.

Content:
Most of the activities address at least two STEM fields, where one of these fields is (or might be) more dominant than the others. The activities have different formats, such as problems describing real-life situations, games, programming, professional oriented problems, experiential and interactive activities, etc. For instance, one activity concerns girls' engagement in exploring the construction of stairs emphasizing different aspects such as geometrical (e.g., height, length, slope), architectural (e.g., plan view, safety) and engineering ones (e.g., electrical elevator). Another activity concerns girls' engagement in programming through Scratch and game design while a third one concerns girls' involvement in exploring the DNA helix through manipulatives and digital tools. Aditionally, there is an escape room as game that gives the girls the opportunity to discover the clues and get knowledge about women in science and also an activity through which are trying to get to space and discovers the characteristics of the planets. Moreover, all the activities will be followed by reflections on women's role and self-projection of the girls in the related domains (studies, potential professional careers, etc). The STEM labs will be adapted to various levels and profiles (e.g., age, school grade, special needs & interests) of the participating girls. Apart from the labs

there is also the last learning zone during which lectures by women scientists, video screenings, discussion panel take place.

Format of the activities:
The activities are planned in such way in order to be amusing, interactive and participating. Certain necessary material is sent to the participants so as to be able to make simple constructions and be creative while listening also to certain theoretical background of each activity.
We plan to have some lectures, panel discussions and mentoring by women from a variety of disciplines, to provide advice to girls as they plan for their future, to get to know "the woman behind the scientist," and to be inspired by their personal stories.
Expected learning outcomes:
Through these activities, we anticipate the participants to:

- acquire a significant knowledge about STEM fields and make connections between them,
- explore some possible STEM professions in WoW,
- get involved in competitive projects and to develop team working spirit,
- realise that many women have excelled in STEM domains,
- gain confidence in their abilities and believe that they have their own place in STEM world,
- apply their school knowledge to new contexts related to STEM.

Presentation of hosting Higher Education Institution and lecturers:
The National and Kapodistrian University of Athens (NKUA) is a public university with 33 departments, 2.100 academic staff members and about 40.000 undergraduate students. The Department of Mathematics has about 1.200 undergraduate students and 44 academic staff members with a variety of academic expertise (e.g., Statistics, Algebra and Geometry, Analysis or Didactics of Mathematics). The department offers a variety of courses but there are two main directions in the teaching program, pure and applied mathematics, and there are three specializations (Computational mathematics, Statistics and operational research and Mathematics education). Members of the Mathematics Department serve in the board of the Greek Mathematical Society and participate in scientific committees of the Ministry of Education, the body responsible for educational policy, for curriculum and textbook development. Every year the Mathematics Department admits 250-300 undergraduate students. About half of them will follow a teaching career after their studies while other continue their professional careers and further studies in STEM-related areas (e.g., finance, programming, big data analytics). Additionally there is a Master's programme in Mathematics Education that is attended by many in-service and pre-service mathematics teachers. There are several research collaborations with other European universities through e.g. Erasmus+. Consequently, the Mathematics Department has strong relations with various bodies and groups of stakeholders in Greece and abroad and this could support project's dissemination and sustainability.
Department webpage: https://en.math.uoa.gr/
NKUA webpage: https://en.uoa.gr/

Please add the link of your Summer Camp support site: We will link your support site on our official GEM Project Website together with your summary of the summer camp.

LINK:
http://scholar.uoa.gr/gpsych/GEMSummerCamp2021

Additional information for the EC:

Please, write in short about your problems and difficulties of the implementation of your Summer Camp in 2021 under the COVID-19 circumstances.

- What would you have planned in your Summer Camp under normal circumstances and what do you plan to do instead.

Due to barriers posed by COVID-19 it was decided the summer school to take place online. The activities we have planned for the school with physical presence we modified so as to align with the online communication. For instance, activities involving manipulatives have been replaced by digital ones while group work is planned to take place in workout rooms within the online platform.

6. Learning Outcomes

Through these activities, we anticipated the participants to:

- acquire a significant knowledge about STEM fields and make connections between them,
- explore some possible STEM professions in WoW,
- get involved in competitive projects and to develop team working spirit,
- realise that many women have excelled in STEM domains,
- gain confidence in their abilities and believe that they have their own place in STEM world,
- apply their school knowledge to new contexts related to STEM

7. Mentors

The lecturers working labs with the girls are from various fields such as mathematics and physics. More specifically,

- **Maha Farah:** She has studied mathematics at the University of Lebanon, where she has also completed her postgraduate studies in the field of "Modelling and Informatics". Then, she has completed her doctoral studies in applied mathematics in France, where she worked in secondary schools for about 5 years. In recent years, she has been supporting the French school of Athens in Greece as a temporary teacher, teaching mainly mathematics.
- **Elisavet Kalogeria**: Elisavet has studied mathematics and has completed postgraduate and doctoral studies in Mathematics Education. She has been working as a teacher in secondary schools for almost 20 years. Her involvement with STEM starts from her PhD in mathematics education with digital tools but also through training seminars she has attended. Elisavet, when teaching, looks for ways to combine mathematics with other fields of science.
- **Ekaterini Spanou**: Ekaterini is a physicist specializing in environmental physics and with experience in teaching physics to secondary school students. She has completed her postgraduate studies at the University of Athens in Digital Transformation and Educational Practice. In addition, she has attended seminars on teaching practices in primary and secondary education and a STEM training course for instructors.
- **Polixeni Tsitsa**: Polyxeni is a mathematician and has been working as a secondary school teacher for over 15 years now. She has completed postgraduate studies in Education. Since 2009 she designs and implements, in the high school she teaches, a program on "Mathematics & Literature" with the participation of students and invited speakers related to the subject.
- **Maria Vassilopoulou**: She is a mathematician specializing in the Mathematics Education and a PhD candidate in the same field. She works for approximately 5 years now to Secondary Education but also in programs for primary schools' students. She has

extensive experience from STEM teaching and participates as a STEAM educator at MENSA Greece.

We plan to have some lectures, panel discussions and mentoring by women from a variety of disciplines, to provide advice to girls as they plan for their future, to get to know "the woman behind the scientist," and to be inspired by their personal stories. More specifically,

- **Sofia Lambropoulou**: She is Professor of the National Technical University of Athens in Greece at the School of Applied Mathematical and Physical Sciences. Her main research interests are in mathematics (knots theory) but also physics and biology. She had her studies in Greece and UK and in 2002 she was qualified Maître de Conférence by the French Ministry of Education. Most recently, she was honoured with representing Greece in the exhibition "Women of mathematics throughout Europe", which was inaugurated at the 8th European Congress of Mathematics in Portoroz, July 2021 (interviewed & portrayed in Geneva, February 2019).
- **Myrto Denaxa**: She is a PI at the Alexander Fleming Biomedical Sciences Research Center, Greece. Denaxa obtained her bachelor's degree from the University of Patras, Greece, and her master's and PhD from the University of Crete Medical School, Greece. She subsequently joined the group of Vassilis Pachnis at the National Institute for Medical Research, London, as an MRC postdoc fellow. Later, she became a senior research associate at the Francis Crick Institute, London. Her research is focusing on deciphering molecular mechanisms implicated on cortical interneuron development and function.
- **Paraskevi Pitta**: Dr. Paraskevi (Vivi) Pitta is an Associate Researcher focusing on Microbial Ecology at Hellenic Centre Marine Researches, Institute of Oceanography. She assumed her duties in April 1996. She completed her doctoral training at the Institute of Marine Biology of Crete, Greece. Her thesis work focused on the dynamics of the plankton community in sea bream (Sparus aurata) larvae rearing mesocosms. She earned her doctoral and master's degrees in Marine Biology from the University of Crete, Greece. She holds a second master's degree in General Ecology from the Universite de Paris-Sud (Paris XI), France and a bachelor's degree in Biology from the University of Athens, Greece.
- **Marina Sagnou**: She is an Associate Researcher at the National Center for Scientific Research "Demokritos" in Greece for 15 years now. She writes about herself: "My main research focus is in design, synthesis and biological evaluation of novel small organic molecules, natural products or organometallic complexes with potential target-specific pharmacological properties. The areas of potential application of such designed molecules in which my research is currently engaged are: diagnosis of Alzheimer's disease, diagnosis and/or therapy of cancer, function and imaging or p-glycoprotein and multi-drug resistance in CNS pathology and cancer, natural products in rewarding and addiction, and small molecules in stem cell proliferation. I have also been actively involved and participate in the foundation and development of the NCSRD spin-off company "STEP@biomaterials" in the production and development of novel human bone allograft products, bovine xenografts, synthetic allografts and other related biomaterials for dental and orthopedic application. Finally, it is a great interest and concern of mine how to get younger kids inspired about science. So, getting them to know "Demokritos", laboratory experience, hands-on experiments, outreach events are of high priority of mine".
- **Ekaterini Orfanogiannaki**: She is mathematician specialized in Statistical Seismicity. She has been involved for the last 20 years in numerous national and international research activities, collaborations and programs of the Institute of Geodynamics of the National Observatory of Athens and the Athens University of Economics and Business related to natural disasters from earthquakes, tsunamis, and landslides. Ekaterini Orfanogiannaki

has participated upon invitation, as an expert in Statistical Seismicity, in the creation and subsequent development of the electronic platform for statistical analysis of seismicity (Community Online Resource for Statistical Seismicity Analysis – CORSSA, http://www.corssa. org/en/home/). She has extensive experience in organizing workshops and conferences, as she has been a member of the organizing committee in international conferences on natural disasters from earthquakes and tsunamis. In addition, she has been a guest researcher at Universities and Research Institutes in New Zealand (2008), Switzerland (2010) and Japan (2013, 2019). She has been awarded by the Hellenic Statistical Institute and the American Geophysical Association for the preparation of papers presented in the framework of respective conferences and has secured funding for the elaboration of doctoral and postdoctoral research, as well as self-reliant research as coordinator in the form of scholarships. He is the scientific responsibility of the project "Tracing the mysteries of earthquakes through an innovative educational journey" which has received funding from the Hellenic Foundation for Research and Innovation and is implemented in cooperation with primary and secondary schools.

We focused on having in the team instructors with experience in education and STEM fields to need the least time possible to train them and introduce them to the idea and mentality of carrying a summer school for secondary education students.

8. Evaluation data collection

During the application and while designing the specific form, we took into consideration these issues of consent. Therefore, the application included relevant questions on consensus for taking pictures, questionnaire completion etc.

9. Challenges encountered

There three main challenges we had to handle.

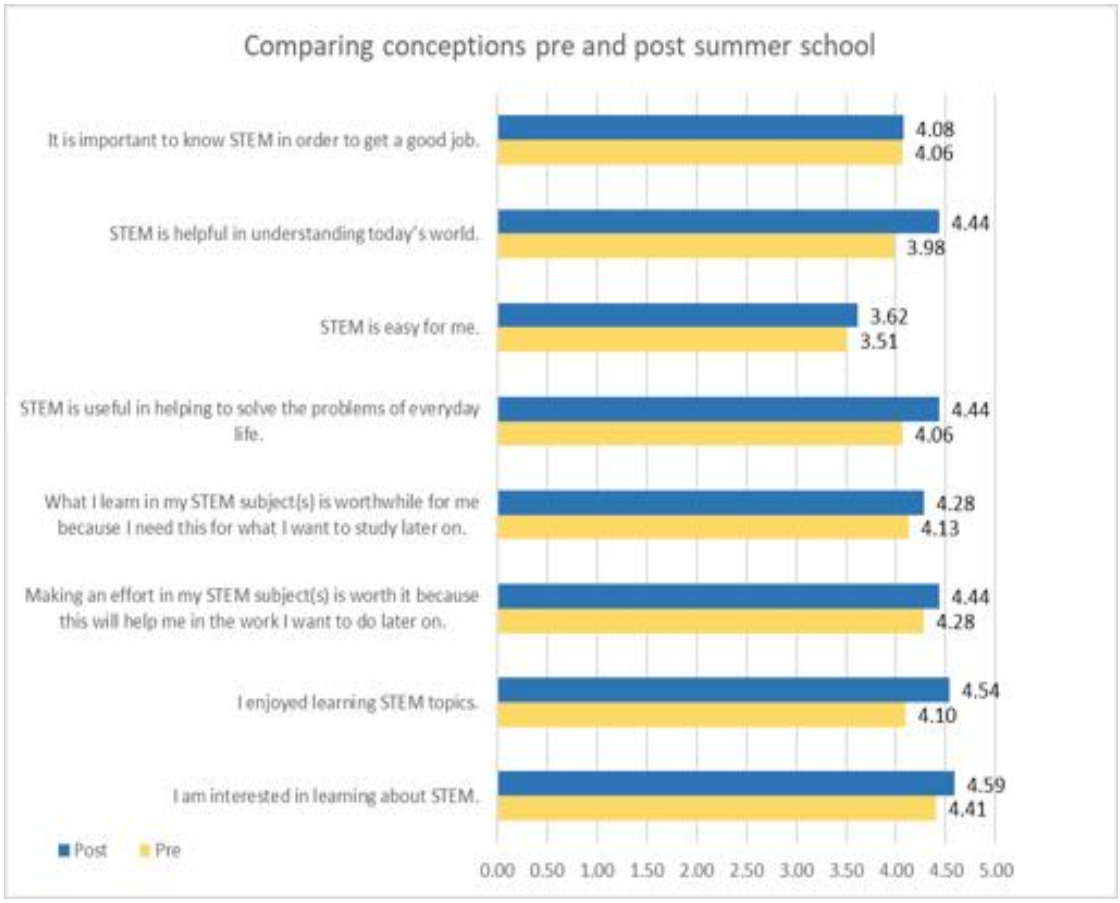
1. The fact that the summer school would be online. We had to ensure that there would be no technical issues, for that reason we had recruited a partner who was present in all the labs and oversaw keeping all technical issues resolved.
2. The large numbers of participants. The number of applications exceeded all expectations, therefore we had to reject some of them and create a list of runner-ups. The target number we had when designing the summer school 2022 was 50 girls, however the applications were more that 100 in total, and so we decided to run the summer school with 70 participants in total.
3. Finding enough number of volunteers. Since the budget of the summer school was limited, we had to be able to attract a sufficient number of volunteers (postgraduate students or teachers) to support the implementation of the workshops. We managed to achieve this and as a reward for the volunteers we issued a relevant certificate of voluntary participation.

10. Other

N/A

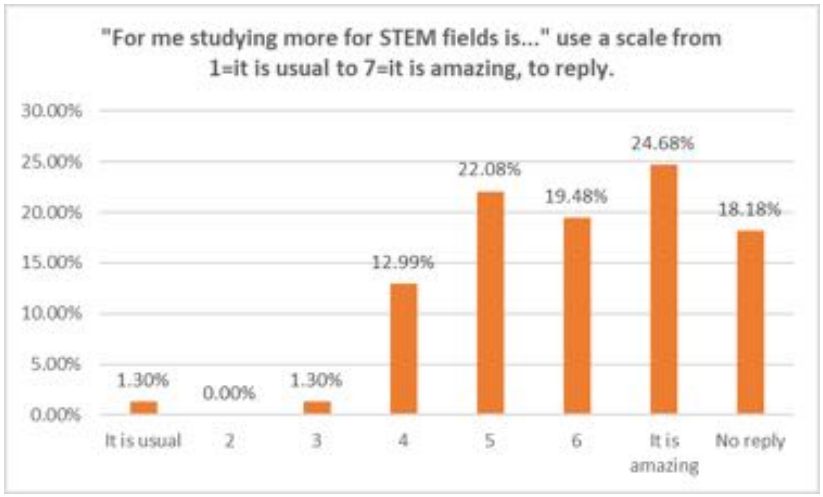
11. Evaluation of the summer camp

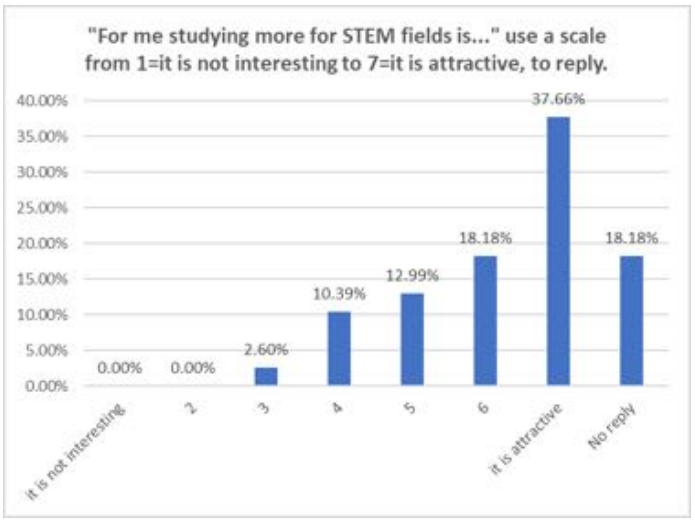
(a) Quantitative



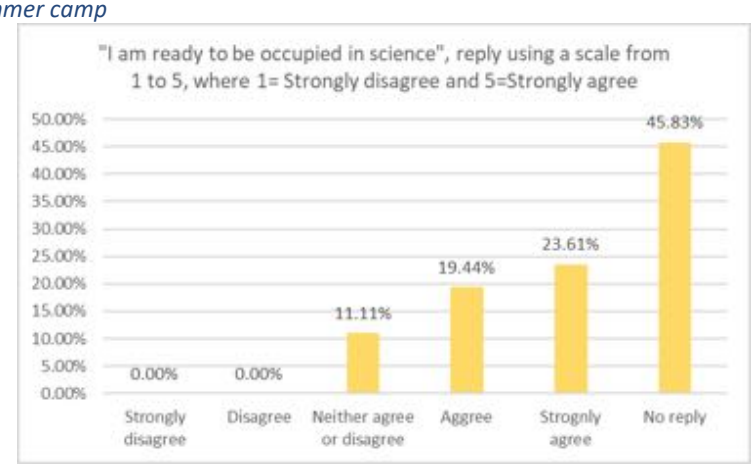
(i) Pre-summer camp

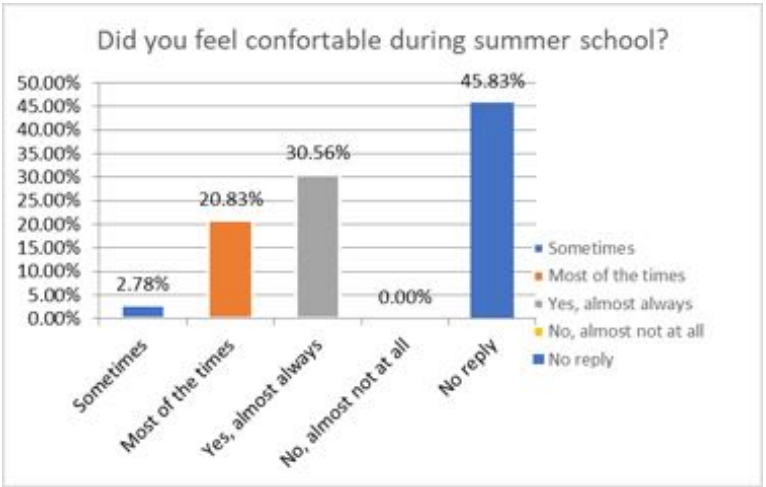
Number of participants: 70 girls
Ages: 13-15 years old
Secondary Education

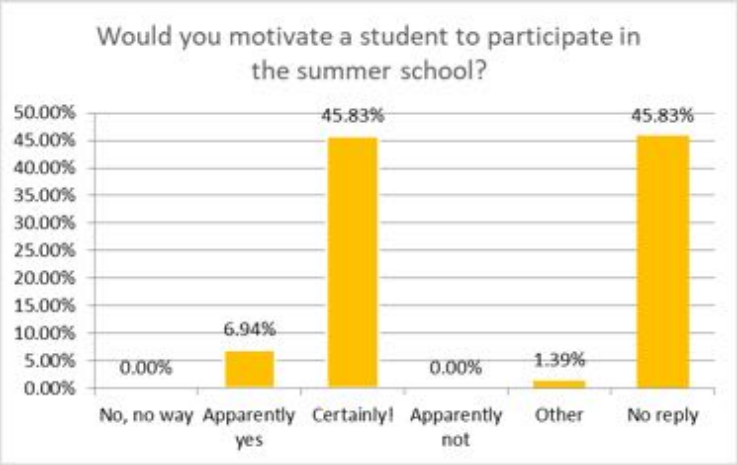




(ii) Post-summer camp







Mainly enjoyed the DNA lab and the programming lab but a low percentage enjoyed the panel sessions. They less enjoyed the lab with the stairs and the astronomy lab, since they did not have interest in the specific science involved in the specific labs.

(b) Qualitative

Both, the girls and the educators, enjoyed the summer school however they still felt awkward being in distance. The girls in general found interesting and most would participate again if they had the opportunity.

Quotes from the participants:
"I suggest that we have in parallel with the speech about some experiment or phenomenon presented with some experiment"

"Some activities such as planning and decoding DNA could allow more time to implement. A speech or an activity on medicine could be added. Also something similar could be done on robotics and specifically on how it helps nowadays."

"Chemistry should be included as well. Somehow boys should know that girls can be STEEM too, and that they are equally capable"

12. Lessons learnt

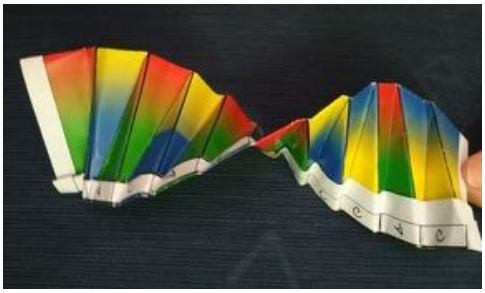
The organisation of a summer school under the circumstances of distance activities it was a lesson by itself. The usual practice is to realise STEM activities in person with the students. Though we found out that STEM can also be realised by distance, if when designing the activities the instructor has in mind to adapt them to be able for a student to deliver them only with following instructions. The combination of STEM activities and discussion panels was found of high interest by the students meaning that they need the connection between science, career and labour market, on other words examples of studies-work-life balance

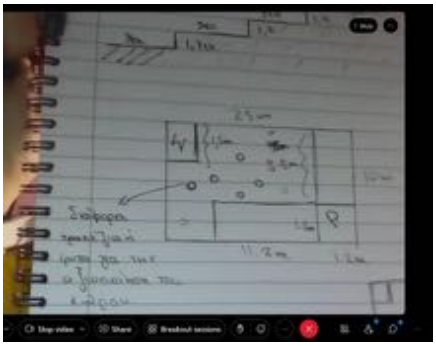
13. Recommendations related to the organization of out of school events for girls

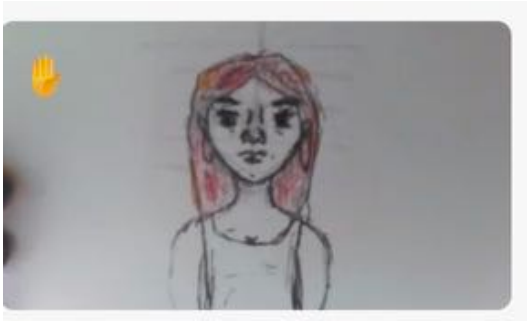
We plan to inform respectively the national Institution of Educational Policy and present our work of GEM

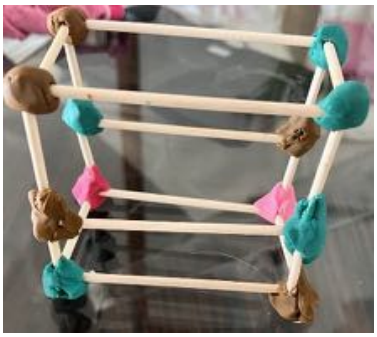
Presenting the work of GEM to national funding sources and presenting initiatives for expanding the idea to more participants.
Planning to have meeting and ask permission to visit school in order to introduce teachers to STEM education events
Research funding to organise summer schools for teachers (pre service and in service) in STEM education and its implementation

14. Photos and other evidence









GEM Summer Camp 2022 – Lithuania

1. The Context

The Lithuanian education system is centralised. Primary education starts at the age of 6-7. It lasts for 4 years (grades 1-4). This education is compulsory, but parents have the right to choose a public or private school. General education lasts for 6 years (grades 5-10, grammar school grades I-II). It is also compulsory education. Secondary education is not compulsory. It consists of a 2-year programme (Grades 11-12 or Gymnasium III-IV). Secondary education is chosen by pupils who intend to continue their education with a vocational qualification or a higher education diploma. Pupils who do not intend to go on to higher education can follow vocational training programmes in vocational training institutions. Vocational training is designed to acquire or upgrade qualifications. The main language of instruction in public schools is Lithuanian. The following subjects are taught in primary school: Lithuanian language, mathematics, world knowledge (science, history), moral education, artistic education (art and technology, music and dance), foreign language, informatics, physical education. In secondary school, pupils study Lithuanian language and literature, mathematics, history, chemistry, biology, physics, art education, foreign languages, information technology and citizenship education. Pupils can take economics, entrepreneurship education, psychology, philosophy, theatre and other elective subjects. Lithuanian schools can choose how to teach STEM subjects, either as an integrated science course or as separate science subjects.

3. Recruitment and Summer camp support site

Information dissemination and communication took place online - information about the summer school was published on the Vilnius University website, the School and Academy website, the Faculty of Philosophy website, and social networks. Information about the summer school together with the invitation was sent to all schools in Vilnius City. The participant selection strategy and the school's publicity measures were discussed at the Vilnius University GEM team meeting. Based on the experience of previous summer schools, we have modified the registration form to include a request to write more detailed reasons for attending the summer school.
The invitation and information about the summer school will be sent to schools in Vilnius City and will also be forwarded to the science teachers' associations.
The content of the information includes the following points:
Invitation (date, place, age of participants)
Brief information about the project
Brief information about the school already held
Detailed school programme
Participant registration form (participant details, motivation letter - reasons why you want to participate in the summer schools).
https://www.vu.lt/kviecia-vu/mokyklos-ir-akademijos#vasaros-mokykla-ismanusis-miestas-2022
https://www.fsf.vu.lt/naujienos/fakulteto-ivykiai/4311-gem-projektas-mergaiciu-gebejimams-stiprinti-2

4. The Plan

Target group: girls from Vilnius city schools, aged 12-14.
Location: Vilnius University, Business School, Saulėtekio al. 22.
Days: 3 days (5, 8, 8 hours per day).
Main activity: exploring automation solutions for a safe and comfortable life using Arduino kit and sensors. Focus on competences: Problem solving, Collaboration, Creativity, Communication, Critical thinking, Digital fluency.
Educational excursion to VIVISTOP, a creativity-software and hardware space https://www.vivistopuzupis.lt/

(a) Pedagogy

The Summer School activities were based on the principles of constructivist learning theory. The curriculum was based on the construction of new knowledge through the student's experience, the student's involvement in practical activities, the promotion of curiosity, interest, creativity and the experience of success. The participants of the summer school gained new STEM knowledge and skills through the process of creating mini-projects with Arduino.

(b) Focus on entrepreneurship

Once the models and posters were finished, a presentation was organised. This is an exciting and anticipated time when teams present the results of their work. It was a great pleasure to have Professor Olga Kurasova and Professor Mažena Mackoit-Sinkevičienė from Vilnius University present. The reflection session went well, with the visiting scientists not only attentively watching the girls' presentations, but also commenting on them and asking questions.
One of the aims of this school was to give girls a portrait of what an interesting and entrepreneurial career as a scientist can be like, helping them to fulfil themselves and create a better world for people. The aim was to show the importance of digital skills and the mastery of modern technologies for women's fulfilment and careers. The school's guests are truly inspiring role models - Professor Olga Kurasova has been awarded the 2021 Lithuanian Science Prize in Technology Sciences for her series of articles "From Data Science to Artificial Intelligence Technologies". Dr Mažena Mackoit-Sinkevičienė is the President of the Young Minds Division of the European Physical Society in Lithuania.

(c) Technology

Technology was used to create mini projects/models:
House/garage/street lighting (Arduino+LEDs+button/remote controller and IR/RFID reader and card/Wifi)
Traffic lights (Arduino+LED)
Motion detection in the yard (Arduino+PIR sensor+LEDs/light/LCD)
Alarm for unauthorised access (Arduino+buzzer+LED)
Creation of access control for authorised persons only (Arduino+servo motor+RFID+LED+LCD)
Remote control of the boom barrier (Arduino+servo motor+LEDs+LCD)

5. The learning plan for the summer camp

We planned the school's programme based on the GEM project's objectives - to unlock girls' abilities, to motivate girls to learn STEM subjects, to be interested in coding activities, and to foster their digital and entrepreneurship skills. The three-day school programme was intensive due to the variety of hands-on activities and leisure activities.

On the first day of the school, the girls were welcomed by Professor Valentina Dagienė, introduced to the GEM team, and then discussed the school programme in detail. After the welcome, the student volunteers organised team-building games, thus creating a warm and friendly atmosphere. The first activity of the school was "How to use 3D pencils and hot glue?" was led by student volunteers who were already volunteering in their third summer school. Next, Dr Anita Juškevičienė started a discussion on how modern technology is making life more comfortable and what inventions could make people's lives even more comfortable. Dr. Anita Juškevičienė introduced the girls to the elements of a smart home, explained the theoretical basics of programming with Arduino, gave them the knowledge needed to create mini-projects, and Arduino prototypes were presented. The first day's activities were more theoretical, to prepare for the next day's hands-on activities.

The second day started with generating ideas for mini projects. As in the previous summer schools, the girls actively proposed ideas for mini-projects and discussed how people's lives would change if their ideas were implemented. This was followed by a discussion of the selected mini-project ideas and their possible aesthetic design.

We went to the creativity-software and hardware space VIVISOP Užupis to get creative ideas for the aesthetic design of the models. VIVISOP is an inspiring space to create, to develop your creative ideas, a space where you can find all kinds of tools to realise your creativity. The girls created model sketches, chose tools and materials. After the field trip, the girls continued building and programming models with Arduino. While on the first day of school the girls were eager to take part in the playtime breaks, on the second day you could see their interest and involvement in the model making - they worked in small teams of two or three, discussing with each other, being independent and sharing their work. Of course, it wasn't easy, as the programming required the help of mentors and advice. But there was a lot of joy when the result was finally achieved.

On the third day, the development of the models continued, followed by testing the models with Arduino. The last day of school was always very intense - it was important to get the work done on time, to be able to get the artwork done, to make posters. All the girls had to answer the following questions when designing their presentation poster:

The purpose and application of the model;

- what subject knowledge was needed to construct the model;
- the tools used to create the model;
- the difficulties experienced;
- what we have learned.

So, once the models and posters were finished, a presentation was made. This is an exciting and anticipated time when teams of participants showcase the results of their work. It was a great pleasure to have Professor Olga Kurasova and Professor Mažena Mackoit-Sinkevičienė, researchers from Vilnius University, present. The reflection session went well, with the visiting scientists not only attentively watching the girls' presentations, but also commenting on them and asking questions. How many interesting questions were asked, how sincere and impressive were the girls' answers!

One of the aims of this school was to give the girls a portrait of a scientist and to introduce them to the career of a scientist. The last activity of the summer school is a meeting with young female scientists. The theme is "It's fun to be a scientist!". The inspiring stories of successful careers of female scientists were aimed at challenging stereotypes, getting girls interested in scientific research, and providing personal examples of how interesting and engaging the world of science can be. The aim was to show the importance of digital skills and the management of modern technologies for a woman's self-fulfilment and career. The school's guests are truly inspiring role models - Professor Olga Kurasova has been awarded the Lithuanian Science Prize 2021 in the field of Technological Sciences for her series of papers "From Data Science to Artificial Intelligence Technologies". Dr Mažena Mackoit-Sinkevičienė is the President of the Young Minds Chapter of the European Physical Society in Lithuania.

- After the meeting with the women scientists, the awarding of certificates took place. The girls were particularly pleased to receive certificates from young, but already accomplished scientists who have received international and national recognition.

Throughout the school, the girls were looked after by excellent volunteer teachers Martyna Vilutytė, Gabija Raubaitė, Elena Kuprytė.

At the end of the school, it was good to be asked by the participants - will we meet next summer? Clearly, the Smart City 2022 Summer School had the girls "hooked". That's what we were aiming for.

Monday (20 June)	
13.00 – 13.45	Registration. Vilnius University, Business School (Saulėtekio al. 22, Room 010)
13.45 – 14.00	"Welcome to the world of STEM!" Prof. V. Dagienė, Assoc. Prof. Dr. A. Meškauskienė
14.00 – 14.45	Let's meet! Students from the Institute of Education Sciences
15.00 – 17.00	How to use 3D pencils and hot glue? Students from the Institute of Education Sciences
17.00 – 18.00	How to live more comfortably? STEM activities with Arduino. Dr. A. Juškevičienė, Vilnius University
Tuesday (21 June)	
10.00 – 12.00	Idea generation. Mini project ideas. Dr. A. Juškevičienė, Vilnius University
12.00 – 13.00	*Lunch.*
13.00 – 15.00	Educational excursion to VIVISTOP, a creativity-software and hardware space https://www.vivistopuzupis.lt/
15.10 – 18.00	Creating and programming models with Arduino. Dr. A. Juškevičienė, Vilnius University
Wednesday (22 June)	
10.00 – 12.00	Creating and testing models with Arduino (3D pencils, hot glue). Dr. A. Juškevičienė, Vilnius University
12.00 – 13.00	*Lunch.*
13.00 – 15.00	Preparing posters and presentations. Dr. A. Juškevičienė, Vilnius University
15.00 – 16.30	Presentation of projects. Reflections
16.45– 17.45	It's exciting to be a scientist! Discussion with Vilnius University scientists (prof. O. Kurasova, Faculty of Mathematics and Informatics, Institute of Data Science and Digital Technologies; dr. M. Mackoit-Sinkevičienė, Faculty of Physics, Institute of Theoretical Physics and Astronomy)
17.30-18.00	Certification. Closing of the school - "See you later!"

6. Learning Outcomes

Competences to be developed: problem solving; collaboration; creativity; communication; critical thinking; digital literacy, entrepreneurship.
Learning outcomes: The girls will acquire and deepen their knowledge in STEM subjects;
Girls will acquire problem-solving, collaboration, critical and information literacy skills. They will become more creative, out-of-the-box and original thinkers.
Girls will learn about women scientists, their international careers and success stories that motivate them to become leaders who will create a better world. Girls will learn about future careers related to digitisation.

7. Mentors

The mentors/educators of the Summer School are members of the GEM project team.

Valentina Dagienė – Professor at Vilnius University. Main areas of activity: formulation of directions for the implementation of computer science and information technologies in schools, development and systematization of terminology, technological tools and methods for teaching programming (algorithmic), research and experimental development of educational and training software localization. In the summer school, they will take part in discussions and mentor girls in the development of mini-projects.

Anita Juškevičienė – PhD in Computer Science, researcher, Vilnius University Institute of data sciences and digital technologies. Research interests: programming, computational thinking, She is coordinating the main activities of the school - building models with Arduino.

Aušra Kynienė - Doctor of Natural Sciences (Physics), Research Fellow at the Department of Atomic Theory, Institute of Theoretical Physics and Astronomy, Vilnius University. Research interests: atomic theory and atomic spectra. Relativistic and many-electron effects in atoms, interaction of electrons and photons with atoms, study of processes in astrophysical and laboratory plasmas. She is responsible for organising school activities and will advise the girls on programming models.

Asta Meškauskienė – Associate professor at the Institute of Educational Sciences of Vilnius University, Doctor of Social Sciences, research interests: educational innovations, learning methods, non-traditional learning environments. She is the head of the Centre for Teacher Competence Development.

8. Evaluation data collection

An electronic questionnaire has been developed. Girls answer the questions on the first day of school (before classes) and on the last day of school (after classes, after mini project presentations). School teachers and mentors answer the questions after school.

9. Challenges encountered

A few of the summer school participants joined a little later, so they had to find time to complete the questionnaire in the midst of their busy schedules. There were no major problems at all, and the

parents/guardians of the participants were very understanding in agreeing to complete the questionnaires.

10. Evaluation of the summer camp

Participants of the survey were 36 girls aged 12-14 (grades 6,7,8). The questions were asked on a 5-point Likert scale, with 1 being the least favourable answer and 5 being the most favourable answer.

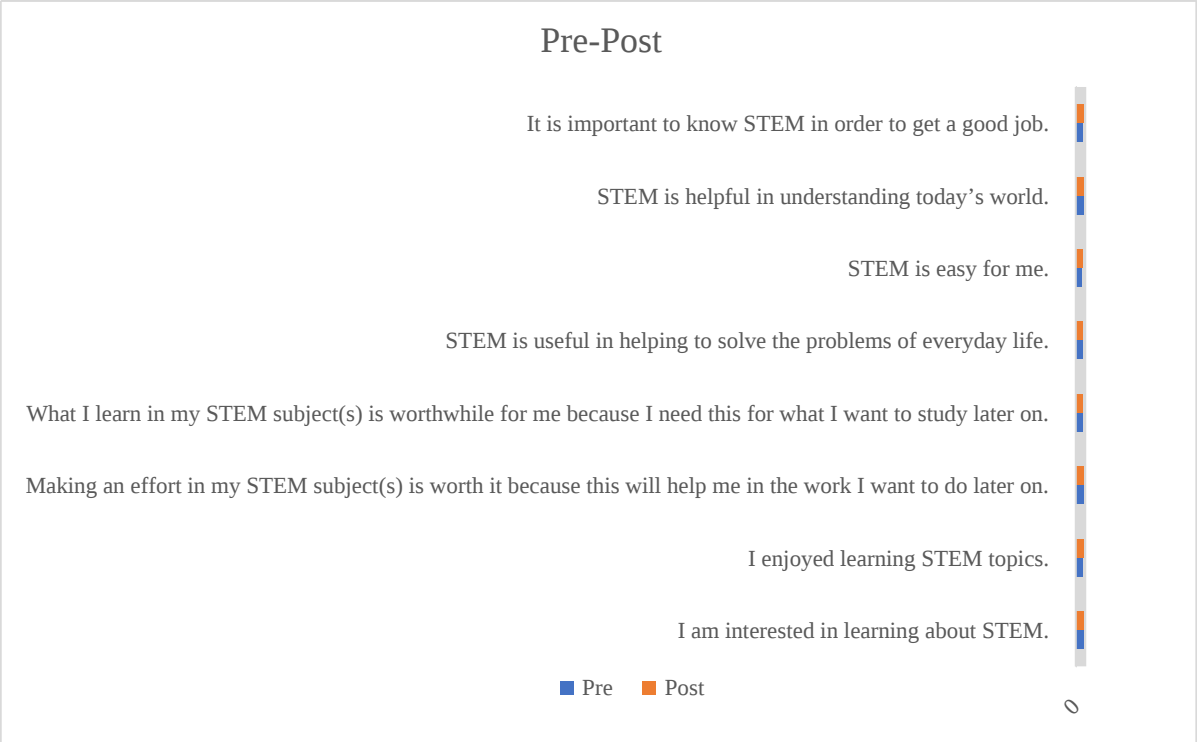
Girls' answers on their career aspirations vary widely. Girls answered that they would like to become an astronomer, a medical doctor, a photographer, a biologist, a criminologist, a computer programmer, an architect, a financier and a pilot. Natural sciences and creative fields were the most frequently mentioned.

Comparison of students' attitudes towards STEM

Table 1 shows the girls' responses on their interest in STEM. We can see that girls' interest in STEM has increased after the summer school.

Table 1	**Pre**	**Post**
I am interested in learning about STEM.	4	4,5
I enjoyed learning STEM topics.	3,6	4,5
Making an effort in my STEM subject(s) is worth it because this will help me in the work I want to do later on.	4,1	4,0
What I learn in my STEM subject(s) is worthwhile for me because I need this for what I want to study later on.	3,8	3,8
STEM is useful in helping to solve the problems of everyday life.	3,6	3,8
STEM is easy for me.	3,2	3,4
STEM is helpful in understanding today's world.	4	4,3
It is important to know STEM in order to get a good job.	3,5	4,0

Here we can see how girls' attitudes towards STEM changed after summer school. It is clear that girls' attitudes towards STEM have become stronger, with a higher proportion of girls believing that STEM helps them to solve problems in everyday life and to understand the world better.



These are the most typical answers from the summer school participants about the school and its activities:

"Interesting, you can learn a lot about Stem and programming";
"The summer school could be longer, like 10 days";
"Because you can learn more about technology and make new friends";
"I liked drawing with 3D stickers and glue the most, I haven't tried to draw with them before, it was fun to try;"

"I enjoyed making the model. It was difficult at first, but then it became clearer and more interesting. I was very happy with the result";
"I liked the VIVISTOP classes. There were lots of different tools to create, you could fantasize".

11. Lessons learnt

If possible, organise a direct selection of participants, interview them and find out why they applied for the summer school. We believe this would help avoid situations where parents fill in the online registration form for the girls. We have had cases where girls had no motivation to start school and only attended because their parents registered them. Some girls were interested and got involved. Unfortunately, there were cases where girls felt out of place.

We should spend more time on presenting mini-projects. Although the atmosphere in the school is really friendly, the girls were excited to present their projects. Perhaps a more relaxed, informal

environment is needed. The format of the presentation could be not a presentation, but a conversation, sharing of lessons learned, for example an idea club, a wrap-up discussion.

12. Recommendations related to the organization of out of school events for girls

We would like to organise summer schools in other Lithuanian cities. The biggest challenge is to find sponsors - entrepreneurs, STEM companies, the Ministry of Education, Science and Sports - who could cover at least half of the summer school budget. We should find a school in a Lithuanian city that has all the necessary infrastructure - from computer labs to accommodation for the summer school participants.

13. Photos and other evidence

(Include here)

GEM Summer Camp 2022 – Malta

1. The Context

Education in Malta is compulsory from ages five to sixteen years. Compulsory education covers six years of primary education followed by five years of secondary education. Education is free in all state schools. Apart from state schools, parents may opt to educate their children in Church or Independent schools. Education in Church schools is also free whereas Independent schools are fee paying schools.

State and Independent schools are co-educational while most Church schools cater either for boys or girls.

All schools are required by law to follow the National Curriculum framework (NCF, 2012). The NCF identifies a list of specific Learning areas for the Primary years which include Languages, Mathematics, Science, Technology Education, Health Education, Physical Education and Sports, Personal, Social and Health Education, Religious Education/Ethics, Citizenship and Arts Education.

Following their primary education, students proceed to secondary education at eleven years of age. In state schools students are grouped by academic ability into different sets for the three core subjects (Maltese, English and Mathematics). For other subjects classes are mixed ability. During the first two years of secondary education students usually study integrated science and ICT apart from the three core subjects and a number of other compulsory subjects. Towards the end of their second year of secondary education students choose two additional optional subjects which are then studied together with the compulsory subjects during the final three years of secondary education. During the last three years of secondary education, students are required to study at least one science subject which replaces integrated science. Most schools offer physics as a compulsory subject. Some church schools and independent schools allow students to decide which science subject to choose as the compulsory science subject from biology, chemistry and physics. When students choose their two elective subjects at the end of the second year of secondary school, they may opt for an additional two science subjects. Examinations taken at age 16 determine progression into post-secondary institutions. Students who wish to pursue a STEM subject at post-secondary level normally would have studied that subject at secondary level. (https://eacea.ec.europa.eu/national-policies/eurydice/content/organisation-education-system-and-its-structure-49_en)

2. Recruitment

Together with the National GEM Team (an advisory group made up of teachers, a policy maker responsible for STEM subjects, a person with experience in running science-related activities for girls, and a person who owns a business related to ICT) the University team agreed that it was best to organise the summer camp for girls who had finished their first year at secondary school since during the following year they would make their subject choice for the remaining years at school. In this way, the summer camp experience may encourage some of the girls to choose science subjects.

When planning the summer camp for summer 2022 it was decided that all schools in Malta and Gozo would be contacted and invited to participate. First, a letter with information about the project and the GEM summer camp, was sent to the Director for Learning and Assessment Programmes within the Ministry of Education. The director is responsible for all schools in Malta and Gozo irrespective of whether they are State, Church or Independent schools. The Director supported the idea and helped in the recruitment process. We prepared an information letter for schools and an attractive electronic poster. Once the dates of the summer camp were decided, the information letter and the poster were sent to all schools in Malta and Gozo by the Director for Learning and Assessment Programmes. Through this information letter we invited girls to participate in the Girls4STEM week. Their parents were invited to register their interest by filling in an electronic form. When schools received the information letter, they forwarded the advertising material to the parents/guardians of their students.

An online information meeting for parents and participants was held on the 14th June 2022 in the evening.

This recruitment campaign was very successful and 80 girls applied to join the summer camp. The first 65 who applied were allowed to join. This selection method was chosen after lengthy considerations of pros and cons. It was decided that this was the fairest and most transparent method of selection in the local context.

After the initial registration of interest, parents were asked to fill and sign consent forms for data collection and photography. Students were asked to fill and sign an assent form for data collection. Information letters for parents and students, consent forms and assent forms in English and Maltese are presented as an appendix to this report.

The poster used to advertise the event

3. Summer camp support site

A summer camp support site was prepared. This consisted of information about the project and summer camp on the website of the Faculty of Education of the University of Malta. For more information people were invited to send an email to the University of Malta GEM team. Although this site was available, in our case, the direct contact with the schools through the circular issued by the Director for Learning and Assessment Programmes proved to be the best recruitment tool. Link to the summer camp support site https://www.um.edu.mt/educ/ourresearch/gem

4. The Plan

The learning plan was meant to provide an opportunity for girls to experience STEM in its entirety and to stimulate and motivate girls to STEM. The plan included a spectrum of STEM related activities and all areas of STEM were addressed.

The sessions were held from Monday 12th September to Friday 16th September at the University of Malta with the exception of Wednesday when participants were taken on a trip to ESPLORA, an interactive science centre. Each day started at 9.00 am and ended at around 1.30 pm.

The activities were coordinated by female STEM professionals from various fields and were planned in a way that most sessions could be held with small groups of students at a time, with stand-alone activities that could be alternated. All activities included hands-on interactive sessions and presentations.

Throughout the summer camp students worked in a group of around 6 to 7 students accompanied by a young female mentor. Ten such groups followed an activity at any particular time of the camp. The students worked within the same small group for the whole duration of the summer camp.

(a) Pedagogy

The constructivist approach to teaching and learning science was the underlying philosophy. The overall pedagogy employed during these sessions focussed on students' engagement and a strong element of enjoyment. In a general manner, a 'hands-on' style of learning allowed students to grasp some abstract ideas being presented during the sessions. Students were engaged in the thinking process and inquiry-based learning provided students with opportunities to work together, plan, think and discuss. For typical examples of how the participants were engaged in the activities, one can refer to the sessions on medical diagnosis and the electromagnetics. Students also worked on an environment-related inquiry in a valley bordering with the university campus. The element of fun present throughout the sessions was accentuated when students visited ESPLORA. During this visit, the 'wow' factor was evident and greatly appreciated by the participants.

(b) Focus on entrepreneurship

The female entrepreneur leading this session started off by explaining the key words related to the area. She then shared life experiences related to her career. Finally she went on to ask the students to work in groups and prepare a business plan for a project based on what they like doing. The ideas presented provided evidence of a high dose of creativity and ingenuity. Furthermore, most participants showed strong initiative and flair when it came to marketing their product.

(c) Technology

One session focussed mostly on students making use of technology. In the session students were asked to make use of simple coding activities using a micro bit and worked in groups to design their own flashing designs. This activity allowed participants to experience technology in a direct and practical manner and to enhance their computational thinking skills. During the week students also used technology to prepare a power-point presentation.

5. The learning plan for the summer camp

Overall, throughout the Girls4STEM Week, 65 participants worked in small groups of 6 to 7 students at a time. Throughout the week, these were accompanied by a young female mentor. The activities were planned and coordinated by STEM professionals. The students worked within the same group for the whole duration of the summer camp.

During the week, girls worked on an inquiry-based investigation linked to an environment-related issue on the University Campus. They worked in groups to collect data, analyse, discuss and come up with solutions related to the issue.

Day 1 – Monday 12th September 2022 at the University of Malta

Activity 1 (1 hour 15 mins) – Electromagnetics in medical diagnosis and treatment

Activity 2 (1 hour 15 mins) – Science in the investigation and preservation of Malta's national cultural heritage

<table>
<tr><th></th><th>09:00 – 10:15</th><th>10:30 - 11:45</th><th>12:15 – 13:30</th></tr>
<tr><td>Group 1</td><td rowspan="2">Introduction
Pre-Questionnaire
Ice-breaker
activities in small
groups</td><td>Activity 1</td><td>Activity 2</td></tr>
<tr><td>Group 2</td><td>Activity 2</td><td>Activity 1</td></tr>
</table>

Activity 1 – Electromagnetics in medical diagnosis and treatment

In this workshop, Dr Lourdes Farrugia guided the participants in getting a basic understanding of electromagnetic fields through hands-on activities related to magnets and magnetic fields. The scientist used these activities as a springboard to talk about her research related to the use of electromagnetic radiation in medical diagnostic and therapeutic treatment.

Activity 2 – Science in the investigation and preservation of Malta's national cultural heritage.

The session was led by Ms Roslyn DeBattista from the Diagnostic Science laboratories (DSL) of Heritage Malta.The DSL are dedicated to the scientific investigation and preservation of Malta's national cultural heritage collection. The DSL provide the necessary scientific support 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 activity focussed 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.

Day 2 – Tuesday 13th September 2022 at the University of Malta

	09:00 – 10:15	**10:30 – 11:45**	**12:15 – 13:30**
In Groups	Investigation: Introduction	Investigation: Planning	Investigation: Gathering Data

Investigation – The inquiry started off with a meeting with Ms Tamsin Caruana, manager of Wied Għollieqa (valley) and Ms Davinia Shead from Wasteserv Malta. Ms Caruana spoke about the valley, and the challenges encountered in managing it. Ms Shead spoke about litter and how this can be reduced. The students then worked in small groups on an investigation related to the environment. Together they planned what they were going to do and then went out to collect data/carry out observations on campus and in Wied Għollieqa. This is a valley found on the university campus. The investigation focussed on an environment-related issue and was done using an inquiry-based pedagogy. The small groups collected data from the valley, analysed it, discussed the findings and came up with solutions related to the issue.

Day 3 – Wednesday 14th September 2022 at the Esplora Interactive Science Centre

Activity 3 – NASA's Moon Survival Challenge

Activity 4 – Catch them young

Science show - Take Off!

	09:00 – 10:00		10:15 – 11:00		11:45 – 12:45
Group 1	Activity 3	Break	Show	Break	Activity 4
Group 2	Activity 4				Activity 3

Activity 3 – NASA's Moon Survival Challenge

Participants were invited to engage with this experience: *Oh no! Your spacecraft experienced mechanical difficulties and you've been forced to land on the moon. Your only chance of survival is to hike 320km across the moon to the mother ship and you can only carry 15 essential items. Do you have what it takes to survive on the moon? This experiential learning activity was not only a great team-building activity, but a great way of applying STEM knowledge and skills to the problem at hand.*

Activity 4 – Catch them young In this workshop participants were asked - *Are you curious and creative? Do you love solving problems? Are you fascinated with the world around you? Then join us in our quest to inspire the next generation into STEM! But what does a scientist look like and what does it take to become one? In this workshop, students explored stereotypes in STEM and the skills which STEM professionals need, to carry out their amazing work.*

Day 4 – Thursday 15th September 2022 at the University of Malta

Activity 5 – Entrepreneurship

Activity 6 – Health

	09:00 – 10:15	10:30 – 11:45	12:15 – 13:30
Group 1	Investigation: Data Analysis	Activity 5	Activity 6
Group 2		Activity 6	Activity 5

Activity 5 – Entrepreneurship

The main aim of this session, led by Dr Leonie Baldacchino was to invite students to consider entrepreneurship as a viable career option. The session included an introduction to entrepreneurship, an interactive discussion about the advantages of being one's own boss, and examples of female business founders.

Reference was also made to intrapreneurship and to the importance of developing an entrepreneurial mindset, which will enhance participants' future prospects not only if they aspire to start up their own business, but also if they wish to build a rewarding career within a successful organisation.

Activity 6 – Health

The session was led by a young female radiographer. Ms Maria Mangion talked about her work related to medical imaging and how science helps us learn about medical conditions. Through Activity 6 she introduced students to health-related professions. During her workshop students learned about the human skeleton and worked on a number of case studies.

Friday 16th September 2022 at the University of Malta

Activity 7 – Coding

	09:00 – 10:15	10:30 – 11.45	12:15 – 13:00	13:00 – 13:30
Group 1	Activity 7	Investigation: Preparing a presentation	Investigation: Presentation of Investigations	Conclusion + Post Questionnaire
Group 2	Investigation: Preparing a presentation	Activity 7		

Activity 7 – Coding

Participants conducted simple coding activities using a micro:bit aimed at enhancing their computational thinking skills. Participants also worked in teams to design and prototype their own flashing designs, through an inquiry-based and exploratory learning approach.

6. Learning Outcomes

The general learning outcomes of the GEM project were taken as the overall learning outcomes of the GEM summer camp. Then each activity had a series of learning outcomes derived from the general learning outcomes. The general learning outcomes were:

- Girls will have increased interest in STEM/digital disciplines
- Girls will become aware of their own potential
- Girls will be enabled to perform successfully in STEM/digital disciplines
- Girls will be encouraged to study or pursue careers in STEM/digital sectors
- Girls will have the confidence to consider leadership positions in STEM/digital sectors
- Girls will have an enhanced employability with regards to STEM/digital labour markets
- Girls will want to know more about STEM
- Girls will want to be involved in STEM

7. Mentors

Throughout the summer camp students worked in small groups accompanied by a young female mentor. These mentors were recruited by issuing a call for applications. Applicants were required to be females with a science or ICT background. Experience in formal or non-formal education settings was considered to be an asset.

The applicants' CVs were considered and those with the right requirements were shortlisted.

The mentors involved in the 2022 GEM summer camp were:

- one Physics teacher with experience in STEM activities for girls in non-formal education settings.
- one Biology teacher with experience of teaching Year 7 students.
- one graduate with a BSc in Biology and enrolled in the Master in Teaching and Learning course.
- one graduate with a BSc in Science for Education and Communication.
- two students following the BSc in Science for Education and Communication course.
- two students following a BSc with specialisation in Physics course with experience running
- out-of-school activities for students.
- one student following a course leading to a degree in Electrical Engineering, with experience of running out-of-school activities for students.
- one graduate of a teacher training programme specialising in Ecology with experience in outdoor learning and in designing educational interactive trails.

Mentors were required to attend for two training sessions. The first session (1.5 hours) was an introduction to the GEM project and the learning plan. The second training session (6.5 hours) was divided in three parts, the first part was related to leading groups during the GEM summer camps, the IBL pedagogy and the activities involved. The second part was dedicated to leading a session on computational thinking and coding. The third part was a site visit to Wied Ghollieqa, the valley where girls carried out environment-related investigations.

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GEM project Call for Mentors to lead students participating in a Girls4STEM week

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In Projects 11:07, 01 Jul 2022

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The Department of Mathematics & Science Education (Faculty of Education), within the University of Malta is currently participating in the GEM Project, an EU project, financed by the DG Communication Programme of 2019.

The project aims to inspire and enable Europe's girls to tap their STEM, digital and entrepreneurial potential.
For the purposes of this project, the University requires the services of **female** mentors.

Applicants applying for this opportunity must:

- be individuals either possessing a B. Ed. (Hons.)/B. Sc. (Hons.) or equivalent, or are currently following a degree course in a STEM/ICT subject
- have experience in teaching/leading groups even in the non-formal sector
- be of sound moral character
- be in possession of a recent clean police conduct certificate
- be in possession of a valid VAT number, or willing to apply for it

The services of Mentors will be required for events taking place between Monday 12 and Friday 16 September 2022 (between 08:30 and 13.30). Remuneration will be at the rate of EUR10.00 (incl. VAT – if applicable) per hour. The selected candidates will also be required to attend training sessions.

The payment by the University of Malta will be made upon completion of the commissioned tasks and duties, against the provision of VAT receipts by the same candidate.

Mentors will be expected to work according to the needs of the project.

Candidates must submit their letter of application, a copy of their curriculum vitae, a scanned copy of their certificates and a scanned copy of a recent Police Conduct Certificate by email **by not later than 7 July 2022.**

Late applications will not be considered.

See More

UM delegation attends PRIME-VR2 project meeting and conference
PROJECTS
11:18, 24 Oct 2022

Project Meeting for Erasmus Project BLISS
PROJECTS
16:03, 20 Oct 2022

University of Malta and Orthopaedic Centre Malta develop a new prosthetic hand prototype
PROJECTS
08:42, 19 Oct 2022

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The call for applications for mentors

8. Evaluation data collection

The evaluation was planned via the pre- and post- student questionnaires and a questionnaire for the mentors. The questionnaires were given in English since students are familiar with the use of the language at school.

Ethics clearance was obtained from the Faculty of Education Ethics Committee.
Once clearance was obtained, information letters and consent forms were sent to parents who registered their interest in the event. Once parents gave their consent for their daughters to fill in the questionnaires, the students were sent an information letter and were asked to give their assent.

In these letters, students and parents were informed that participation is voluntary and that when filling in the questionnaires, students will be asked not to write their names and they may choose not to complete them. Furthermore, the questionnaires were to be coded and the identity of the school was not requested. Participants were reassured that raw data would be securely stored and the data obtained would be solely used for the compilation of the research.

The pre-questionnaire was given to students as the first activity of the summer camp, while the post-questionnaire was the last activity. Mentors were asked to fill in a questionnaire giving their views and feedback after the summer camp.

9. Challenges encountered

The camp attracted a good number of students from all over Malta. Around 80 students wished to participate in this summer camp. This provided a dilemma for the organisers as due to logistical reasons the number of places were limited. This type of response is indicative of the need for such events and is an encouraging factor.

Another challenge encountered was financial in nature. Remunerating the mentors and buying the materials needed, proved to be expensive while the budget was limited. Where possible we tried to use inexpensive things, borrowed some materials and looked for sponsorships. Even so we were unable to cover the cost of lunches for the students except for the lunch at the Esplora interactive centre which was sponsored.

The field work at Wied Ghollieqa valley involved two major concerns. The first was the fact that participants needed to collect data in hot sunny weather. Participants were asked to get with them appropriate clothing to protect them from the heat and the sun. Furthermore, they were asked to get lotions and mosquito repellents. Secondly, during an exploratory visit of the valley made by the valley manager, organisers and the mentors some parts of the valley were deemed dangerous for the students. Keeping in mind that 65, 11 year-old participants were involved in this investigation, the organisers decided that these were no-go areas and students were not allowed to go in these areas.

10. Other

Maybe, the greatest challenge of all involves the need to continue with these camps in the coming years. This has been a preoccupation of the camp organisers from day one, especially when experiencing the need for such event and the positive effect on the participants. This has prompted the organisers to meet up with interested stakeholders such as the education officers of state schools to identify ways and means of keeping this yearly activity going. The future seems bright as now we already have a prototype of how it could be organised.

11. Evaluation of the summer camp

(a) Quantitative

A total of 65 female students participated in the Girls 4 STEM Week. Out of these, 60 completed the pre-questionnaire. These consisted of 11 and 12-year-old girls. Table 1 shows the STEM subjects studied at school.

Table 1: Percentage of students studying STEM subjects at school

Subject	Percentage of students studying the subject
Biology	13.24%
Chemistry	13.24%
Computing or IT	88.24%
Engineering	5.88%
Integrated Science	86.76%
Mathematics	88.24%
Physics	13.24%
Technology	54.41%

Their career aspirations vary, both within STEM and beyond. With regard to STEM careers, students mentioned doctor, dentist and architect, engineer and biologist, among others, whilst a number of students are interested in careers related to law, beauty and graphic design. Only 5 students (0.08%) stated that they are not sure which job they will be interested to take up in the future.

The feelings of students about STEM subjects are generally positive. Table 2 illustrates the feelings of students (from 1 which is ‘means nothing’ to 7 which is ‘means a lot’) for the different STEM subjects.

Table 2: Feelings of students about the different STEM subjects

Subject	1	2	3	4	5	6	7
Science	0.00%	0.00%	0.00%	11.76%	16.18%	16.18%	44.12%
Mathematics	0.00%	1.47%	1.47%	8.82%	16.18%	19.12%	41.18%
Biology	5.88%	0.00%	0.00%	2.94%	10.29%	5.88%	33.82%
Chemistry	5.88%	0.00%	0.00%	2.94%	7.35%	8.82%	33.82%
Physics	5.88%	0.00%	0.00%	2.94%	8.82%	8.82%	32.35%

The interest of students in STEM subjects is also generally positive. Table 3 illustrates the interest of students (from 1 which means 'is boring' to 7 which means 'is interesting') in the different STEM subjects.

Table 3: Interest of students in the different STEM subjects

Subject	1	2	3	4	5	6	7
Science	0.00%	0.00%	2.94%	5.88%	11.76%	25.00%	42.65%
Mathematics	2.94%	2.94%	13.24%	13.24%	16.18%	19.12%	20.59%
Biology	8.82%	0.00%	1.47%	10.29%	5.88%	11.76%	48.53%
Chemistry	8.82%	0.00%	0.00%	11.76%	2.94%	16.18%	47.06%
Physics	8.82%	0.00%	1.47%	10.29%	2.94%	17.65%	45.59%

Overall, more than 75% of students consider furthering their studies in STEM as fascinating (Figure 1) and appealing (Figure 2).

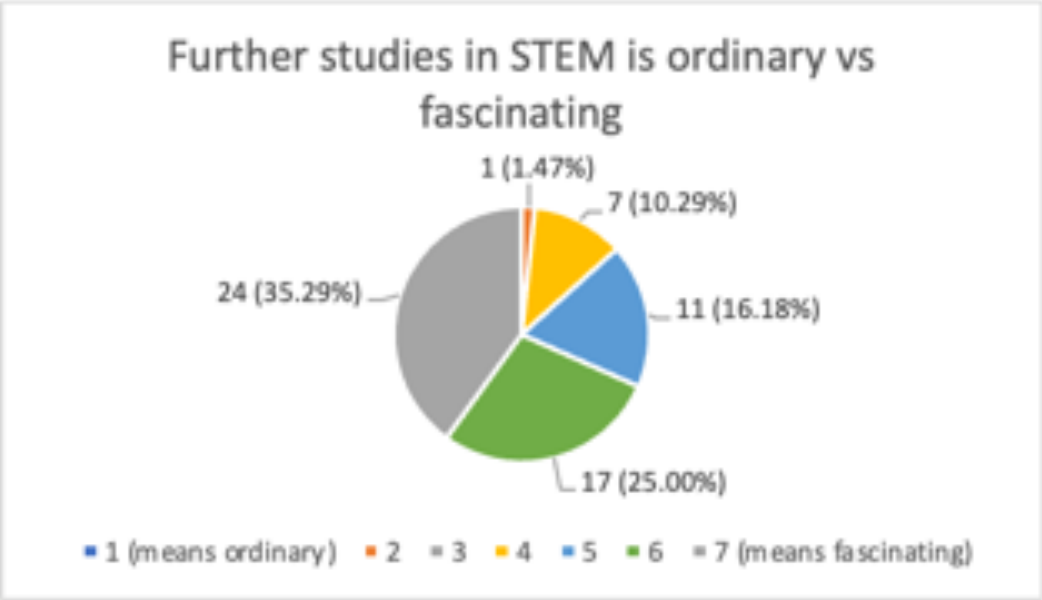

Figure 1: Continuing studies in STEM as 'ordinary' vs 'fascinating'

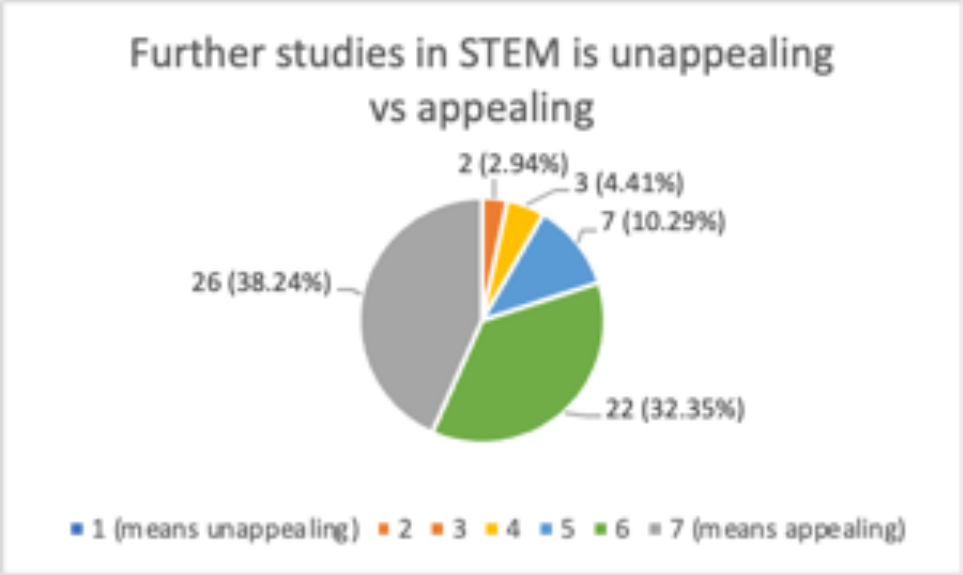

Figure 2: Continuing studies in STEM as 'unappealing' vs 'appealing'

Generally, the students' feelings about STEM subjects is quite positive. The majority of students confirmed agreement (either agreed or strongly agreed) to all statements, as illustrated in Table 4.

Table 4: Students' feeling about STEM subjects (pre-Girls 4 STEM Week)

Statements	SD*	D*	N*	A*	SA*
I am interested in learning about STEM	0.00%	2.94%	2.94%	41.18%	41.18%
I generally have fun when I am learning STEM topics	0.00%	0.00%	11.76%	41.18%	35.29%
Making an effort in my STEM subject(s) is worth it because this will help me in the work I want to do later on	0.00%	1.47%	13.24%	20.59%	52.94%
What I learn in my STEM subject(s) is worthwhile for me because I need this for what I want to study later on	0.00%	1.47%	14.71%	32.35%	39.71%
STEM is useful in helping to solve the problems of everyday life	0.00%	1.47%	16.18%	50.00%	20.59%
STEM is easy for me	0.00%	5.88%	32.35%	33.82%	16.18%
STEM is helpful in understanding today's world	0.00%	0.00%	4.41%	35.29%	48.53%
It is important to know STEM in order to get a good job	0.00%	2.94%	27.94%	30.88%	26.47%

**SD denotes Strongly Disagree, D denotes Disagree, N denotes Neither Agree nor Disagree, A denotes Agree and SA denotes Strongly Agree*

A total of 62 students completed the post Girls 4 STEM Week questionnaire. In general their feelings regarding the identified outcomes for the camp are quite positive, as illustrated in Table 5. Most notably, nearly all students (87.10%) are aware of gender stereotypes and the vast majority are ready to engage in science (83.87%).

Table 5: Students' feelings about the Girls 4 STEM Week outcomes

Statements	SD*	D*	N*	A*	SA*
I can mention ICT-related uses and applications	1.61%	0.00%	16.13%	62.90%	14.52%
I am aware of gender stereotypes	3.23%	0.00%	4.84%	27.42%	59.68%
I am aware of the relevance of digital technologies in my life	1.61%	1.61%	4.84%	37.10%	50.00%
I am ready to engage in science	1.61%	0.00%	9.68%	27.42%	56.45%
I am ready to engage in ICT	1.61%	6.45%	11.29%	40.32%	35.48%
I can imagine myself working in a science-related job	3.23%	6.45%	22.58%	20.97%	41.94%
I can imagine myself working in an ICT-related job	3.23%	17.74%	32.26%	30.65%	11.29%

**SD denotes Strongly Disagree, D denotes Disagree, N denotes Neither Agree nor Disagree, A denotes Agree and SA denotes Strongly Agree*

With regard to the students' feelings about STEM subjects, as previously attested through the pre-questionnaire, the majority of students, again confirmed agreement (either agreed or strongly agreed) to all statements, as illustrated in Table 6.

Table 6: Students' feeling about STEM subjects (post-Girls 4 STEM Week)

Statements	SD*	D*	N*	A*	SA*
I am interested in learning about STEM	1.61%	0.00%	4.84%	25.81%	62.90%
I enjoyed learning STEM topics.	1.61%	0.00%	3.23%	24.19%	66.13%
Making an effort in my STEM subject(s) is worth it because this will help me in the work I want to do later on.	1.61%	3.23%	8.06%	17.74%	62.90%
What I learn in my STEM subject(s) is worthwhile for me because I need this for what I want to study later on.	1.61%	4.84%	11.29%	17.74%	59.68%
STEM is useful in helping to solve the problems of everyday life.	1.61%	1.61%	16.13%	35.48%	40.32%
STEM is easy for me.	0.00%	4.84%	22.58%	46.77%	20.97%
STEM is helpful in understanding today's world.	1.61%	0.00%	8.06%	20.97%	64.52%
It is important to know STEM in order to get a good job.	3.23%	6.45%	27.42%	25.81%	32.26%

**SD denotes Strongly Disagree, D denotes Disagree, N denotes Neither Agree nor Disagree, A denotes Agree and SA denotes Strongly Agree*

In terms of preparation for the Girls 4 STEM Week, 40.32% of students learned about the event from a school advertisement, while 25.81% from their parents, 12.90% were recommended by a school teacher, 9.68% from friends and 6.45% through social media. The majority of students (56.45%) participated as they are interested in Science. All students enjoyed the Girls 4 STEM Week to some extent, with 82.26% almost always enjoying the programme, while 8.06% enjoying the activities most of the times. Students generally felt comfortable during the summer camp, with 74.19% almost always, 16.13% most of the times and 4.84% sometimes.

In terms of the impact of the Girls 4 STEM Week on the students' perception of Science, the programme yielded an overall positive effect, as shown in Figure 3.

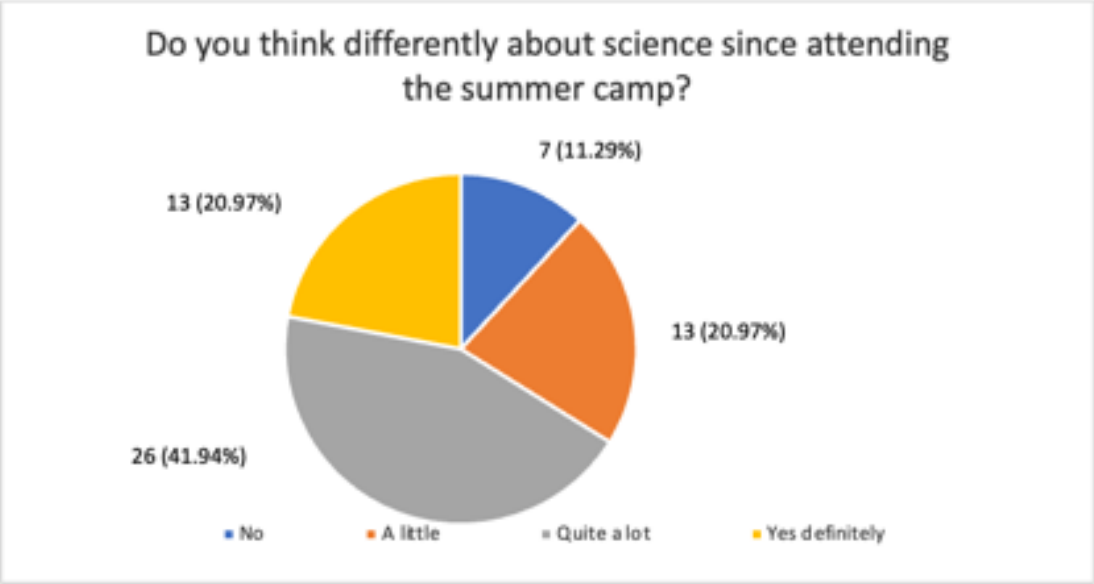

Figure 3: Students' perception of Science following the Girls 4 STEM Week

A selected sample of feedback received from the students, who think differently about Science since attending the Girls 4 STEM Week, is listed in Table 7.

Table 7: Students' positive change in feeling about Science after attending the Girls 4 STEM Week

"some things i didn't know about science and coming here made me know more and its quite fun in my opinion"
"I was interested in science and stem subject but since I was attending the summer camp I realized how much more fascinating science is"
"Yes because we learned Science in a fun and creative way"
"Yes, I realized how important science is for the real world and that it helps solve problems"
"At first i would say that science is hard and it would be hard to work on a science related job but now i have motivation to work on a science related job"
"how STEM related jobs can help a lot of people and I also learned that girls can be great at all STEM subjects"
"I learned about various science careers in depth which i wouldn't have learned about in school"
"now i understand that there are more things in life to be in the future that needs science"
"In this summer camp I realized there is so many different sciences that they don't teach at school"
"The summer camp showed me how science also has a fun side"
"Throughout this camp I really enjoyed making new friends. Science gave me a new picture after this course. This also thought me deeper on my passion for STEM. I hope this course will happen again. Make more courses since I love them. STEM4girls!"

With regard to the most and least favourite activities, it appears that no activity can be singled out as the most or least preferred amongst students. All activities were mentioned as being the most favourite by individual students; mostly due to their challenging nature and relation to the future career prospects, but mainly because the sessions were fun. In terms of the least favourites, most students could not identify one. When they could identify an activity, the reason they gave was the lack of interaction or due to the session not being fun. A selected sample of feedback received from the students is shown in Table 8.

Table 8: Students' most and least favourite activities

Activity	Most/Least Favourite	Feedback
Activity 1 – Electromagnetics in medical diagnosis and treatment	Most Favourite	*"The physics magnetism lesson was extremely interesting. I had learnt about magnetism and magnets in primary school, but I found it very engaging and fun when I could play and experiment hands on with the magnets"* *"Magnetic and non-magnetic lesson. It was very fun and interesting! It was also i topic i really enjoy in physics since I loved how when you dropped the big magnet it floated and how the iron makes a spiky shape when near magnets"*
	Least Favourite	
Activity 2 – Entrepreneurship	Most Favourite	*"The be the boss lesson was extremely motivating for me , and I saw many more options for my future life. I loved this camp, not only because it was fun, but I learnt so much things, life lessons and educational subjects"*
	Least Favourite	*"the Entrepreneurial talk because i am not into opening a business on my own and be my own boss"*
Activity 3 – Preservation and restoration of cultural heritage	Most Favourite	*"The in-depth lectures about many different topics which helped me finalize my choice to have a career in STEM"*
	Least Favourite	*"The one which involved x-rays on the first day. We had to identify the difference between two photos and I didn't enjoy it so much in fact, I found it quite boring"* *"The art restoration because we didn't have any activities"*
Activity 4 – ESPLORA Interactive Science Centre	Most Favourite	*"Esplora, since it was very fun and interesting and I learned a lot"* *"My favorite activity was the outing to Esplora."*
	Least Favourite	

Activity 5 – Health and wellbeing	Most Favourite	*"i liked all of them but the most one that I liked was the radiography"* *"my favorite was the lesson about Radiographers because by hearing the teacher explaining her job i was amazed and then i knew i wanted to be a Radiographer"*
	Least Favourite	
Activity 6 – Coding	Most Favourite	*"The Micro bit (last day) because I never experienced a Micro bit so i really enjoyed it!"* *"My favorite part was when we used the micro bit as I had never used one before and i found it quite fun."* *"I enjoyed programming on the last day because we got to code a robot"*
	Least Favourite	
Throughout the week - Investigation	Most Favourite	*"i enjoyed most in Wied ghollieqa because it was interesting and fun"* *"I loved the soil sample activity mostly. I enjoyed walking in the valley"* *"The pollution plate, showed us how polluted the air was"* *"My favourite summer camp activity was when we were working on the presentation for the last day because we laughed a lot and we worked together"* *"making the project of our discovery because it was very fun and i really like projects which include sharing my discoveries"*
	Least Favourite	*"the power point presentation because i dont really like public speaking"* *"My least favourite activity would be when we were testing the soil PH because I don't really enjoy touching soil and dirt"*

Moreover, all students would recommend the Girls 4 STEM Week to others, as illustrated in Figure 4. This was mainly due to the programme being interesting, fun and useful. In terms of suggestions for improvement, in general, students propose a longer programme (lasting more than a week) in order to include more hands-on activities and less presentations.

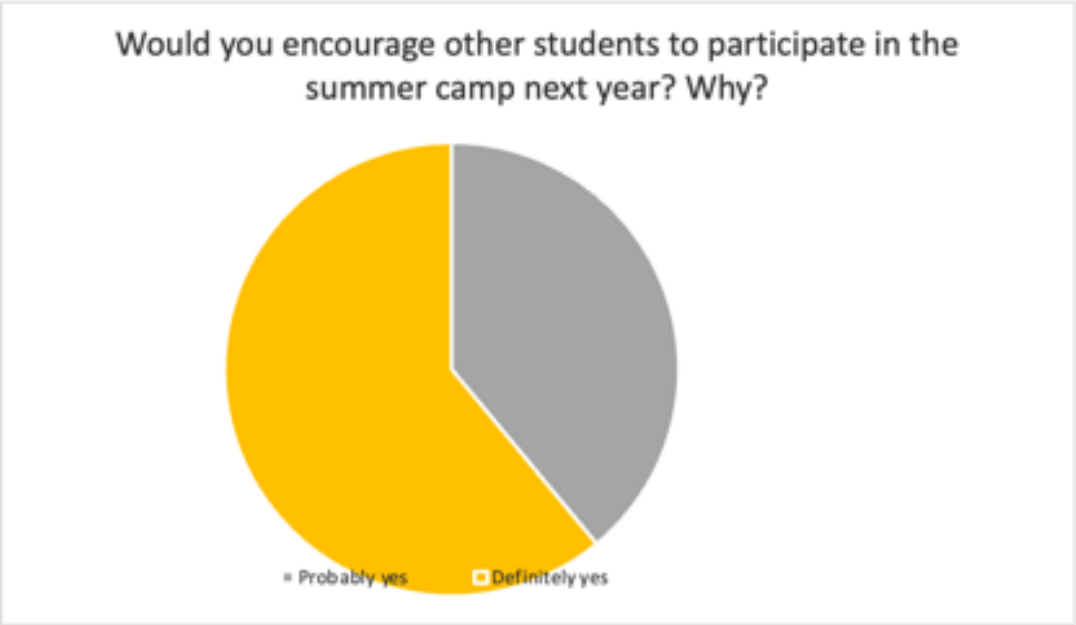

Figure 4: Encouraging other students to participate in the Girls 4 STEM Week

(b) Qualitative

Based on the feedback received from a range of stakeholders (including students, parents and organisers) the below good practices emerged:

- activities which motivate and engage the students ("*I would like to thank you for providing such an enriching experience to our daughters. My daughter was really motivated and curious about this experience*" – Parent 1 and *"My daughter was totally engaged and enthralled by the programme and has been talking about it constantly"* – Parent 2)

- activities which draw upon the connection between STEM subjects and life/careers/etc. (*"Such a positive experience will definitely remain throughout her life and will help her to build deeper connections with STEM subjects"* - Parent 3 and "*My daughter was reflecting on how STEM is present and evident in our everyday lives and how different areas/subjects interconnect. It was truly an empowering experience!*" - Parent 4)

- activities which involve hands-on experiences ("*You managed to provide the students with an experience to witness Science at first hand. In this way STEM subjects do not remain as alien subjects but are seen as a dynamic product*" – Parent 5 and "*I believe that the Girls4STEM Week has given participants an excellent opportunity to live, breathe and explore STEM through a hands-*

on inquiry-based approach, which enabled them to be immersed in on-going activities aimed at enhancing their knowledge and appreciation of STEM", Organiser)

Furthermore, the below practices could be improved:
- shorter presentations and more time for hands-on experiences (*"Doing less presentations which are inside as it gets very boring"* - Participant and *"Less talks and more activities"* - Participant)

- inclusion of more outdoor-based activities (*"The 'lectures' could have had been outdoors"*, - Participant and "Being more out doors" - Participant)

- inclusion of STEM-based competitions (*"A fun and scientific competition"* - Participant and *"i think i would add some more ideas like we do a treasure hunt because i would really like that"* - Participant and *"An escape room with mathematical questions"* - Participant)

Overall, students thoroughly enjoyed the activities, the organisation and outcomes of the Girls 4 STEM Week ("*We want more. Please do one next year for Year 8 and then Year 9*" - Participant)

12. Lessons learnt

Below are important considerations learnt from the organisation of the Girls 4 STEM Week:

- Hands-on activities: Girls are more motivated and engaged during activities during which they are actively doing something rather than passively listening to speakers or presentations. Therefore it is very important to include inquiry-based hands-on experiences which allow girls to explore, tinker and be creative.

- Experienced role models: Girls need to see women who are currently working in STEM careers as relatable role models in order to believe that they can also achieve their dreams. It is important to have a good mix of senior and junior role models (mentors) so that girls can feel supported at all stages of their journey.

- A supportive environment: Girls need to feel safe and supported in order to take risks and experiment. Creating an inclusive and welcoming environment is crucial in order to engage girls in STEM activities. The role of the mentors is therefore crucial to the success of the progamme.

- Fun: It is important to make sure that the activities are enjoyable and engaging so that girls continue to be interested in STEM. Making the activities relevant to their everyday lives can be a great way to make them more relatable and fun.

- Persistence: Girls need to be encouraged to persist in the face of challenges and difficulties. This can be done by emphasising the importance of grit and determination and showing girls that failure is a normal part of the learning process. Again, proper training of mentors will ensure that the participants are well-supported and empowered to succeed in STEM.

13. Recommendations related to the organization of out of school events for girls

Below are recommendations related to the organisation of out of school STEM-related events for girls:

- More events: There is a need for more events like the Girls4STEM Week so that girls can have more opportunities to explore and be exposed to STEM. These events need to be well-advertised and easily accessible so that as many girls as possible can participate.

- Continued support: It is important to provide continued support for girls even after they have participated in an event like the Girls 4 STEM Week. This could include follow-up activities, mentorship programs or online resources that girls can access.

- Funding: There is a need for more funding to support STEM-related events for girls so that they can be run on a larger scale and reach more girls. Nationwide campaigns can also be considered to help raise awareness about the importance of STEM education for girls.

- Diverse range of activities: It is important to offer a diverse range of activities at STEM-related events so that girls can find something that interests them and that they can see themselves pursuing in the future. This could include workshops, panel discussions, hands-on activities, etc.

- Promote positive role models: It is important to promote positive role models at STEM-related events so that girls can see what is possible for them if they pursue a career in STEM. This could include inviting female guest speakers, showcasing successful women in STEM fields, etc.

14. Photos and other evidence

Appendix: Information letters, consent forms and assent forms in English and in Maltese

Information Letter – Parents

14th June 2022

Dear Parent,

We are two lecturers in Science Education at the University of Malta, Faculty of Education. We are presently taking part in a research project entitled '**GEM - Empower Girls to Embrace their Digital and Entrepreneurial Potential'**. The main objective of the project is to inspire and enable Europe's girls to tap their STEM, digital and entrepreneurial potential.

In Malta, this research project will involve a week of activities organised for around sixty-five Year 7 girls from different schools. The event will be organized between the 12th and 16th September 2022 at the University campus in the mornings [9:00 hrs – 13:30 hrs] and will focus on STEM and ICT activities. These will be hands-on activities such as simple experiments and basic coding tasks. In order to evaluate the activities, we would like to obtain feedback by means of two short questionnaires given to the participating girls. The questionnaires will be distributed, one at the start and one at the end of the week. The filling in of the questionnaire will take around 15 minutes.

We would be grateful if you would give permission for your daughter to participate in this week of activities and research study by filling in the attached consent form. Participation is voluntary and assent forms will be distributed to students only once parents give consent. When filling in the questionnaire, students will be asked not to write their names on it and they may choose not to complete it. Furthermore, the questionnaires will be coded, so that even the identity of the school will be anonymised. All raw data will be securely stored and the data obtained will be solely used for the compilation of this research.

We would like to assure you that we will abide by all the ethical guidelines issued by the University Research Ethics Committee of the University of Malta throughout the course of our research. Should you require further information, please do not hesitate to contact us (please see contact details given below).

Finally, it would be greatly appreciated if you would sign the consent form included and return it to us by email on stephen.bezzina@um.edu.mt. Your cooperation in this is greatly appreciated.

Thank you for your kind consideration,

Sincerely,

Josette Farrugia

Office No: 2340 3702
Email address: josette.farrugia@um.edu.mt

Charles Bonello

Office No: 2340 3415
Email address: charles.bonello@um.edu.mt

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

Consent Form – Parents

I confirm that I have read the attached '*Information letter – Parents*' for this study and that I have had the opportunity to ask questions and discuss the study.

On the basis of the information given, I agree to give my consent to allow my daughter [INSERT HERE] _____ to participate in the week of activities organised as part of the GEM project, that Dr Josette Farrugia and Dr Charles Bonello are organizing. This will take place between the 12th and 16th September 2022 at the University campus in the mornings [9:00 hrs – 13:30 hrs]. I am aware that my daughter will also be asked to fill in two questionnaires as part of the research project.

[INSERT HERE]	[INSERT HERE]	[INSERT HERE]
Parent's name	Parent's signature	Parent's contact email

Date: [INSERT HERE]

Researcher's Signature

Researcher's Signature

Information Letter – Students

14th June 2022

Dear student,

We are two lecturers in Science Education at the University of Malta, Faculty of Education. We are presently taking part in a research project called '**GEM - Empower Girls to Embrace their Digital and Entrepreneurial Potential'**. The main objective of the project is to inspire Europe's girls about science and technology (STEM and ICT).

In Malta, this research project will involve a week of activities that will be organised for around sixty-five Year 7 girls from different schools. The event will take place between the 12th and 16th September 2022 at the University campus in the mornings [9:00 hrs – 13:30 hrs] and will focus on STEM and ICT activities.

We would be grateful if you would consider participating in this week of activities. Participation is voluntary and if you assent you will be asked to participate in activities related to STEM and ICT at the University. These activities will be held during the morning from 9.00 am to around 2.00 pm. These activities are planned to be enjoyable and engaging activities for you and should be interesting and fun.

In order to obtain feedback about the activities we will ask you to fill two short questionnaires. These questionnaires will focus mostly on your views about STEM and the activities and will require around 15 minutes to fill in.

When filling in the questionnaires, you will not be asked to write your names or the name of the school and you may choose not to complete it. All information collected will be securely stored and will be only used for this research. The two questionnaires will be distributed, one at the beginning and one at the end of the week.

Thank you for your kind consideration,

Sincerely,

Josette Farrugia

Office No: 2340 3702
Email address: josette.farrugia@um.edu.mt

Charles Bonello

Office No: 2340 3415
Email address: charles.bonello@um.edu.mt

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

Assent Form – Student

I confirm that I have read the attached '*Information letter – students*' for this study and that I have had the opportunity to ask questions and discuss the study.

On the basis of the information given, I agree that I am willing to participate in the week of activities organised as part of the GEM project, that Dr Josette Farrugia and Dr Charles Bonello are organizing between the 12th and 16th September 2022 at the University of Malta, in the mornings [9:00 hrs – 13:30 hrs]. I am also aware that I will be asked to fill in two questionnaires as part of the research project.

[INSERT HERE]	[INSERT HERE]	[INSERT HERE]
Student's name	Student's signature	Student's contact email

Date: [INSERT HERE]

Researcher's Signature

Researcher's Signature

Ittra ta' Informazzjoni - Ġenituri

14 ta’ Ġunju 2022

Għażiż Ġenitur,

Aħna żewġ letturi fit-tagħlim tax-Xjenza fl-Università ta’ Malta, Fakultà tal-Edukazzjoni. Bħalissa qed nieħdu sehem fi proġett ta' riċerka intitolat '**GEM - Empower Girls to Embrace their Digital and Entrepreneurial Potential’.** L-għan ewlieni tal-proġett huwa li jispira u jinkoraġixxi lit-tfajliet Ewropej juzaw il-potenzjal tagħhom fejn jidħlu l-oqsma STEM, diġitali u intraprenditorjali tagħhom. F’Malta, dan il-proġett ta’ riċerka se jinvolvi numru t’attivitajiet mifruxa fuq 5 t’ijiem li se jkunu organizzati għal madwar ħamsa u sittin tifla tas-sebgħa sena minn skejjel differenti. Dan ser ikun organizzat bejn it-12 u s-16 ta’ Settembru 2022 fil-kampus tal-Università filgħodu [9:00 - 13:30] u se jiffoka fuq attivitajiet STEM u ICT. Dawn se jkunu attivitajiet prattiċi bħal esperimenti sempliċi u kompiti bażiċi ta' programmazzjoni. Sabiex nevalwaw l-attivitajiet nixtiequ niksbu feedback permezz ta' żewġ kwestjonarji qosra mogħtija lill-parteċipanti. Il-kwestjonarji se jitqassmu, wieħed qabel u wieħed fl-aħħar tal-ġimgħa. Il-mili tal-kwestjonarju jieħu madwar 15-il minuta.

Inkunu grati jekk tagħti permess lil bintek biex tipparteċipa f’dawn l-attivitajiet u studju ta' riċerka billi timla l-formola tal-kunsens mehmuża. Il-parteċipazzjoni hija volontarja u formoli ta’ kunsens se jitqassmu lill-istudenti biss meta l-ġenituri jagħtu l-kunsens. Meta jimlew il-kwestjonarju, l-istudenti jintalbu biex ma jiktbux isimhom fuqu u jistgħu jagħżlu li ma jimlewhx. Barra minn hekk, il-kwestjonarji se jiġu kkodifikati, sabiex anke l-identità tal-iskola tkun anonimizzata. Id-dejta mhux ipproċessata kollha se tinħażen b'mod sikur u d-dejta miksuba tintuża biss għall-kumpilazzjoni ta' din ir-riċerka.

Nixtiequ nassigurawkom li se nimxu mal-linji gwida etiċi kollha maħruġa mill-Kumitat tal-Etika tar-Riċerka Universitarja tal-Università ta' Malta matul ir-riċerka tagħna. Jekk teħtieġ aktar informazzjoni, jekk jogħġbok, toqgħodx lura milli tikkuntattjana (jekk jogħġbok ara d-dettalji ta' kuntatt mogħtija hawn taħt).

Fl-aħħarnett ikun apprezzat ħafna jekk tiffirma l-formola tal-kunsens inkluża u tirritornaha b’email lil stephen.bezzina@um.edu.mt. Il-kooperazzjoni tiegħek hija apprezzata.

Grazzi tal-konsiderazzjoni tagħkom,

Dejjem tiegħek,

Josette Farrugia

Numru tat-telefon: 2340 3702
Indirizz elettroniku: josette.farrugia@um.edu.mt

Charles Bonello

Numru tat-telefon: 2340 3415
Indirizz elettroniku: charles.bonello@um.edu.mt

`GEM - Empower Girls to Embrace their Digital and Entrepreneurial Potential'

Forma ta 'Kunsens - Ġenitur

Nikkonferma li qrajt l-'**Ittra ta' Informazzjoni - Ġenituri**' mehmuża għal dan l-istudju u li kelli l-opportunità li nistaqsi mistoqsijiet u niddiskuti l-istudju. Fuq il-bażi tal-informazzjoni mogħtija, naqbel li nagħti l-kunsens tiegħi biex inħalli lil binti [IKTEB HAWN] _____ tipparteċipa fl-attivitajiet mifruxa fuq 5 t'ijiem li Dr Josette Farrugia u Dr Charles Bonello qed jorganizzaw bejn it-12 u s-16 ta' Settembru 2022 fil-kampus tal-Università filgħodu [9:00 - 13:30] u se jiffoka fuq attivitajiet STEM u ICT.

Jiena konxju li binti se tintalab ukoll timla żewġ kwestjonarji bħala parti mill-proġett ta'riċerka.

[IKTEB HAWN]	[IKTEB HAWN]	[IKTEB HAWN]
Isem il-ġenitur	Firma tal-ġenitur	Email tal-kuntatt tal-ġenitur

Data: [IKTEB HAWN]

Firma tar-Riċerkatur	Firma tar-Riċerkatur

Ittra ta' Informazzjoni - Studenti

14 ta' Ġunju 2022

Għażiża studenta,

Aħna żewġ letturi fit-tagħlim tax-Xjenza fl-Università ta' Malta, Fakultà tal-Edukazzjoni. Bħalissa qed nieħdu sehem fi proġett ta' riċerka msejjaħ '**GEM - Empower Girls to Embrace their Digital and Entrepreneurial Potential'**.

L-għan ewlieni tal-proġett huwa li jispira u jinkoragixxi lit-tfajliet Ewropej dwar ix-xjenza u t-teknoloġija (STEM u ICT). F'Malta, dan il-proġett ta' riċerka se jinvolvi numru t'attivitajiet mifruxa fuq 5 ijiem li se jkunu organizzati għal madwar ħamsa u sittin tifla tas-sebgħa sena minn skejjel differenti. Dan ser ikun organizzat bejn it-12 u s-16 ta' Settembru 2022 fil-kampus tal-Università filgħodu [9:00 hrs – 13.30 hrs] u se jiffoka fuq attivitajiet STEM u ICT.

Inkunu grati jekk tikkunsidra li tipparteċipa f'dawn l-attivitajiet. Il-parteċipazzjoni hija volontarja u jekk taqbel int se tintalab tipparteċipa f'attivitajiet relatati ma' STEM u ICT fl-Università. Dawn l-attivitajiet se jsiru mid-9.00 am sas-2.00 pm. Dawn l-attivitajiet huma ppjanati li jkunu attivitajiet pjaċevoli u ta' involviment għalik u għandhom ikunu interessanti u divertenti. Sabiex niksbu feedback dwar l-attivitajiet aħna nitolbuk timla żewġ kwestjonarji qosra. Dawn il-kwestjonarji se jiffokaw l-aktar fuq il-fehmiet tiegħek dwar STEM u l-attivitajiet u se jeħtieġu madwar 15 minuta biex jimtlew.

Meta timla l-kwestjonarji, ma tintalabx tikteb ismek jew l-isem tal-iskola u tista' tagħżel li ma timlihomx. L-informazzjoni kollha miġbura tinħażen b'mod sigur u tintuża biss għal din ir-riċerka. Il-kwestjonarji se jitqassmu, wieħed qabel u wieħed fl-aħħar tal-gimgħa.

Grazzi tal-konsiderazzjoni tagħkom,

Dejjem tiegħek,

Josette Farrugia

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Indirizz elettroniku: josette.farrugia@um.edu.mt

Charles Bonello

Numru tat-telefon: 2340 3415
Indirizz elettroniku: charles.bonello@um.edu.mt

GEM - Empower Girls to Embrace their Digital and Entrepreneurial Potential

Formola ta' Kunsens - Student

Nikkonferma li qrajt l-'Ittra ta' Informazzjoni - studenti' mehmuża għal dan l-istudju u li kelli l-opportunità li nistaqsi mistoqsijiet u niddiskuti l-istudju.

Fuq il-bażi tal-informazzjoni mogħtija, naqbel li nipparteċipa fl-attivitajiet mifruxa fuq 5 t'ijiem li Dr Josette Farrugia u Dr Charles Bonello qed jorganizzaw bejn it-12 u s-16 ta' Settembru 2022 fil-kampus tal-Università filgħodu [9:00 hrs - 13:30 hrs] u se jiffoka fuq attivitajiet STEM u ICT. Jien konxja wkoll li se nintalab ukoll biex nimla żewġ kwestjonarji bħala parti mill-proġett ta' riċerka.

[IKTEB HAWN]	[IKTEB HAWN]	[IKTEB HAWN]
Isem l-istudent	Firma tal-istudent	Email tal-kuntatt tal-istudent

Data: [IKTEB HAWN]

Firma tar-Riċerkatur	Firma tar-Riċerkatur

GEM Summer Camp 2022 – [Netherlands]

The educational system in the Netherlands is structured with a primary school (ages 4-12) and a secondary school (age 12-18). From age 16 it is possible to learn in schools for vocational education (mbo), this is prepared from age 12 in junior vocational schools (vmbo). From age 12 (end of primary school) about half of the students go to vmbo and half to the other schools (havo/vwo), apart from school for special needs.

The main curriculum comprises languages Dutch and second language English (some students also choose for extra languages). In the STEM area we see mathematics, science (biology, chemistry, physics), sometimes combined, sometimes apart. There are also growing possibilities for computer science, and special schools 'Technasia' with extra effort and program for STEM.
We also see extra effort for 'basic skills' (mathematics, language, citizenship and digital literacy). This is also interesting for 'reshaping' possibilities for more STEM based learning routes.

1. **The Context**
2. **Recruitment**

(Provide information about the advertising and recruitment campaign, what worked and what was less successful. Describe activities, tools, materials used in the advertising strategy.)

In NL/Utrecht we work mainly with one of the national vohonetwerken (networks secondary-higher education) -> U-talent (U-Talent.nl). This is our regional network, from Utrecht University and the University of applied Science.

We made this advertisement to the participating 24 schools:

"Are you in 3rd or 4th grade, have you participated in GirlsClub WIN and find math, computer science and physics interesting? Then sign up NOW for the new GirlsClub WIN Summer Days program. Because math, computer science and physics need more girls! Are you in for the WIN? You don't have to get high grades, motivation is more important to join!

WIN = Wiskunde - Informatica - Natuurkunde (Mathematics - Computer Science - Physics)

What will you do? You'll be coming to Utrecht University for three days on 11-13 July. Every day you will work on mathematics, computer science and physics and meet (female) scientists and female students. Every day is different and we work on an art project. You get to work yourself, for example by doing an experiment or programming. And you get the chance to look around in places of the university where students normally do not come.

Finally, and perhaps most fun of all, you will get to know 29 other WIN`ers who, like you, are enthusiastic about mathematics, computer science and physics! Together you will follow the program of the Summer Days, get to know each other better and discover the university together."

This advertisement (and accompanying activities) did not work (only 4 girls reacted).

We decided to move the Summer Camp to the Autumn of 2022, October 24-26

Now we could invite enough girls: 20

3. Summer camp support site

(Provide brief information and link to the summer camp support site.)

We decided to have a website as part of the already existing cooperation within U-Talent (u-talent.nl), a regional network in the Utrecht region with more than 30 schools secondary education.

All information was supported by an information letter to the U-Talent coordinator of each School (this is a contact person for all activities of U-Talent).

And we also produced an information letter to parents, because of the special character of the 3 days.

Link to the summer camp support site:

https://u-talent.nl/activiteit/girls-club-win-zomerdagen/
(transformed to https://u-talent.nl/activiteit/girls-club-win-herfstdagen/, autumn)

4. The Plan

(Give a description of the ideas behind the learning plan; people supporting the plan such as any companies e.g. ICT or software companies. You may include copies of adverts, posters etc. Describe your plans. What did it involve? (How many days and how many hours in each day? Where were the sessions held? What kind of activities have you planned? Did you organise trips? Who was involved? What is the agenda?)

We already have a Utrecht University cooperation around the 'GirlsClub': https://u-talent.nl/girlsclub/, from 2019 onwards.
Within the Faculty of Science different departments are involved (Physics, Computer Science, Mathematics). The girls (age 14-16) come from the U-Talent schools. They follow a program of about 5 to 6 days throughout the year. For an idea of the days that are organised for the GirlsClub see https://elbd.sites.uu.nl/tag/girlsclub/ (in Dutch).

This collaboration was a good starting point for preparing the Summer/Autumn Days for girls. We decided to stay focused on the same group of schools (from U-Talent), with special interest for the girls that were involved in earlier activities of the GirlsClub.

During and after the summer of 2022 we started to prepare the program. This 'organizing committee' consisted of :

- two coordinators/teachers from U-Talent
- a representative from the Physics department
- a representative from the Computer Science department
- two representatives from the Freudenthal Institute (mathematics)
- a representative from the outreach-group of the Faculty of Science

Beecause of the experience from the GirlsClub we already had a kind of network with people that were invited in earlier programs/workshops.
We tried to have a connection with the National 'VHTO' (organisation for women in higher education), but this was not followed-up by a real connection.

(a) Pedagogy

(Include a description of the pedagogy employed in the activities, giving examples.)

The pedagogical ideas was to have a lot of collaborative work (in small groups), with several 'supporters' (mentors) to have an eye on the social interaction.

To get a good and meaningful learning environment we decided to have the three days associated with 'bigger ideas'

- Trees Monday: measuring and calculating trees, practical 'exciting surfaces' and drawing a pythagorean tree;
- The Eye Tuesday: eye-tracking, medical physical research on eyes and building and using a camera obscura; and
- The Design Wednesday: mathematical folds, pseudo-coding and heights.

Each day there was a new Girl of the Day talking about her scientific research and a speaker combining a workshop with a super interesting presentation. On the last day, as a group activity, the physics topics around forces, gravity and altitude were combined with a climbing workshop!

(b) Focus on entrepreneurship

(How was the focus on entrepreneurship achieved?)

Our focus on entrepreneurship had the following characteristic:

The instruction for the activities was not an extended version. There were more or less open contexts with some general question, but not with a method.
The girls had to find out a lot of subsequent steps to come to a product.

This is really different from a normal school situation.

(c) Technology

(How was technology incorporated to enhance girls' digital competences?)

Special focus on 'hands-on' technology.
So not only working with computer screens and programs,
but working with design and handson activities:

- Folding mathematical structures
- Building your own camera obscura
- A more 'high-brow' activity was working with (software for) eye tracking

5. The learning plan for the summer camp

(Include a copy of your learning plan.)

Venue: Every day starts at 09:45 in front of the Botanic Gardens (Campus),
Mondag October 24 - Tree Day
Tuesday October 25 - Eye Day
Wednesday October 26 - Paper Day

A light packed lunch was provided (by caterers at the University).

Students, in groups of five, were led by a mentor who will accompany them throughout the summer camp. She is their contact person during the days. Among other things the mentor will make sure that the group works safely, keeping to social distancing rules, sanitizing tables and any equipment used.

Students will be asked to answer questionnaires. These will be distributed online.

Day 1 – Monday October 24 on Campus - Tree Day

10:00-10:30 - Introductory games

10:30-12:45 - Trees and ... Mathematics and Physics:

- pictures of different trees
- Measuring height and diameter
- Volume calculation of trees
- Surface of a leave
- How many leaves are there on one tree?
- Calculation rule 'da Vinci', can you measure from a real tree?
- Pythagoras trees
- The shape of a water drop on a leave
- Identification of a hydrofile/hydrofobe leave

12:45-13:15 - Lunch (and a talk by STEM UU students)

13:15-14:15 - Girl of the Day

In the afternoon continuing activities.

Day 2: Tuesday October 25 - The Eye

10:00-12:30 - Eye-tracking in the Educational Lab

13:30-15:30 - Camera Obscura

Morning : short presentation : Eye anatomy, eye movements.

Students are first given an assignment on paper. In it, they are going to measure the distance and speed of eye movements (between the points of a measurement). As a follow-up, they solve the formula in this assignment. After this, they start programming. Anna has written a code, but certain parts are left out (if-loops etc. not while-loops! Figure out the mathematical connection and not the programming-moderate connection). The task is to fill it in. They have to fill in the same/similar

formula as solved in the previous assignment. We are programming in matlab/octava.
Calculate distance and speed of eye movements in coordinate system (simple dataset, without computer on paper).
Program activity: Adapt the Octave code: differences between saccades and fixations.

Eye movements and perception
Analysis and visualisation

Day 3: Mathematical Folding and the Climbing wall

In the morning the girls were guided bij Jacoliene van Dijk, she is a PhD at the Freudenthal Institute, and mathematics teacher. She used this source:

http://www.formeeldenken.nl/lessenreeks-origami/

In the afternoon there was a climbing activity.

General
The general learning outcomes of the GEM project were taken as the overall learning outcomes of the GEM summer camp. Then each activity had a series of learning outcomes derived from the general learning outcomes. The general learning outcomes were:

Girls will have increased interest in STEM/digital disciplines
Girls will become aware of their own potential
Girls will be enabled to perform successfully in STEM/digital disciplines
Girls will be encouraged to study or pursue careers in STEM/digital sectors
Girls will have the confidence to consider leadership positions in STEM/digital sectors
Girls will have an enhanced employability with regards to STEM/digital labour markets
Girls will want to know more about STEM
Girls will want to be involved in STEM

The mentors involved in the 2022 GEM autumn camp were:

6. Learning Outcomes

(List the learning outcomes targeted.)

Learning Activities	STEM/ICT subject knowledge	Knowledge of inspiring role models and their meaning	Knowledge about the STEM/digital world of work	Entrepreneurial mind-sets
Trees and mathematics	X		X	
Trees and physics	X		x	
Eye tracking	X	x	X	x
Camera obscura	X		X	
Folding mathematics	X	X	X	x
Folding computer science	X	X	X	x
Climbing	X			x

7. Mentors

(Describe the involvement of mentors, how they were recruited, the number, their STEM backgrounds, how they were trained/prepared for the summer camp.)

Anne Bartilla	physics
Iris Beerepoot	computer science

Marjolein Gelauff	biology
Nadine van der Heijden	physics
Vincent Jonker	mathematics
Sanne Korte	biology
Anna Shvartz	mathematics
Monica Wijers	mathematics

Other people involved

Anne Aarts - Universiteit Utrecht
Lydia Bax - Politie - Eenheid Midden-Nederland - CCT & TDO
Sylvia van Borkulo - Universiteit Utrecht - Freudenthal Institut
Fleur Doorman - Post.nl
Carla Groenland - Universiteit Utrecht - Wiskunde
Yavanne Tiggelen - Universiteit Utrecht - betafaculteit
Anja Volk - Universiteit Utrecht - Informatica

8. Evaluation data collection

(Describe the preparation related to data collection such as obtaining permissions, consents.)

During the application process the parents were asked to indicate whether they provide consent for data collection, including recording of some sessions, photos and responding to questionnaires. All parents provided the written consent for data collection for research purposes and for the use of photos for research purposes.

9. Challenges encountered

(Describe challenges encountered and how these were tackled.)

We are working on a next step for this event (autumn days for girls).

Marjolein Gelauff has an interesting contact in Italy (about gender projects and collaboration in the near future),

and different reseachers from the Freudenthal Institute (and the Faculty of Science) like to do some research with 'only girls involved'.

10. Evaluation of the summer camp

(a) Quantitative

(In this section provide a quantitative evaluation of the summer camp, reporting changes related to how they perceive STEM, if any).

(i) Pre-summer camp

Who are the students participating in the summer camp? Number of participants, ages, subjects studied, career aspirations.

What are their attitudes towards science and STEM?

(b) Qualitative

(In this section provide a qualitative evaluation of the summer camp, emphasizing good practices that worked and practices that could be improved. Include quotations from the students' and educators' feedback and other observations and comments collected. Include information related to specific activities or events.)

Pre-questionnaire:

1. 'Which subjects'. This question clearly shows almost no computer science, R&D or engineering (and a 100% score in maths and physics).
2. 'What job later': beta side, Maths teacher, Something with design of engineering, 3 times 'doctor/surgeon/pediatrician', Vet, Something with environment, Quantum physics and 4 times 'I don't know'.
3. people find it predominantly important and interesting, no obvious differences between subjects (at most biology is seen as 'slightly more fun/interesting').
4. follow-up studies are scored strongly towards 'fascinating' and 'appeal to me'.
5. Questions 5 to 12 (opinion on science subjects, subsequent studies, etc.). These questions are not scored very 'distinctive'.

Post

- Among the first 7 'opinion questions' (with 5-point scale, see questionnaire used), the most striking stands out: "Can I imagine myself working in the STEM field?" -> very much agree!
- Question 8 with some sub-questions on opinion of STEM subjects at school and further studies in STEM is answered somewhat neutrally
- For question 9 'How did you hear about this autumn camp': mainly through the teacher and a school advertisement
- For question 10 'Why did you participate in this autumn camp?': mainly 'I am interested in STEM subjects'.
- 11. Did you like the autumn camp? -> 9 girls 'yes' and 6 girls 'mostly yes'
- 12. Did you feel comfortable -> 13 yes, 1 mostly yes and 1 sometimes
- 13. Did you think differently about STEM subjects thanks to this autumn camp? -> 9 girls 'a little', 6 'no'

14. Which activity did you enjoy the most? Why?

- Climbing
- I thought everything was fine
- I liked the computer science assignment on Tuesday best. The explanations were good and otherwise the assignments were very interesting.
- I think either climbing or programming
- The climbing was fun with the whole group
- Exciting surfaces, because I enjoyed working with those formulas and climbing
- The camera obscura, because I had heard about it before but now I understand better how it works. And you got to do fun crafts.
- analysing trees
- I liked climbing best and I thought it was interesting to be able to ask questions about the topics covered
- Folding and climbing
- Eye-tracking programming
- The climbing and the trees the climbing because it was a bit different day school but the trees because I found that very interesting
- Eye tracking because I found it interesting and challenging. And climbing
- Climbing I found very enjoyable and fun. I liked learning to fuse and after the twister on the wall I dared to challenge myself more.
- Eye sensoring and mathematical folding

15. Least fun?
I found the assignment with the tubes and the water on Monday the least interesting; Everything was fun;
The trees assignments, I didn't find it very useful; Not necessarily anything; The process mining, because I really do think that for butter cheese and eggs your opponent's steps are also very important, so then I didn't think the flow chart was right; Mining programme; Making the instructions for folding because we couldn't really finish it in time; The digital part I can't do that very well; About instructions, because I already knew that it's difficult to give instructions so that the other person executes it properly; The eye explanation in English because that was sometimes hard to understand and hard to follow; The pythagoras tree because I had already made that once; Process mining, I didn't quite understand.

16. Would you recommend other students to join next year as well? Yes! Why.
You learn more about STEM subjects in a fun way; I would recommend it if people want to get a general idea of STEM subjects in a fun way, I wouldn't recommend it if you like going deeper into subjects; It's super fun; I didn't learn as much as I would have thought at first. And I also had to miss school for this, so that's also a factor; It is in fact super fun and educational; Because I found it really fun and interesting; It was nice to get to know people and I learnt something new about a lot of things.

Lessons learnt

(Include a description of what you have learnt from the organization of summer camps for girls. This may refer to content, organization and other matters.)

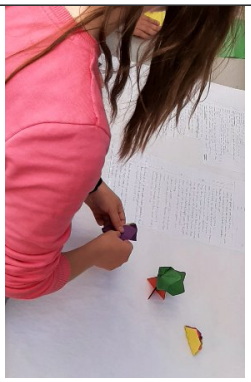
- Important activity for U-Talent
- Big opportunities for gender research
- Important for internal networking within the Faculty of Science
- We 're-iterate' a lot of activities in the coming years

11. Recommendations related to the organization of out of school events for girls

(Include any recommendations such as recommendations for policy makers)

We definitely need another communication strategy.

12. Photos and other evidence

GEM Summer Camps 2022 – Slovakia

1. „Scientific Excursion around Sustainable World “

1.1 The Context

Educational context of the GEM Summer Camp 2022 with the title **Scientific Excursion around Sustainable World** lays in Slovak national educational policy dealing with environmental and ecology topics in education. There is not special subject for ecology education at any type of school in Slovakia. Slovak National Educational Program defines the ecology contexts in education as the cross-subjects' topics. The strategy of including the ecology topics depends on particular school and its school educational program, however every school is obliged to deal with the ecology topics. The number of teachers as ecology specialists is very low at Slovakian schools, so the ecology topics are incorporated to STEM subjects dominantly. It is obvious, that the quality of education in ecology topics depends on personal attitude of teachers, dominantly biology, physics and chemistry specialists and on their personal knowledge and willingness to study certain ecology topic and adjust the topic to education on the particular subject. In many cases this strategy works, but in many cases it does not work and seems very superficial and artificial during lessons. The aim of the GEM summer camp was to show to students and teachers different approach in dealing with ecology and environmental topics. The activities are suitable for teenagers, students of secondary schools, age 15 – 19. At the end of secondary school student should decide her future destiny in two ways generally: continue to study at the university or choosing the entrepreneurship. The experience during the GEM summer camp activities could open new dimension for girls in choosing their university study programmes towards the STEM subjects and/or research as well as orient those, who are not willing to continue at the university, to choose some job in environmental sector.

1.2 Recruitment

The successful recruitment campaign was based on personal visits of schools and presenting the program and activities of the GEM summer camp to school management and teachers. Sending the GEM summer camp posters and invitation letters by post or via e-mails to school management does not work. There are many out of school activities offered by various organizations and projects to schools during the school year. The school management (head teacher and deputy head teachers and teachers – leaders of the particular subject) are permanently over helmed by many offers and requirements connected with pedagogical research, competitions for individual students or team projects. The personal contacts of experts, in our case GEM team of CPU in Nitra, and personal explanation details of the activities is the key of success in the recruitment. GEM team of CPU in Nitra visited five secondary schools in Nitra in June 2022 and offered the GEM summer camp activities for next school year (September – November 2022), and succeeded completely in one only: Secondary Vocational School of Gastronomy and Tourism in Nitra https://sosnrlev.edupage.org/

1.3 Summer camp support site

No special link for the GEM summer camp was necessary to open since personal visits were the most acceptable method for advertising the summer camp to schools, girls-students of secondary schools in Nitra. The general GEM project info website is available during the whole time of the project GEM implementation.

Link to the summer camp support site:

https://www.fpvai.ukf.sk/sk/vyskum-fpv-ukf/projekty/52-veda-a-vyskum/projekty/1473-gem

1.4 The Plan

The central theme of the summer school is *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. The GEM summer school focuses on presenting the role of science and research in fulfilling the economic, environmental, and social goals of *sustainable development*. The summer school includes 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. The environmental goals of sustainable development are in the focus of the summer school. Participants, teenager girls, will gain knowledge that will help them 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 will address in their projects will 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 acquired knowledge and skills will enable girls to prepare activities aimed at sustainable development for their children's and adult clients in tourism.

(a) Pedagogy

(

Icebreaking activities
Lecture
- on the basic goals and principles of sustainable development and the role of science in achieving the goals of sustainable development;
- with focus on 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
Workshop
- focused on Socio-economic goals of sustainable development - an interactive simulation game aimed at finding a compromise between socio-economic and environmental activities of people at the global and local level;
- 3D applications of GIS;
Scientific excursion with focus to applied research and development in the ZOO
Terrain research workshop focused to biodiversity protection
Interactive educational trail with ICT support focused on discovering of animals' world
Interactive outdoor workshop Landscape from a mathematical point of view.

(b) Focus on entrepreneurship

Students projects aimed at finding innovative ways to transform tourism into sustainable tourism using scientific methods.

(c) Technology

Geographical Information Systems (GIS)
Interactive educational trail in ZOO Bojnice, https://zoobojnice.sk/vzdelavanie/
Interactive simulation game: https://mitsloan.mit.edu/teaching-resources-library/fishbanks-a-renewable-resource-management-simulation
Students projects presentations using presentation applications and software

1.5 The learning plan for the summer camp

1. day (venue: Secondary vocational school of tourism):

1. block – introduction of the GEM project, project partners and Summer camp learning plan, Icebreaking activities
2. block – lecture on the basic goals and principles of sustainable development and the role of science in achieving the goals of sustainable development
3. – 4. block - workshop focused on Socio-economic goals of sustainable development - an interactive simulation game aimed at finding a compromise between socio-economic and environmental activities of people at the global and local level

2. day (venue: ZOO Bojnice):

1. block - lecture focused on the environmental goals of sustainable development and the role of the ZOO in the implementation of these goals at the national and international level
2. block - terrain research workshop focused on biodiversity protection
3. block - scientific excursion – applied research and development in the ZOO
4. block - interactive educational trail with ICT support focused on the discovering of animal's world

3. day (venue: CPU Nitra):

1. block - lecture focused on the environmental goals of sustainable development and the role of the Geographical information systems (GIS) in the implementation of these goals at the at the global and local level
2. block - workshop focused on working with modern 3D applications of geographic information systems
3. – 4. block - interactive outdoor workshop Landscape from a mathematical point of view. Assignment of student projects aimed at finding innovative ways to transform tourism into sustainable tourism using scientific method

4. day (venue: CPU Nitra):

1. - 2. block – Students projects presentations
3. - 4. block – GEM project summer camp feedback

1.6 Learning Outcomes

Participating girls will learn about the goals and principles of sustainable development and the possibilities of their implementation in special methods and forms of research:

- how to design experimentation, what are the specifics of laboratory and field research,
- how to use geographic information systems for modelling and simulation of processes in the country,
- what are the possibilities of using remote sensing of the Earth to gain new knowledge about the current state of the environment,
- how to scientifically demonstrate the impact of human activities on the environment,
- how to understand the landscape uniqueness suitable for research to popularize research,
- how to prepare a thematic walk for tourists with the support of ICT and digital technologies.

The main idea is to gain in-depth knowledge of informed European citizenship with a focus on comprehensive environmental protection in terms of sustainable development.

1.7 Mentors

Mgr. Jarmila Čameková - teacher of Geography, History and Tourism at the Secondary School of Tourism in Nitra, expert in the field of creating interactive educational trails with the support of ICT

Ing. Andrea Klasová, - specialist in the protection of endangered species in zoos. She is an employee of the ZOO Bojnice in the position of public relations and lector of environmental education

prof. Mgr. Ivan Baláž, PhD. – expert in zoology, ecology and protection of small terrestrial mammals

Ing. Katarína Vajlíková – expert in the protection of meadow ecosystems and environmental education

Mgr. Imrich Jakab, PhD. – expert in GIS, ICT and digital tools in education; expert in environmental formal and informal topics pedagogy; indoor and outdoor pedagogy; experience projects manage

doc. PaedDr. Soňa Čeretková, PhD. – expert in STEM education, digital tools in education and project manager

1.8 Evaluation data collection

Permissions of the school management for using the school rooms for the project educational activities.
Permission of the school management and parents for taking students to the outdoor trip to ZOO Bojnice.
Permission of the school management and CPU management for teachers and lectors to the outdoor trip to ZOO Bojnice.

1.9 Challenges encountered

Time management of the GEM Summer Camp was a challenge: How to incorporate the activities into the existing timetable of teachers and students. Since the summer cam activities were very welcome by the school management, it was possible to organize the activities very smoothly.
Permission of visiting the National ZOO in Bojnice by quite large group of students – visitors. One of the activities of ZOO Bojnice is education and research. Students with teachers are welcome to participate on educational activities prepared by experts working in ZOO. The important condition of the visit is to plan the visit and its activities about 14 days before the visit.
The last two sessions were planned to organize at the CPU university lecture rooms. University rooms were busy in the scheduled time, so the secondary school offered rooms for the last two sessions freely.
Gem questionnaires fill in online was a challenge, but participating lectors- secondary school teachers open the space and time for filling in the GEM questionnaires during informatics lessons time and promote the activity as an important ICT skill for students for their future work.

2. “Physics as You Do Not Know IT FAJN”

2.1 The Context

The compulsory education in Slovakia starts in the age 5, kindergarten. A year later, in age 6, the pupils attend primary school consisting of grades 1-4. Grades 5-9 are considered as lower-secondary and 10-13 as upper-secondary education. There are two streams of lower-secondary education. Pupils can after grade 5 apply and join academic preparation (8-year gymnasium, e.g. secondary grammar school – general education for further university students). All the other choose the upper-secondary education after grade 9. There is also possibility to attend academic preparation (4-year gymnasium or 5-year bilingual gymnasium) or vocational education stream. Vocational schools have different curricula for STEM education comparing to academic education at gymnasiums.
Mathematics is compulsory at primary and lower-secondary level, in grades 10-13 at gymnasiums and 10-12 in vocational education. Compulsory education in technology (informatics) starts in grade 3 and continues until upper-secondary level. Computational thinking is included in informatics.
Science education in integrated in primary level, but starting from lower-secondary it is divided to the three subjects: physics, chemistry and biology. The science subjects are compulsory in the first two year of gymnasium, further study of science is voluntary.

2.2 Recruitment

Constantine the Philosopher University in Nitra has been working in popularisation of mathematics and science for pre-primary, primary and lower-secondary pupils for many years. There are out of school activities organised in the premises of the university during the school year or directly in schools’ venues by the members of the university staff. The teacher educators also closely collaborate with in-service teachers in the region.
The GEM summer school camp: Physics as You Do Not Know It was advertised via STEM teachers and leaders of the out of school time activities.

2.3 Summer camp support site

https://www.fpvai.ukf.sk/sk/vyskum-fpv-ukf/projekty/52-veda-a-vyskum/projekty/1473-gem

2.4 The Plan

The summer camp ‘Physics As You Do Not Know It (FAJN) aims at bringing new perspectives and strengthening positive attitudes towards physics among the girls. We consider the overarching topic of the FAJN 2022 ‘Optics’, to have a great potential to attract girls.
The light as a spectrum of colours and optical principles of sight and eye-disorders were in the focus of the summer camp. The optical principles and properties of colours were studied simultaneously with principles of mixing colours in visual arts, including applied arts (fashion, design). Besides that, geometrical optics and its application in medicine, especially ophthalmology

were inquired. Participating girls investigated the human eye as a lens and the impact of changes of the lens to eye-disorders.
During the summer school, the participating girls became familiar also with photometric. They investigated illumination and its impacts of ergonomics and therefore interior design and marketing.

The program includes five consequent working days in one week, from Monday to Friday from 8:00 to 16:00. All the days except Thursday were organised in premises of the University. The program on Thursday started at the university but then all the participants moved to laser arena in Nitra. The activities in the summer camp can be divided into socialisation activities aiming primarily on transversal skills (ice-breakers, team-building) and educational activities (searching terms, EUREKA activities, measurements in laser arena). Most activities will be conducted in groups formed on Monday and keeping for the whole week. The pedagogies involved are based on inquiry-based science and mathematics education, including collaborative problem-solving, hands-on activities and laboratory work in the university research laboratories.
Ice-breakers
As the summer camp will take a week, the participating girls need to know each other. The communication skills and collaboration are addressed in this activities.
Team-building activities
To be successful in collaborative problem-solving in STEM, the group-members should be able to collaborate, communicate effectively. The activities support the creativity and critical thinking, flexibility, leadership and social skills.
Searching terms
These activities are focused on understanding the essential concepts in physics related to optics. The terms are connected with the female scientists and researchers.
Eureka activities
Eureka activities are the main learning activities of the summer camp. These are activities conducted in small groups of 3-4 girls supervised by one camp-leader. The participating girls solve a problem in STEM (with content or context in optics) with the scaffolding provided by the camp-leader. Some of the Eureka activities involve use of IP Coach system, tablets and other technology to enhance the information and technology literacy skills. There were all together 8 Eureka activities during the camp week: Computers and colours, UV measurements, What makes us see, Colour spectrum, Optical environment, Mirror image, Scatterometer imaging, Water lens.

(a) Pedagogy

The inquiry-based science and mathematics education was the main approach in all the camp activities. Within the summer camp we tried to address all the five sets of competencies defined in the project. We found the topic of Optics particularly valuable for girls, as there are lot of topics in everyday life and word of work that are based in optics.
Activities involved in the experimenting included biophysics of human body (sight, eyes, physical basis of sight-impairments), disinfection using UV light and models of mixing the colours in computers (CMYK, RGB) aiming to offer the point of view of various STEM fields.

(b) Focus on entrepreneurship

The activities in the camp were often conducted in teams so, the collaboration and communication skill were required and developed. There were several types of activities, the learning units were particularly in the Eureka activities. During these the groups of 3-4 participants solved a STEM problem under the guidance of one of the camp leaders.

(c) Technology

The technology was organically incorporated to most of the camp activities. Participating girls used tablets with Coach Labs, GeoGebra or BBC micro:bit or even authentic laboratory equipment. In laser arena the participating girls work with lasers, do measurements with the equipment for players, but on top they investigated germicidal lamp based on UV light.

2.5 The learning plan for the summer camp

MONDAY
8.00 - 10.00 Introductory administration, meet-and-greet activities (various ice-breaking games)
10.15 -11.15 SIGHT TESTING - 7 activities regarding eye-sight
The initial introduction of the girls with the overarching theme of the camp, optics, will be carried out through various eye examinations. We include this activity at the beginning of the programme, mainly because the affective reasons, so the girls will not be afraid of the topic of optics and gradually got into this topic in a peaceful way. Active learning pedagogies will be used in the eye examinations.
The girls will have several stations prepared. The camp leaders will be on stages and examine their eyes. Similar to the medical clinic, we will test their near and distance reading. At other stations, they will have their colour-blindness checked, they will be examined using a cheiroscope and solve some optical illusions. In addition, they will observe the difference when looking at a picture with the right and left eye separately and with both eyes at the same time. They will find that their brains combine the images they see with their right and left eye into one coherent image. The girls will also have the opportunity to try on special 3D glasses and 'drunken glasses', with which they will try to walk in a straight line. The girls will be thus introduced to the different devices used by ophthalmologists, as well as to the various visual problems that can occur.
11.15 - 12.15 GROUP CREATION - work in groups - each member introduces herself with the best photograph involving light
12.15 - 12.45 INTRODUCTION OF GROUPS - present the name of the group, explain why they chose it,
introduce the captain and sub-captain of the team, a power outcry and a selfie group that puts on social media
12.45 - 14.00 lunch
14.00 -15.30 SEARCHING TERMS
This activity will be repeated almost every day. It consists of several stages visited by each group. At the stage, the girls complete a sports activity, for which they will find out a physical concept. It

will be explained to them and each member will learn the term and the explanation. Although, we do not want any lecturing, we want girls to be able to verbalise the obtained knowledge, i.e. to explain the term with their own words and examples.

TUESDAY
8.00 - 8.30 Tree of satisfaction - write and stick on cardboard - THE MOST ENLIGHTING EXPERIENCE
8.30 - 11.00 HEUREKA SCIENTIFIC RESEARCH - each group 2 tasks
The activity that will take place almost every day. Eight research tasks have been prepared – Computers and colours, UV measurements, What makes us see, Colour spectrum, Optical environment, Mirror image, Scatterometer imaging, Water lens. During the week each group will participate in each activity, but the order will be different.
11.00 - 12.45 SEARCH TERMS
12.45 -13.45 lunch
13.45 -15.15 HEUREKA SCIENTIFIC RESEARCH each group 2 tasks
15.15 - SPORTS COMPETITIONS

WEDNESDAY
8.00 - 8.30 Tree of satisfaction - write and cut on cardboard - THE MOST ENLIGHTING EXPERIENCE
8.30 - 10.30 STAR WAY
One of the variants of Searching terms activity. Girls will be given a map of the starry sky on which they will mark their path. Each star will be labelled by the name of the leader responsible for particular term. They need to go to each station three times to succeed; the difficulty of the tasks will increase each time. The task will be considered successfully completed when the group travels the entire star way.
10.30 - 12.45 HEUREKA - SCIENTIFIC RESEARCH each group 3 tasks
12.45 -13.45 lunch
13.45 -15.45 SEARCHING TERMS

THURSDAY
8.00 am to 8.30 am Tree of satisfaction: writing on cardboard - THE MOST ENLIGHTING EXPERIENCE
8.30 am to 9.15 am Way to the laser arena
9.15 to 9.30 Instructions
9.30 am to 11.00 Team competition with lasers (3 × 30 min)
11.00 to 12.30.
Measurement: distance of effect of laser weapon
Measurements: reflected beam examination
Measurement: measuring wavelength and intensity UV radiation sources for disinfection
Measurement: measuring the impact of other radiation to the laser weapon
Blind-chasing (what if the laser shoots our eyes)
12.30 to 13.30 lunch
13.30 to 2.45 pm Individual competition with lasers
14.45 - 15.00 Travelling to the school venue

FRIDAY
8.00 - 8.30 Tree of satisfaction - write and stick on cardboard - THE MOST ENLIGHTING EXPERIENCE

8.30 - 9.30 What we learned in the lase arena - presentation of the results of the groups
9.45 - 11.45 - GPS competition outdoors - SEARCHING TERMS
11.45 – 12.45 BUILDING A LEGO HOUSE - non-traditional group building a LEGO HOUSE - development of communication in a group (blinded)
12.45 -13.45 lunch
14.00 - 15.15 Knowledge competition - CHARGED HEADS
15.15 - until participants leave EVALUATION OF THE CAMP - DIPLOMAS AND PRICES AWARD

2.6 Learning Outcomes

The STEM content outcomes were tested in the knowledge competition in the end of the camp. The tasks in competitions were based on the topics covered in Eureka activities, but standard needing the application of obtained knowledge. The competition was again held in groups.

2.7 Mentors

Ľubomíra Valovičová (assoc. prof. in Physics education, experienced summer camp organizer) focuses her research work on empirical cognition in physics from pre-primary to secondary education, mainly via inquiry-based activities. She is experienced in organising the summer camps (more than 15 years) popularising activities for mathematics and science and will be responsible for the organisation of the camp and be the head of camp-leaders in the summer school.
Ján Ondruška (researcher in material physics) is an experienced summer-camp leader. He was involved in management of the activities. He collaborated in the design of the summer-camp activities.
Veronika Klobušická (human medicine student) was involved in activities focused on eye-disorders.
Dominika Mikušová (student of material physics) is an experienced summer-camp leader.
Mária Siptáková (energetic auditor) has a doctoral degree in Physics. She works as the energetic auditor in the national body. She agreed to participate as a camp-leader based on her experience as camp-leader when she was a graduate student.
Janka Medová (researcher in mathematics education) focuses her work on inquiry-based mathematics education and related education of pre-service and in-service teachers. She collaborated in design of interdisciplinary activities involving mathematics and physics.
The students of initial teacher education participate as the camp-groups-leaders. They were selected in June 2022 out of the following applicants: Juraj Blunár (physics – biology), Michal Fojtík (mathematics – computer science), Patrícia Kopecká (physics – chemistry), Renáta Klimanová (physics – geography), Peter Lenický (mathematics – physics), Adela Synáková (mathematics – physics).

2.8 Evaluation data collection

The signed written consent with including participating in research based on the camp activities was collected from the parents.
Most of the activities were audiotaped, the girls fill in the pre- and post-questionnaires provided by the coordinators of the GEM project online.

2.9 Challenges encountered

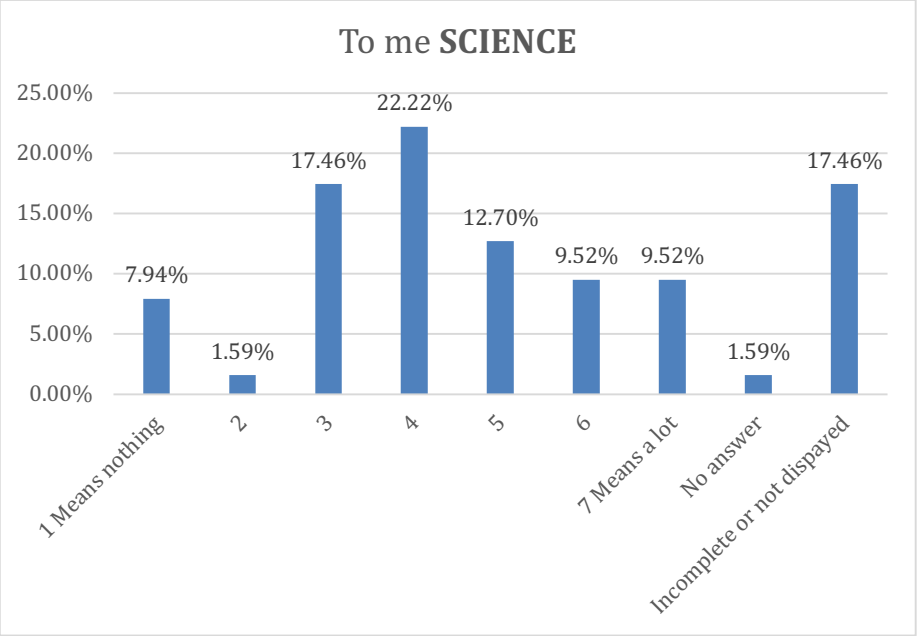
The biggest challenge was related to the idea of having camp solely for girls. We got quite a lot of applications from boys and feel this separation as a discrimination. We will organise the mixed camp this year, but with special focus on needs of girls.

10. Evaluation of the summer camps in 2022

(a) Quantitative

(i) Pre-summer camp

Age scale of participants was from 10 years (Physics FAJN) to 18 years (Sustainable world).
Average age of participants was 15 years.
There were 63 questionnaire inputs registered in the on line system in pre-questionnaires and 48 post-questionnaires were completed.
The deviation, 15 participants participated only during the first GEM summer school: Scientific Excursion. Their participation on the next GEM Summer School activities, excursions, were not possible because of necessity of completing other school duties, which were scheduled in the same days as the GEM Summer School activities.



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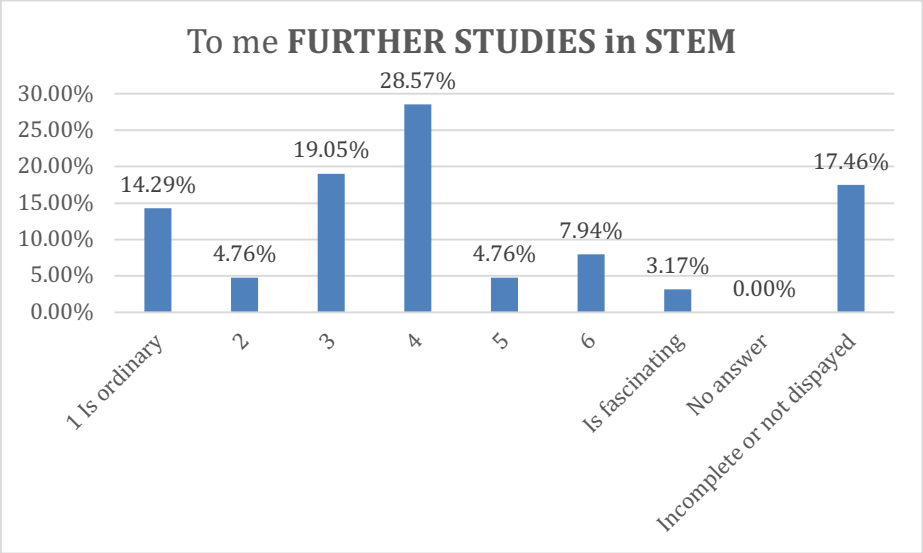
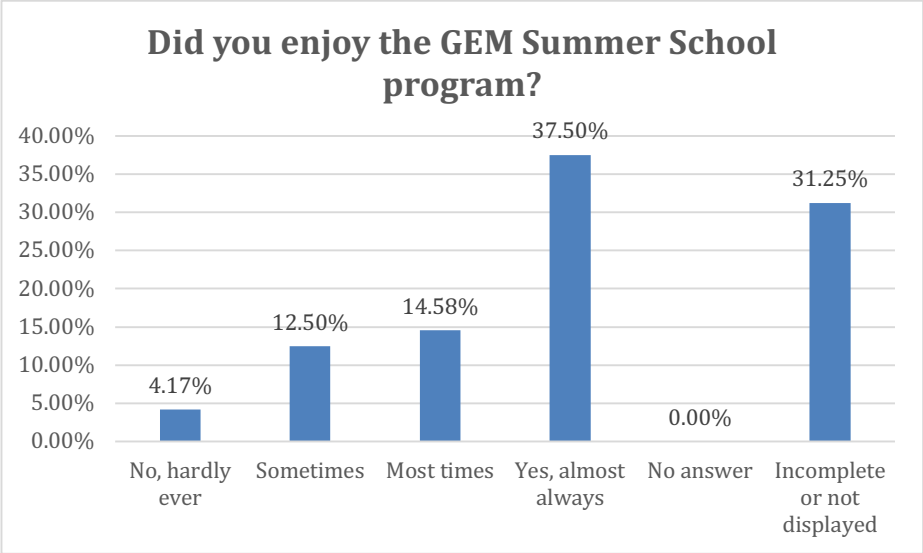
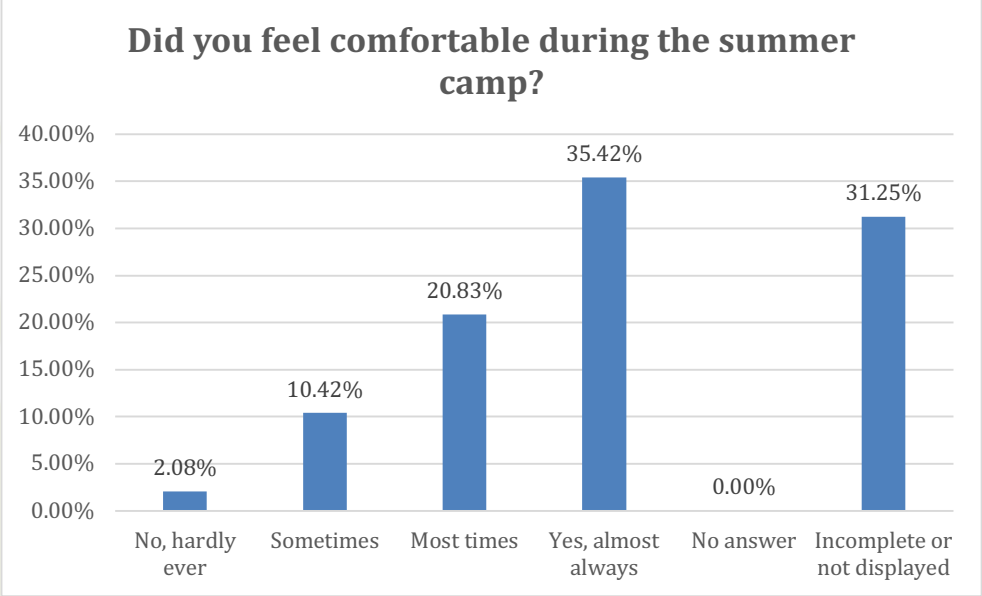
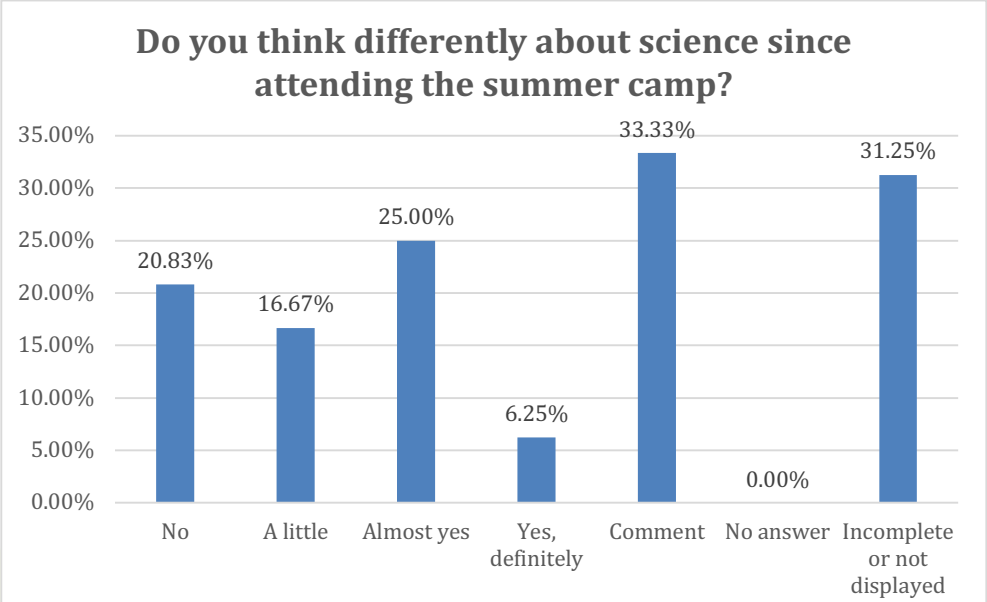
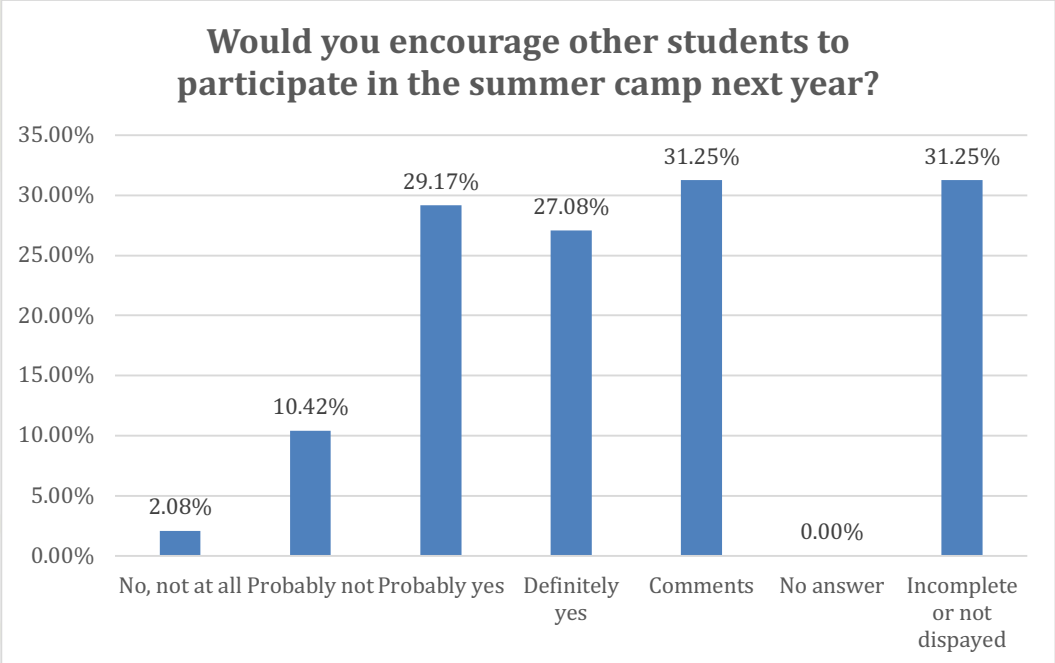

To me FURTHER STUDIES in STEM
30.00%
25.00%
20.00%
15.00%
10.00%
5.00%
0.00%
14.29%
4.76%
19.05%
28.57%
4.76%
7.94%
3.17%
0.00%
17.46%
1 Is ordinary
2
3
4
5
6
Is fascinating
No answer
Incomplete or not dispayed

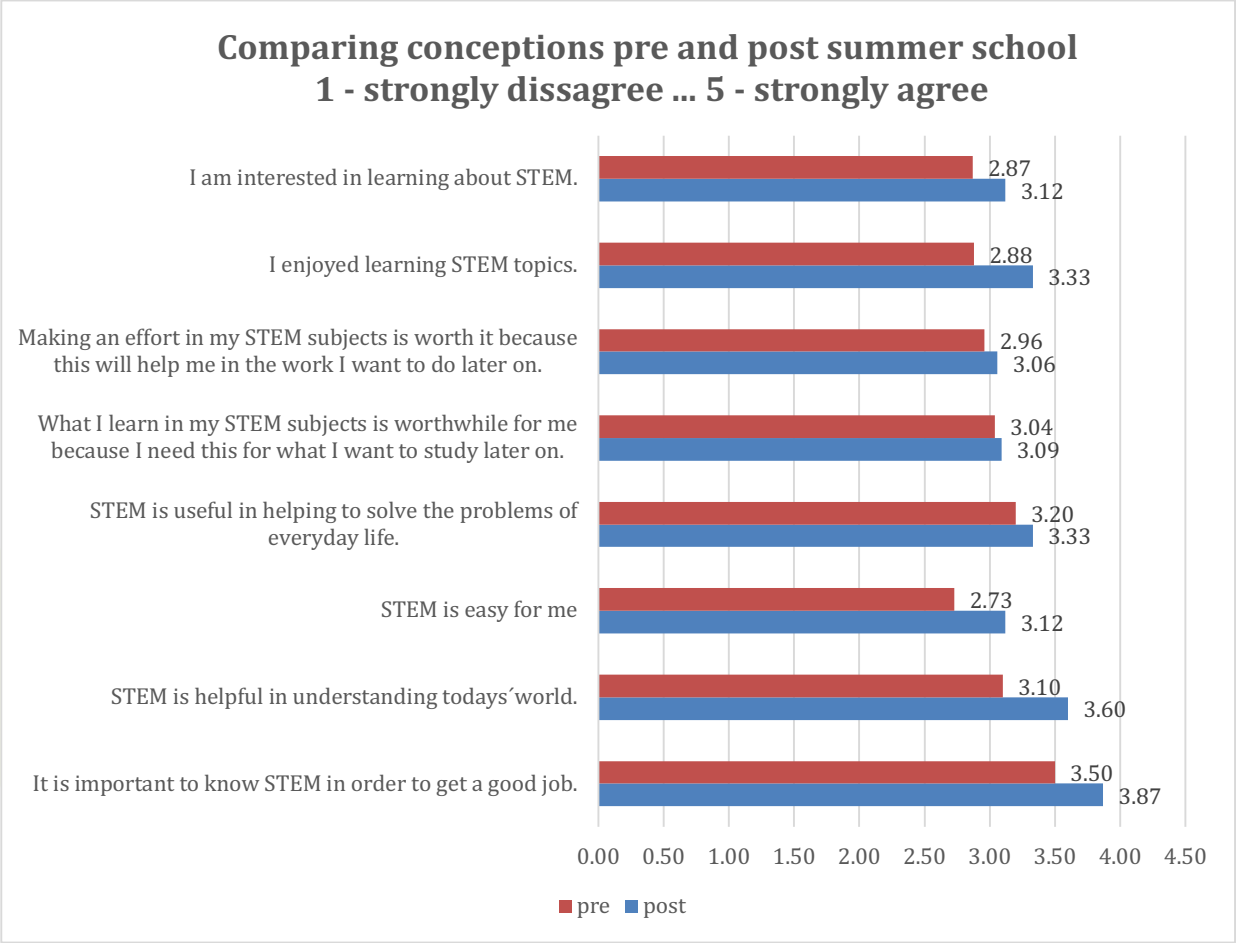
(ii) *Post-summer camp*






Do you think differently about science since attending the summer camp?
35.00%
30.00%
25.00%
20.00%
15.00%
10.00%
5.00%
0.00%
20.83%
16.67%
25.00%
6.25%
33.33%
0.00%
31.25%
No
A little
Almost yes
Yes, definitely
Comment
No answer
Incomplete or not displayed


Would you encourage other students to participate in the summer camp next year?
35.00%
30.00%
25.00%
20.00%
15.00%
10.00%
5.00%
0.00%
2.08%
10.42%
29.17%
27.08%
31.25%
0.00%
31.25%
No, not at all
Probably not
Probably yes
Definitely yes
Comments
No answer
Incomplete or not dispayed



(b) Qualitative

Pre-questionnaires answer to the question about future job were very diversified and some, of course, were not serious (from chimney-sweep to superhero and intergalactic duke). Some more serious answers reported about jobs required university study, such as: teacher, psychologist, IT specialist, actress, human medicine doctor, dentist and some declared ambitious in having own café or managing travel agency.
Post questionnaires answers to open questions:

How did you learn/hear about the summer camp? Dominant answer is: teacher (35,42%) and parents (20,8%). Nobody reported social media or poster at school. The answers are based on recruitment at CPU policy of participants: personal advertisement to teachers (schools in region) and to parents.

Why did you participate in the summer camp? The most frequent statement was about my friends (schoolmates) participation (27,08%), my teacher recommendation (20,83%); my personal interest to science (12,5%) and also a role of parents was denoted (6,25%). The answers copy the social orientation of teenagers: being with friends is dominant, and then the authority of teacher is interesting point. We could interpret this fact as an

importance of teachers' influence to teenagers' orientation in their future study and life, probably.

Comments to the question: **Do you think differently about science since attending the summer camp?**

"we learned here in a fun way"
"it was explained here in a more interesting way than at school and that's why I enjoyed it more"
"I am more interested in certain things than usual"
"everything can be learned here in an easier way"
"I learned new information"
"I thought that science was boring, but now that has changed"
"I learned more about science"
"because I know that science is true"
"because I learned what optics is"
"they can explain it here much easier than my teacher"
"after all, I know that science is important"
"it changed my perception of nature"

The most favourite activity – the least favourite activity
"EUREKA" – laboratory experiments occurred many times also in the **not interesting** activity. Participants complained that laboratory experiments required too much writing, documenting experiments is boring.
Other favourite activities: "I enjoyed making paws"
"various competitions because it was fun and we also learned something"
"interesting experiments"
all of them: I always learned something new"
"competitions I had fun"
"because there were interesting activities"
"Laser arena – Thursday because there was fun" … several times
"sporty it was fun"
"strategic game Fishbank, we were able to agree on what and how to do" occurred many times in favourite and also many times in **not favourite** activity as it requires concentration and good planning in dealing with finances
"Excursion in Bojnice Zoo, because I like animals and nature, I learned interesting facts about animals" was commented as the most favourite activity, too.

Comments to the question: **Would you encourage other students to participate in the summer camp next year?**

- it helped me learn very interesting things
- because they would have fun and meet new friends
- a fun way to learn physics
- I want them to experience this too
- they discovered that learning can be done in an interesting way
- because they would like science here
- they would enjoy it
- I don't know, it's good
- to gain new knowledge
- the more people, the more fun
- it would be more fun
- because there is fun and learning at the same time
- they are not like me
- Because it will change their perception of nature, animals and maybe it will help them in life.

There were only few suggestions about ideas **to make the summer camp better**: more out-side activities or more sportive activities.

To the question: **Do you have any ideas that can be used in another summer camp?** There were only two ideas: the topic “the universe - astrology”; and “business - how to create your own business”.

11. Lessons learnt

Girls in the camp FAJN can experience success in scientific investigations, enjoy the “girl-power” but we, as organisers, miss the opportunity to shape boys’ attitudes on girls in science by showcasing them the girl teams successful in scientific investigations.

The cooperation between university and school in region is crucial for success in the educational activities for girls, teenagers.

Personal contacts to schools in region and to suitable external bodies (like ZOO Bojnice in this case) and experience of lectors of the GEM summer camp in promoting non-traditional educational activities, out of school and outdoor activities is the essential condition for success, too.

12. Recommendations related to the organization of out of school events for girls

Even though the participating girls expressed positive feedback to the camp we do not want to organise the camp solely for girls in the future, but we would prefer to have mixed groups. Educational dimension and activities of scientific centres and willingness of sharing the experience with public, in this case ZOO and teenagers, is important point for successful STEM activities and entrepreneurship dimension of educational aims.
University educator, who are active in cooperation with schools in region are the best lectors of the summer camps although such activities of the university educators are not counting as highly appreciated academic activities and are not counted to the scientific profile of the particular person. It is actual practice at universities in Slovakia: the university management appreciate much more single research impact paper instead of popularization science among young students or paper dealing with pedagogical approach. Also not-research projects are not highly evaluated as the academic activities these days. It is a pity, that the university policy is focused much more to the basic research results and not to popularization or pedagogical experience in popularization of science.
The mentioned fact represents a threat to the future for educational projects, because it is a serious assumption that young and active university teachers will not want to devote their time and energy to projects that are not evaluated as beneficial for their scientific profile and qualified results in scientific activity.

13. Photos and other evidence

GEM Summer Camp 2022 – [Spain]

1. The Context

The GEM Summer Camp in Spain was offered in the context of an intensive immersive experience taking place during the second week of July 2022 at the Campus of the University of Jaen.

In the following, we will provide some background information about the Spanish educational context

The educational system in Spain follows a national curriculum (ages 3-18), although regions have some autonomy to adapt some of the content to the region's history. Educational practices are heavily driven but the national curriculum and shaped by text-books that reflect it. The compulsory education covers ages 6-16 and is designed to promote the development of eight key competences including the STEM competence, the digital competence and the entrepreneurial competence. Compulsory education is free in all public schools. Students can also choose private or semi-private schools for which the parents have to pay tuition fees. In Spain, the main teaching language in schools is Spanish except for the País Vasco, Catalonia and Baleares Islands, where the regional languages are also taught. In some of the private schools the main teaching language is English, while English is the main Foreign Language at most public schools. For primary schools (ages 6-12) the curriculum includes the following subjects: Spanish Language, Foreign Language, Mathematics, Knowledge about the Natural and Social Environment, Religious Education, Physical Education, Values and Ethics and Arts.

During Secondary Education (ages 13-16) the students again focus on general knowledge in various subjects similar to Primary Education, but science is divided into Biology and Geology and Physics and Chemistry. In addition, there are specific subjects about Technology and Digitalisation and Entrepreneurship. In the high school (16-18) the students choose a specialization towards Life Sciences, STEM professions, Social Sciences or Arts. Alternatively, they can opt for vocational studies.

2. Recruitment

(Provide information about the advertising and recruitment campaign, what worked and what was less successful. Describe activities, tools, materials used in the advertising strategy.)

Recruitment in this second edition was much easier than the first time, because the previous summer camp became very popular and we got expressions of interest to participate in this second edition even before starting to advertise the 2022 GEM summer camp. Actually, in both editions we received more applications that the positions offered and we had a waiting cue.

We used the following channels to advertise the 2022 GEM summer camp in Spain:

- An emailing list of secondary schools in the region.
- The strategic connections of our National GEM Team
- Connections with the Delegation of Education and the Teacher Centre in the region.
- Publication in UJA digital daily newsletter.
- Social media using catching messages addressing our target audience (girls aged 13-18) through the channels specifically created for this purpose (FB: EmocionaSTEM, IG: @emocionaSTEM)
- Digital screens.
- Flyers and panels that were shown in different meetings, social media, digital announcement and in the GEM national website.
- Posters strategically located.

Other key action in terms of advertising and dissemination has been the collaboration with the Unit for scientific culture and the Communication Service at the University of Jaén.

As a result, we can find news and publication about the GEM Campus in Spain taking place in July 2022 in different newspapers, regional radio and TV:

https://www.horajaen.com/2022/07/08/la-uja-acoge-la-proxima-semana-el-campus-de-verano-gem-2022/

https://www.europapress.es/andalucia/noticia-uja-acoge-segundo-ano-campus-verano-gem-fomentar-interes-ninas-carreras-cientificas-20220711181442.html

https://www.europapress.es/andalucia/noticia-uja-apuesta-campus-verano-gem-proyecto-estrella-fomentar-vocaciones-cientificas-chicas-20220715172710.html

https://www.linares28.es/2022/07/12/la-uja-pretende-convertir-el-campus-de-verano-gem-en-su-proyecto-estrella-que-conciencie-a-las-chicas-de-que-su-talento-es-clave-para-el-desarrollo-de-la-sociedad/

https://novaciencia.es/campus-de-verano-gem-en-la-uja-para-fomentar-el-interes-de-las-ninas-por-la-ciencia/

In the following you can see interactions accounts and interactions through social media in relation to the GEM summer camp in Spain:

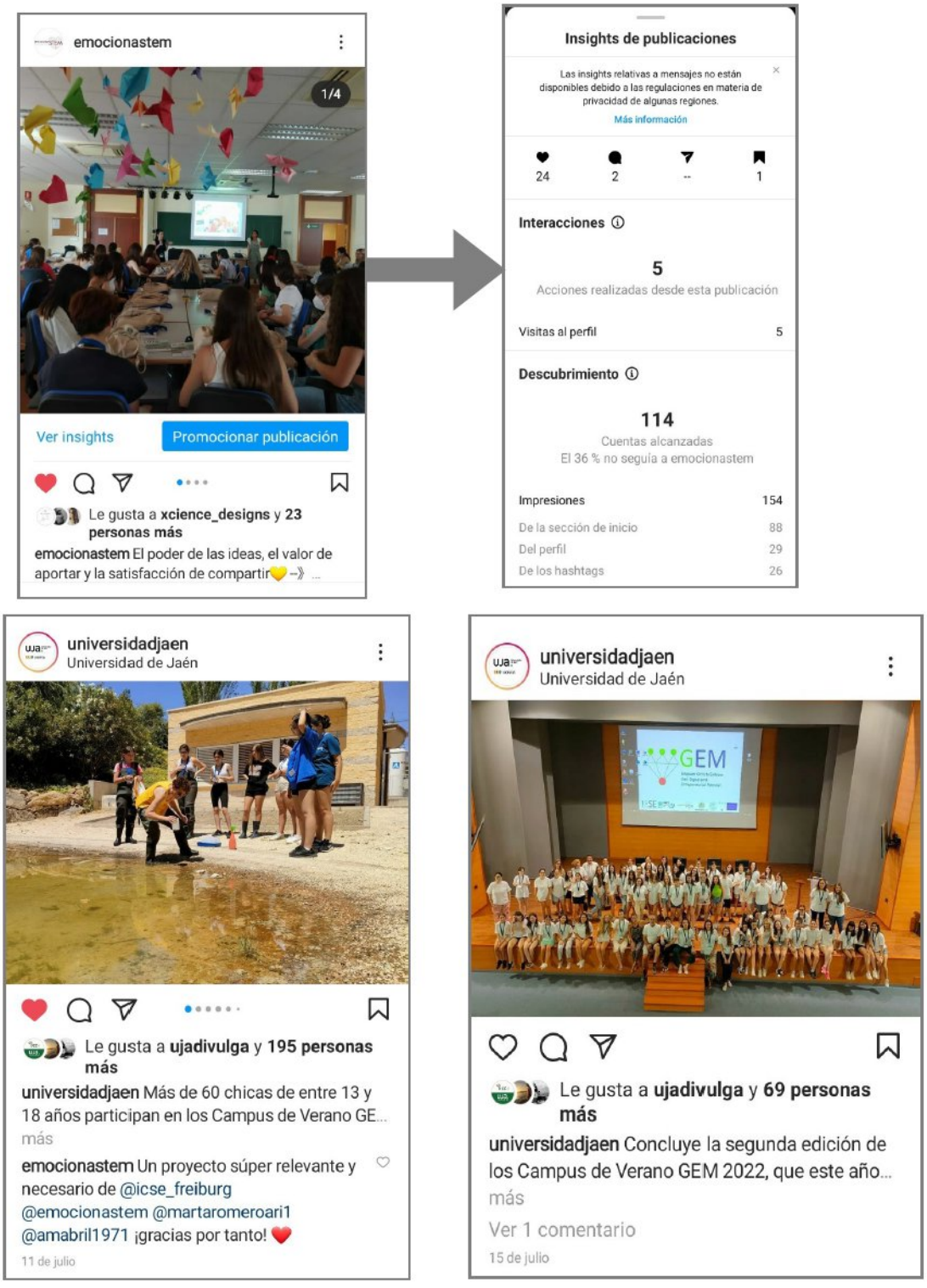


Figure 1. Interaction about the 2022 GEM summer camp in Spain on social media

3. Summer camp support site

(Provide brief information and link to the summer camp support site.)

Link to the summer camp support site: https://gem-esp.eu

We consider that the most powerful and effective vehicle for conveying information has been the GEM national website with thousands of visits https://gem-esp.eu (10667 visits on 4 November 2022).

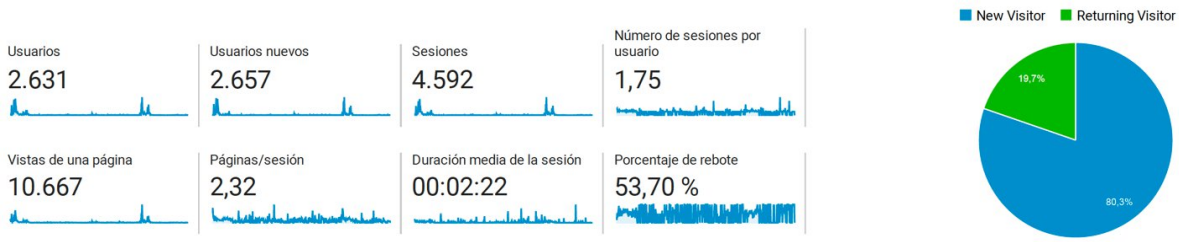


Figure 2. Some statistics from the national GEM website in Spain.

We have been using the national website for dissemination, application, follow-up and informative issues about the Summer School and it includes the following content:

- Information about the GEM project.
- Information about the GEM Summer School in Spain.
- Program of the Summer School.
- Description of the research projects offered to the participating girls.
- Information about the mentors leading the research projects and guiding the girls trough the GEM week (including photos and "a more about me and science" section).
- Expert panel of women that will support several educational, implementation and diffusion aspects off the GEM Summer School.
- Registration form in the GEM Summer School.
- Materials for diffusion of the GEM Summer School.
- "Contact us" section
- Information about the research team leading the GEM project in Spain

- Data privacy information

Forthcoming versions will include "Successful histories" showing some quotations of girls involved in 2021 GEM Summer School as well as pictures and some remarks about the Final GEM Congress.

4. The Plan

(Give a description of the ideas behind the learning plan; people supporting the plan such as any companies e.g. ICT or software companies. You may include copies of adverts, posters etc. Describe your plans. What did it involve? (How many days and how many hours in each day? Where were the sessions held? What kind of activities have you planned? Did you organise trips? Who was involved? What is the agenda?)

The evaluation of the first edition of the GEM summer camp, along with the feedback received from the mid-term evaluation by the European Commission allowed us to identity strong points and areas that could be further strengthen to favour the achievement of the intended objectives. Based on the previously mentioned feedback, the program and the learning plan for the 2022 GEM summer campus at Spain followed a similar structure to the previous summer camp that was highly appreciated by participants but included the following variations:

There was a **stronger emphasis on the development of digital and entrepreneurial skills**. Those skills were worked through specific workshops. In this respect workshops about computer modelling and the use of bioinformatics to study species evolution were integrated in the program, as well as other two workshops about entrepreneurial skills: the first one intended at stimulating creativity, shaping and testing entrepreneurial ideas, and the second one, about the satisfaction of overcoming barriers as a STEM entrepreneur.

In addition, the Campus was a bit longer than the previous one (around 34 hours across 5 days) and included a last day with visit to the mountains to interpret the natural heritage of Mágina Mountains and a walk to watch the night sky and to be introduced to astronomy.

The 2022 GEM summer camp took place mainly within the facilities (laboratories, outdoor spaces, garden and lecturing/meeting rooms) of the Campus Las Lagunillas of the University of Jaen https://tourmkr.com/G1gzBKpstY/27592643p&197.78h&86.57t

Here you can see the schedule of the GEM summer camp carried out during the second week of July 2022: https://gem-esp.eu/wp-content/uploads/2022/07/programa_definitivo_GEM022.pdf

Figure 3. Schedule of the 2022 GEM summer camp in Spain.

As can be seen from the schedule, the GEM summer camp included different types of activities:

- Immersive activities into research projects in different STEM fields in small groups with a mentor acting as role model.
- Workshops on entrepreneurial and digital skills.
- Inspiring talks from referent women that have developed an outstanding career in fields related to STEM and STEM entrepreneurship.
- Activities aimed at knowing each other, exchanging interests and passions and creating positive emotional ties, growing as a community of STEM girls and STEM females.
- Activities outdoors like the scientific gymkhana or the guided visit to the Mágina Mountains.
- A final conference giving girls the opportunity to present the research and entrepreneurial activities they have conducted in collaboration with their mentors

and the role models they have encountered during the 2022 GEM summer camp in Spain.

Here, you can see some images of the posters used to advertised some of the workshops and talks offered during the 2022 GEM summer camp in Spain:

Figure 4. Posters announcing the main workshops and talks offered in the 2022 GEM summer camp in Spain.

The campus was supported by the European Union under the grant agreement n° LC-01380173, the Scientific Communication Unit within the Vicer Rector for Communication and Institutional Projection of the University of Jaen https://www.ujaen.es/gobierno/viccom/en and the International Union of Biological Sciences https://iubs.org

(a) Pedagogy

(Include a description of the pedagogy employed in the activities, giving examples.)

The 2022 GEM summer camp in Spain was designed to integrate the following pedagogical aspects:

Inquiry-based learning

This approach was mainly developed during the research projects conducted in collaboration with mentors, where girls started from a relevant question and used research and data collection to build consistent responses and solutions. Working on real research projects related to relevance issues for society, allowed girls to learn about specific STEM contents through an inquiry-based learning approach enhancing the feeling of self-competence and self-efficacy.

Use of role models

Mentors acted as close role models to girls sharing with them not only their professional background and activities, but also their personal experiences. They showed how they could successfully harmonise their personal and professional life while feeling realised and fulfilled both as women and professionals.

We introduced role models in both the research activities and the workshops and talks led by inspiring STEM women. During the immersion experience in real research, girls were led by female mentors, who were carrying out projects research projects in different STEM fields, acting as STEM role models in the STEM research filed.

The STEM female entrepreneurs and the experts that offered workshops and talks also acted as inspiring role models to girls, sharing with them the kind of challenges encountered and how they have overcome them fighting some gender stereotypes. In this respect the campus gave girls the opportunity to know females in leading positions and funders of innovative businesses with strong entrepreneurial skills.

Using relevant and meaningful learning contexts

Far away from passive lectures, girls are engaged in hands on activities and authentic STEM practices introduced and developed within contexts that provides a sense of meaning and purpose. This is the case of the learning taking place while exploring relevant research questions that address current needs and challenges related to climate change, evolution and genetics or the use of technology to improve people's lives.

Creating a culture of belonging to a community

During the 2022 GEM summer camp in Spain, girls felt part of a female group with common interests, passions and concerns and shared activities that allowed them to experience the beauty and fascination of science and STEM research, feeling competent and empowered.

Working in small groups in a pleasant and safe environment where they can express themselves freely and where mistakes were seen as interesting opportunities to learn enhanced their engagement and positive emotions.

Finally, social and playful activities facilitated knowing each other and establishing affective ties between participants.

In relation to **learning outcomes**, girls had the chance to know about different STEM subjects during the research projects conducted in collaboration with the mentors but also during the planned workshops, such as the one about Bioinformatics, Evolutionary Biology. STEM knowledge about different relevant topics also took place while learning from each other during the final conference presentations.

In addition, the 2022 GEM Summer Camp in Spain offered girls the opportunity to develop transversal skill such as teamwork, tolerance, organizational skills, enthusiasm, self-motivation, open-mindedness and communication skills while working and collaborating with others.

In conclusion, we could say that through a combination of pedagogical approaches such as inquiry-based learning, context-based learning, experiential and social learning, the GEM campus in Spain had provided girls with inspiring role models in the STEM field and meaningful and positive learning experiences. Female role models have been essential for girls to build their STEM identity, feeling part of a GEM community in which, the STEM identity have been developed in an inclusive and collaborative environment.

(b) Focus on entrepreneurship

(How was the focus on entrepreneurship achieved?)

The focus on entrepreneurship was developed following two main strategies:

1. Organising meeting and talks to interesting women who have succeeded in creating their own STEM business and who acted as role models for girls. This was the case of Isabel Cano-Cabellero who funded a knowledge-based company called Bioliza and gave the talk entitled “The happiness of overcoming barriers” or the experiences shared by three young STEM entrepreneurs who have funded the company called Allgenetics.
2. Engaging girls in activities and workshops aimed at developing specific entrepreneurial skills related to the generation of innovative ideas, defining target groups, shaping a business plan and learning how to communicate ideas in an appealing and effective way.

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.

We proposed that girls presented an entrepreneurial proposal 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 has been planned on the first day of the week. Then, each group of girls together with their mentor have worked on their entrepreneurial proposals and presented their entrepreneurial idea at the Final GEM Conference.

This activity has offered an interesting opportunity to acquire key knowledge about STEM entrepreneurship in a meaningful way and to engage in a hand-on activity to shape innovative ideas in a creative way, giving rise to something new and valuable, while developing

(c) Technology

Girls developed digital skills through:

1. The engagement in STEM research projects on different technological applications to improve people's lives. This is the case of the STEM research projects related to programming, robotics or the application of machine learning to
2. The participation in specific workshops. This is the case of the practical activity in a computer room where girls were introduced to bioinformatics and its application to the study of evolution. The participating girls had the opportunity to develop digital skills and resources related to building phylogenetics trees from genomic data through computational methods.
3. Computer-based communication and collaboration when co-creating final products and presentations.

5. The learning plan for the summer camp

(Include a copy of your learning plan.)

The learning plan was designed to make girls:

- Becoming aware of fascinating professional activities led by women in the STEM field.
- Taking part of a STEM research project in collaboration with a mentor.
- Learning about STEM contents related to health and diseases, microorganisms, environment and climate change, artificial intelligence, programming and robotics.
- Acquiring digital skills related to the use of technical devices for data collection, data management, modelling and programming.
- Developing entrepreneurial skills such as creativity, autonomy, leadership and decision-making through the participation in a constructive project to develop an innovative idea in the STEM field.
- Developing digital skills related to the use of ICT for the presentation and communication of research results.
- Developing their identity in scientific research and/or STEM professional fields.

To this end, 59 girls from all around Jaén province lived an intensive week of exciting experiences inspired by 11 female scientists (mentors), who welcomed them in their own

research projects, providing them with an immersion experience in cutting edge research topics, such as artificial intelligence for a better world, using machine learning for making good decisions, microorganisms zoos and much more. The community of girls and female mentors had plenty of opportunities to experience and discuss the social relevance of the research conducted by close role models and shared a wide range of activities, including outdoors visits to interesting natural places, like Mágina Mountains, speeches by interesting female entrepreneurs, such as a designer of scientific jewellery or the founders of STEM enterprises such as Bioliza or Allgenetics, as well as playful interactive activities, where they had the opportunity to communicate to each other and create something innovative together, expressing their full ICT and entrepreneurial potential.

The research projects conducted by girls in collaboration with their mentors were:

Artificial intelligence and machine learning to improve society: caring about society and the environment: Girls were introduced to techniques such 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. This project introduced girls in the application of Human Language Technologies (TLH), 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. Girls have learned 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, girls determined 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, girls investigated the molecular causes that lead to infertility in humans. To do this, they learned to manage public biological information sources, from which they obtained data that would be later analyzed using bioinformatics tools.

What do wetlands hide? Finding out cryptic biodiversity through digital images: Girls learned 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.

Microbiological Zoo: During several days, girls used the powerful vision of the microscope to analyze and visualize the surrounding microorganisms and value their relevance.

The 2022 GEM summer camp finished with a final open-door congress, where the participating girls presented their projects to their family and the whole community and disseminated the experience through the media. It was an event that took place the last day of the week and it brought together all the girls participating in GEM and their families, mentors and various representatives of the University and other educational institutions.

6. Learning Outcomes

(List the learning outcomes targeted.)

The learning plan was designed to promote:

- Girls with knowledge of inspiring role models and their meaning.
- Girls with knowledge about the STEM/digital world of work.
- Girls with entrepreneurial mind-sets.
- Girls with transversal skills.

The following table shows which activities contributed to any of the learning objectives:

Table 1. Types of activities and learning outcomes

Learning Activities	STEM/ICT subject knowledge	Knowledge of inspiring role models and their meaning	Knowledge about the STEM/digital world of work	Entrepreneurial mind-sets	Transversal skills
Immersion in real research with mentors	x	x	x	x	x
Entrepreneurship workshop		x		x	x
The GEM Gymkhana	x				x
"Bioinformatic for Evolution" Workshop	x	x	x		x
Scientific Illustration workshop		x		x	x
Visit to the National Museum of Natural Science	x		x		
Entrepreneurship forum		x	x	x	x
Inspiring talk at Final GEM Conference	x	x	x		
Girls' presentation at the Final GEM conference	x			x	x
Free time for building up the GEM community		x			x

7. Mentors

(Describe the involvement of mentors, how they were recruited, the number, their STEM backgrounds, how they were trained/prepared for the summer camp.)

The mentors and lecturers in the Spanish 2022 GEM summer camp were purposefully selected to act as STEM role models. They were selecting according to their potential for engaging girls in STEM activities and making them feel inspired by them and identified with them. They have a previous background in science communication and a positive attitude to overcome the gender gap in STEM. UJA partners had several meetings with mentors in advance to share with them the objectives of the

summer camp and gender-sensitive pedagogies. The following tables show the mentors and lecturers that participated in the Spanish 2022 GEM summer camp

Table 2. Mentors of STEM research project in the Spanish 2022 GEM summer camp

Mentor	Biographic - Project
Maite Martín Valdivia	Vicerrector of ICT and Professor at the Department of Informatics of the University of Jaén. She began her professional career working in a financial institution as a computer technician and now she is dedicated to research in natural language processing. Research project offered: "Talking to robots: Artificial intelligence to improve communication".
Raquel Hernández Cobo	Professor and researcher at the Department of Experimental Biology (University of Jaén). She started her professional career at the University of Jaén at the hands of great researchers, colleagues and now friends, who passed on their passion for science and knowledge as a tool and engine for solving society's challenges. Research project offered: "Histological study of the cellular response to cerebral ischemia".
Gema Parra Anguita	Professor and researcher at the Department of Animal Biology, Vegetal Biology and Ecology (University of Jaén). She started her professional career in marine aquaculture and now she is dedicated to aquatic ecotoxicology. Research project offered: "What do wetlands hide? Finding out cryptic biodiversity through digital images".
Fátima Aguilera Padilla	Lecturer at the Department of Didactic of Science (University of Jaén). She began her professional career in the area of Botany at the University of Jaén and now she is dedicated to teaching and research in Didactics of Experimental Sciences. Research project offered: "Is pollination at risk? study of the production and viability of pollen grains".
Mª José Grande Burgos	Researcher at the Department of Health Science (University of Jaén). She started her professional career in the field of Microbiology and Genetics and now she is dedicated to teaching and research identifying pathogenic microorganisms in food and in the environment. Research project offered: "Microbiological Zoo".
Eva Vargas Liébanas	Postdoctoral researcher at the Department of Experimental Biology (University of Jaén). She graduated in Biology at the University of Jaén in 2014. Then, she studied a Master's in Biotechnology and Biomedicine, which allowed her to get a PhD in Molecular and Cellular Biology. Her research focuses on the study of the molecular bases of infertility through computational analysis.

Mentor	Biographic - Project
	Research project offered: "What is essential is invisible to the eye: genes, proteins, microorganisms and their role in human reproduction".
María José del Jesús Díaz	Professor and researcher at the Department of Informatics (University of Jaén). She began her professional career as a teacher at the university where she started her research. She currently coordinates a research group on Artificial Intelligence, in which they develop techniques that are applied to Medicine, Economics, Ecology, Security and Renewable Energies. She enjoys this profession and tries to transmit that passion. Research project offered: "Artificial intelligence and machine learning for society".
María Dolores Pérez Godoy	Professor and researcher at the Department of Informatics (University of Jaén). Since she began her professional career as a University professor, she has dedicated, on one hand, to teaching in the field of Computer Science and, on the other hand, to research in the area of Artificial Intelligence applied to knowledge extraction. Research project offered: "Artificial intelligence and machine learning for society".
Marta Molina Pérez	Student of the Bachelor in Informatics Engineering. She will support the implementation of the project "Artificial intelligence and machine learning for society" during the GEM Summer Camp 2022 led by María Dolores Pérez Godoy and María José del Jesús Díaz.
María Isabel Cabrera Bermejo	Student of the Master Degree in Informatics Engineering. She will support the implementation of the project "Artificial intelligence and machine learning for society" during the GEM Summer Camp 2022 led by María Dolores Pérez Godoy and María José del Jesús Díaz.

Table 3. Lectures leading conferences and workshops in the Spanish 2022 GEM summer camp.

Lecturer	Workshop/Conference
Ximena Villalonga	Designer of scientific jewelry and founder of the Xcience Designs company. She will lead an entrepreneurship workshop focused on supporting students to polish their seed entrepreneurship proposals, thus set up as a forum for discussion and question/answer approaches.
Gema Torres Luque	Professor and researcher in the Department of Didactics of Body Expression and director of the Secretariat of Physical Activity and Sport (University of Jaén). She will

Lecturer	Workshop/Conference
	organize the GEM Scientific Gymkhana supporting the building of the GEM community between girls who will learn about STEM in a fun and dynamic way.
Carolina Osuna Mascaró	She got a PhD in Fundamental and Systems Biology in the University of Granada for her research about hybridization as an evolutionary driver for speciation. Currently, she is a Postdoc Associate in the University of Nevada (Reno, USA) studying population genetics of different plant species. She will offer the workshop "The power of Bioinformatics to study the past of living beings" together with María Martín Peciña.
María Martín Peciña	She got a PhD in Fundamental and Systems Biology in the University of Granada for her research in evolution and adaptation of genomes to the presence of selfish chromosomes. Currently, she is a researcher in Science Education at the University of Jaén. She will offer the workshop "The power of Bioinformatics to study the past of living beings" together with Carolina Osuna Mascaró.
Alejandra Perina Neus Marí-Mena Paula Ramillo	A company made up of a highly-motivated and extremely well-assembled group of young scientists carrying out hundreds of genomics-related projects for leading research institutions and companies from different countries and continents. They will offer a workshop about enterpreneurship highlighting key points to make an idea come true.
Agueda Gras-Velazquez	Dr. Agueda Gras-Velazquez (Astrophysicist / Management) is the Science Programme Manager of European Schoolnet (EUN). As Head of the Science Education Department at EUN, she is in charge of overseeing and coordinating all the Maths and Science projects in which EUN is involved. Additionally, she is in charge of the day-to-day management of "Scientix" (the community for science education in Europe, http://scientix.eu), coordinates EUN's Ministries of Education STEM representatives Working Group and from January 2017, she manages the European Schoolnet Academy. In her over 10 years at EUN, Agueda has been involved in over 35 European Commission funded projects and 13 private funded ones; and sits in the advisory board of a number of projects. Prior to joining EUN in May 2008, she worked as an independent eLearning Professional, as Tutor, Content designer, IT manager, Administrator, Project Manager and Consultant for international projects. She has co-authored several papers in the area of Science Education Research and has a PhD in Astrophysics from Trinity College Dublin, which she carried out at the Dublin Institute for Advanced Studies in Ireland.

8. Evaluation data collection

(Describe the preparation related to data collection such as obtaining permissions, consents.)

During the application process the parents were asked to indicate whether they provide consent for data collection, including recording of some sessions, photos and responding to questionnaires. All parents provided the written consent for data collection for research purposes and for the use of photos for research purposes.

9. Challenges encountered

(Describe challenges encountered and how these were tackled.)

Some of the challenges encountered are related to the cultural context where the campus was implemented. Since the GEM campus took place during the school summer break in Spain and the participation in the GEM campus was a voluntary activity, girls decided freely if they want to take part or not. Within this context, the ones who chose to do so are those highly interested in STEM, with good referents that encouraged them to take part and with a strong STEM background. Therefore, the main challenge encountered as it is reflected in the pre-questionnaire data, **is to engaged girls with a weak background in STEM education and with low interest in this field**. Anyway, we tried our best to engage those groups by using the following strategies:

1. Explicitly getting in touch with schools in unfavourable socio-cultural conditions and making sure that they got information about the GEM summer camp.
2. Collaborating with schools to identify girls that could most benefit from the GEM summer camp due to their personal background.
3. Reserving some of the positions (at least 5%) for girls in unfavourable conditions.
4. Using an intensive advertisement campaign through different means and channels (school emails and specific emailing lists, newsletters and posts in social media to ensure that we reached a wide audience).

The second big challenge encountered was due to budget restrictions. The budget available was not enough to pay for girls' transport to the campus and for as many mentors as it would have been necessary to accept all the applications received while allowing girls to work in small groups for doing research in STEM projects and being with a mentor acting as a role model. Neither did we have enough budget to pay for girls' overnight accommodation while taking part in the GEM summer camp. This challenge had the following implications:

- There was a limited number of mentors and therefore a limited number of positions that could be offered.
- The campus took place only during the day (with no overnight stay).
- Only those girls that could afford personal transportation to the campus everyday applied for the campus.

The strategies used to overcome this challenge were:

1. To set a maximum number of participants to ensure the quality of the activities and resources being used while ensuring that we achieved the promised minimum figures of participation in any country.
2. To covered part of the costs institutionally.
3. To apply for extra funding to the International Union of Biological Sciences (IUBS).

10. Evaluation of the summer camp

59 girls aged 13-18 joined the 2022 GEM Summer Camp in Spain. In relation to their previous background in STEM subjects, all of them have studied Mathematics, 57 studied Biology, 54 of them studied Physics and Chemistry and 53 of them studied Technology. These data showed that most of participants had a strong STEM background.

Table 4. STEM background of participants in the 2022 GEM summer camp in Spain.

Subjects previously studied	Participants	Percentage
Mathematics	59	100
Biology	57	97
Physics and Chemistry	54	92
Technology	53	90

From the qualitative information collected we can see that 72% of girls stated that they joined the GEM campus mainly because they were interested in STEM, while the rest mentioned the influence other people (parents, teachers and friends), or other causes.

In relation to their intention to study a STEM career, 39% said that they would like to work in a health-related profession such as doctor or nurse, 24% of participants mentioned careers related to Biology, Earth Sciences, Engineering, Technology, Physics or Chemistry. Therefore, over 60% of the participants showed a strong orientation towards STEM related jobs before starting the GEM summer camps and the rest responded that they did not know yet or mentioned other careers such as being a teacher.

In the following table we can see means (M) and standard deviation (SD) for any of the dimensions of the GEM questionnaire distributed before the campus (pre-test) and after the campus (post-test) among all participants (N=59), measuring girls' attitudes towards STEM and STEM careers. When filling those questionnaires girls had to express their agreement with a set of statements using a 5-point Likert scale, with 1 being the least favourable response and 5 being the most favourable response. The results are presented in the following table:

Table 5. Some statistics from participants' pre and post questionnaires.

Dimension	Statement	M (SD) Pre-test	M(SD) Post-test
STEM_interest	I am interested in learning about STEM.	4,51 (0.77)	4,40 (0.65)
STEM_enjoy *	I enjoyed learning STEM topics	4,22 (0.79)	**4,31** (0.68)
STEM_effort	Making an effort in my STEM subject(s) is worth it, because this will help me in the work I want to do later on.	4,49 (0.73)	4,41 (0.75)
STEM_study	What I learn in my STEM subject(s) is worthwhile for me because I need this for what I want to study later on.	4,22 (0.97)	**4,29** (0.82)
STEM_useful *	STEM is useful in helping to solve the problems of everyday life.	4,06 (0.65)	**4,21** (0.81)
STEM_easy *	STEM is easy for me.	3,80 (0.85)	**4,03** (0.90)
STEM_knowledge	STEM is helpful in understanding today's world.	4,48 (0.63)	4,48 (0.68)
STEM_job*	It is important to know STEM in order to get a good job.	4,00 (0.89)	**4,03** (0.94)

* Show some gains with different effect size. No statistical differences found as overall sample. In red are dimensions showing a decrease. In bold are dimensions showing an increase.

it seems difficult to perceive significant changes in the post test mainly due to the high bias in the initial responses. We can see some changes in 5 out of the 8 items of questionnaire. In two of the items (interest and effort) there was a slight decrease in pre and post measurements. It might be due to the fact that the initial level of interest was already high (over 4.5 out of 5) and that being immersed in real STEM research projects offers a view of the science's effort to develop highly reliable and consistent scientific knowledge. This interpretation is supported by some of the girls' quotes "Now I can see to what extent science is important and the huge effort made in science". Anyway, neither of the two reported decreases were statistically significant.

STEM knowledge seems to maintain after the GEM campus with no significant difference. On the contrary, we can see an increase, in terms of gains pre-post, in means scores in 5 out

8 dimensions. In the following, we will discuss and complete the results showed in the above table, triangulating them with data from the qualitative analyses of girls' comments about the campus.

There was an increase (no significant) in girls' perception of the relevance of STEM and their role in it (*"What I learn in my STEM subject(s) is worthwhile for me because I need this for what I want to study later on"*) and their views of STEM future jobs (*"It is important to know STEM in order to get a good job"*). Quantitative results in these two dimensions are strongly supported by other girls' comments identified during the qualitative analysis:

> *"...my view of science has changed because I found out that science has a lot of applications"*
>
> *"I already liked science but now, I can see to what extent it is present in our lives"*,
>
> *"Now I can see science everywhere"*

In addition, we can see increases in the perceived usefulness, enjoyment and easiness when learning about STEM (with different effect size, but not significant), this later being the dimension with lowest pre-test scores and with bigger gains. These results are strongly supported from the qualitative data analysed:

> *"I understand it better"*,
>
> *"Now I understand much more and I think science is incredible"*
>
> *"I see it more real and accessible..."*
>
> *"I have learned it in a very practical way and I have enjoyed it"*
>
> *"I have experienced that I can enjoy it and I want to continue research"*
>
> *"I like it much more than I did before"*
>
> *I find STEM much more interesting now"*

After the 2022 GEM summer camp, participants were asked if their view of science had changed. The majority (83%) considered that they had changed. In addition to the aspects previously commented (perceiving STEM easier than before, more accessible, more interesting and relevant and highly enjoyable), girls mentioned the following issues when justifying the change in their view of STEM.

> *"I have found out different fields in STEM that I did not know before"*
>
> *"because I have learned about innovation and entrepreneurship in STEM"*
>
> *"I have a different view now, I can see that women have a quite important role in STEM, though it seems they don't"*

These data could provide evidence that the campus was successful in enriching and improving girls' views of STEM including the gender perspective and the key role of women. After the campus they felt that they have a developed a better understanding of STEM and

perceived it as more accessible, easier and more enjoyable. They have recognised its presence and relevance in today's society and discover a wide range of professional options they could undertake in the STEM field, developing their digital and entrepreneurial potential.

11. Lessons learnt

(Include a description of what you have learnt from the organization of summer camps for girls. This may refer to content, organization and other matters.)

We can comment on some lessons learnt coming out from the evaluation data and from the organisers' discussion and reflection about the experience lived.

From the qualitative feedback received from the participants' comments, we can see that girls mostly liked outdoor activities such as the scientific gymkhana and the field trip and the research activities conducted with their mentors, as well as some of the practical workshops. They mentioned that what they like worst are talks, especially those which are less interactive or are made online.

In addition, we found several comments expressing appreciation of social aspects and team work:

> *I like it because "we (girls) were together working in team works"*,
>
> *"I would recommend more activities to enjoy time together and express our emotions"*,
>
> *"more team work"*.

The experience shows that a summer school is mostly seen an out of school activity in which the students expect to have fun as well, and spaces for social interaction, therefore interactive activities that combine fun with learning are more suitable.

When participant girls were asked how to improve the campus, they suggested trying to avoid the heat in July and to offer the possibility to spend a whole week with 24 h a day and an overnight stay, instead of just some hours a day. They also suggested including more content about medicine and health related careers, technology and other activities for studying animals.

From the organisational point of view, we have learned that implementing a STEM summer camp requires a lot of resources and enough budget to support transportation, accommodation, meals and all the STEM interactive and research activities, as well as the key participation of mentors and inspiring role models, that could share their personal and professional experience.

In addition, it requires a lot of preparatory work and it is necessary to do it well in advance. The logistics of organising a summer school (co-designing, preparing a wide range of

activities, arranging catering, making a good advertisement campaign, etc…) takes a lot of time and needs to be carefully planned.

12. Recommendations related to the organization of out of school events for girls

(Include any recommendations such as recommendations for policy makers)

There is a need to address the gender gap in STEM and to offer learning experiences that make girls feel that STEM learning is easy, accessible, enjoyable and relevant in today's society. They need to increase their self-efficacy in STEM and feel empowered to choose STEM careers, recognising the key role of women in STEM and the need to ensure that society does not miss human potential and a comprehensive and inclusive perspective when addressing current scientific and technological challenges.

Girls highly appreciate interactive and practical activities where they can collaborate with other girls and express their emotions.

Outdoors activities and research activities in collaboration with mentors are very well evaluated by girls.

Girls appreciate practical workshops that help them to discover new fields in STEM and to develop digital, technological and entrepreneurial skills.

Offering these kinds of activities as a STEM summer camp requires resources and effort and need to be appropriate supported and very well prepared and organised in advance.

13. Photos and other evidence

We can find a lot of images from the 2022 GEM Campus at the following digital library:

https://www.flickr.com/photos/101992261@N07/albums/72177720300453995/

GEM Summer Camp 2022 – Sweden

1. The Context

(Provide some background information on the educational context including for example ages of compulsory education, subjects taught (especially whether STEM, entrepreneurship and ICT are compulsory), age when students make subject choices, if any etc.)

Participants of the summer camp are born in 2007-2008, which means that they just finished year 7 or 8 in secondary in the Swedish school system. This means that they started reading the science courses separately for the first time. In lower secondary all these subjects were treated as one subject cluster “science”, so for the first time biology, physics, chemistry and technology are taken as stand-alone subjects equally as e.g. mathematics. This also means that the STEM subjects are compulsory in the Swedish school, but entrepreneurship is not treated as a subject but a compulsory content/competence that is included in these subjects’ curriculum and syllabuses.

STEM-subjects mandatory hours taught in upper secondary: Mathematics 400h, biology 75h, physics 75h, chemistry 75h and technology 88h.

2. Recruitment

(Provide information about the advertising and recruitment campaign, what worked and what was less successful. Describe activities, tools, materials used in the advertising strategy.)

Since the Teknikkollo has been a re-occurring summer activity the last years it is fairly well-known, and schools around know it runs during the summer. Advertising has been done via existing email-lists to both schools and parents.

Teknikkollo was carried out by KomTek, which is part of the operations at Upptech - Jönköping Science Center in collaboration with Jönköping University. KomTek stands for Municipal Technology School and Entrepreneurship and they work actively to get children interested in science and technology.
Our Teknikkollo (that is our summer school) runs for 4 days/week with a fairly dense program. Both girls and boys are allowed to participate, but we see it more as the boys fill out the places. All girls who apply get a place but not guys. Our experience is that girls develop better in a heterogeneous environment and that the boys' view of girls and technology is at least as important to get girls more comfortable with technology in the future. The second years summer school had less participants than the first year.
The difference in the number of participants had nothing to do with demand but the opportunity to staff Teknikkollo in 2022. In 2021, 47 participants participated in total, of which 18 were girls (Conducted over three weeks) In 2022, 17 participants participated, of which 7 were girls (Conducted for one week). So if we would have had been more successful in recruiting teachers/mentors we could have had larger groups of students also this year. Those who had taught earlier years summer schools had gone to other assignments and could not be hired this year.

3. Summer camp support site

(Provide brief information and link to the summer camp support site.)

At our support site there´s brief information about the summer camp, who arranges, venue, dates, information on targets group, content delt with and information on how to apply.

Link to the summer camp support site:

https://ju.se/GEM

4. The Plan

(Give a description of the ideas behind the learning plan; people supporting the plan such as any companies e.g. ICT or software companies. You may include copies of adverts, posters etc. Describe your plans. What did it involve? (How many days and how many hours in each day? Where were the sessions held? What kind of activities have you planned? Did you organise trips? Who was involved? What is the agenda?)

Departing from what is included in Swedish STEM school curriculum and syllabuses the summer school is designed to deepen and broadening the knowledge base in these courses and especially create space for more practical work with problem-based approaches and hands-on activities which is more difficult to achieve ordinary school settings. Activities also include meetings with role-models from industry. The days was planned with re-using earlier developed activities in previous summer camps and was the further developed in collaboration with Jönköping university and a representative from Saab enterprise. The entrepreneurial perspective was central, and activities was thus designed to be carried out in mictro-project formats.

Teknikkollo was carried out by KomTek, which is part of the operations at Upptech - Jönköping Science Center. KomTek stands for Municipal Technology School and Entrepreneurship and we work actively to get children interested in science and technology. Our Teknikkollo runs for 4 days/week with a fairly dense program. Both girls and boys are allowed to participate, but we see it more as the boys fill out the places. All girls who apply get a place but not guys. We feel that girls develop well in a heterogeneous environment with us and that the boys' view of girls and technology is at least as important to get girls more comfortable with technology in the future.
The difference in the number of participants had nothing to do with demand but the opportunity to staff Teknikkollo in 2022. In 2021, 47 participants participated in total, of which 18 were girls (Conducted over three weeks) In 2022, 17 participants participated, of which 7 were girls (Conducted during one week)

The first two days, the participants learned basic knowledge in how to connect with simple electrical components in closed circuits and learn to solder. They first manufacture a diode board based on their own design. Some then sewed diodes into caps and pen bag. Some soldered circuits boards and made their own beep box that emits sound based on the light level on the outside of the can. They gained basic knowledge of how a MicroBit works and test how to control and regulate things around us with such a thing as fans, thief alarms, street lamps. They gained basic knowledge in how to design in the cad program Tinkercad. They had to print hooks, keychains in our 3D printers and use the laser cutter to cut out and engrave, for example, signs and coasters.
The last two days it was time for their own project based on their own needs/ ideas where they use the newfound knowledge to make a composite product that will be stylish and unique. Before we start our own project, we have a talk about entrepreneurship and the different steps in a prototype development and product development. We use materials from KomTek Sweden and Teknik Collage. Short films and discussion questions. An example of built things is a radio-controlled car in which the body is designed and then cut out in the laser cutter, paired with the parent control board, motors, servo motor, as well as diodes for front and rear lamps. The car is controlled using 2 Microbits that communicate with each other through radio waves. Another example is a girl who built an automatic cat feeder. It was built in corrugated cardboard and pet bottles where the feed was controlled by a microbit that reacted to the light level dropping when the cat pushed its head into the vending machine. The servo motor then rotated and pushed a decent amount of cat food into the bowl. Someone made a chocolate wheel cabinet where visitors could hope to win a chocolate bar. This was controlled by a microbit that was programmed to start and stop the wheel.
Our initial plans were to cycle to companies and carry out physical study visits to the local area to connect our business to reality. Due to the pandemic, we had to find another solution. Both years, the participants got to meet an engineer digitally in our theatre. She works at SAAB in Linköping and is involved in developing solutions that are used in the reconnaissance aircraft Global Eye. She told her path with technology through life as well as emotions associated with it. The participants were completely enthralled by her story and discovered that you can combine your interests to work with a very interesting job, such as technical gadgets and the environment. The participants got to see a wide range of technology areas that SAAB has worked with in Sweden for a long time and what they are working on now and how they are preparing for the future. The participants asked many questions and all the groups commented afterwards that they had expected to meet an old man and not a young exuberant girl. Some guys reflected that "it didn't feel so fair between girls and guys in the adult world" and asked Emelie the engineer how she viewed it.

The closing day was used to finish their projects and to make a short film describing their week at Teknikkollo. There was also the opportunity to try programming some of our robots we have at the centre. The films were shown to all participants together with popcorn cosiness as a conclusion to Teknikkollot.

5. Learning Outcomes

(List the learning outcomes targeted.)

The purpose of teknikkollo is to inspire young people to technology, provide technical self-confidence and, in the longer term, contribute to a well-thought-out high school choice. Sweden needs a lot of work force with technical skills going forward and we must all contribute to this! In addition, Sweden needs to level the gender-segregated labour market.

This camp will hopefully be a unique experience of science and technology with other young people. Our idea is that it should not end with the camp but that a genuine interest in technology develops.

6. Mentors

(Describe the involvement of mentors, how they were recruited, the number, their STEM backgrounds, how they were trained/prepared for the summer camp.)

Helena is studying to become a STEM teacher at Jönköping University

Lina is studying for a Master of Science in Engineering Physics at Chalmers University of Technology in Gothenburg

Clara is studying for a Master of Science in Materials Science and Engineering at Uppsala University

Edvin studies History of Technology at Stockholm University Elsa studies at upper secondary school Natural Sciences programme

Hugo has studied at the upper secondary school Technical program

Linda Samuelsson is a STEM teacher and executive director of KomTek Jönköping and works at Jönköping University.

Together we were a good mix for the participants, both to be a role model, inspire and contribute with knowledge.

All mentors were engaged in the development and design of the summer school and was thus thoroughly introduced and involved.

7. Evaluation data collection

(Describe the preparation related to data collection such as obtaining permissions, consents.)

See attachment. Utvärdering Teknikkollo 1st Summer school.doc and Utvärdering Teknikkollo 2nd Summer school.doc respectively.

8. Challenges encountered

(Describe challenges encountered and how these were tackled.)

Insert text here

9. Other

(In this section you may include other relevant points not included above.)

Insert text here

10. Evaluation of the summer camp

(a) Quantitative

(In this section provide a quantitative evaluation of the summer camp, reporting changes related to how they perceive STEM, if any).

(i) Pre-summer camp

Who are the students participating in the summer camp? Number of participants, ages, subjects studied, career aspirations.

What are their attitudes towards science and STEM?

See attachments

(ii) Post-summer camp

Did their views and attitudes change after participating in the summer camp?

What do students have to say about their experience in the summer camp? Activities preferred or least preferred.

Educators' views.

Insert text, tables and charts here

(b) Qualitative

(In this section provide a qualitative evaluation of the summer camp, emphasizing good practices that worked and practices that could be improved. Include quotations from the students' and educators' feedback and other observations and comments collected. Include information related to specific activities or events.)

The students who were asked about the summer camp were all very satisfied with the camps. According to the quantitative evaluation all were satisfied to very satisfied, but in the interview setting a few students expressed that they were there more or less only because their parents wanted so. They were however also satisfied with the summer school. Especially they liked the hands-on activities (soldering, 3D-printing) and also they enjoyed meeting the Saabs person, who as the students expressed it "makes the subject more real – meeting a person is something we never do in school". The students also liked the format of presenting their ideas in a film, but some of them had wished for more support in how to do the movies.

11. Lessons learnt

(Include a description of what you have learnt from the organization of summer camps for girls. This may refer to content, organization and other matters.)

These two summer camps where we have used prior experiences from similar courses that we have held a couple of years has on one hand strengthened or belief that we have a format that works well, on the other hand now part of the GEM-project we have learnt how to be more explicit with learning plans, learnt from each other in the project. On a practical level we will be more clear in coming summer schools that we stress that the choice should be of the students themselves, not only parents wanting them to be there.

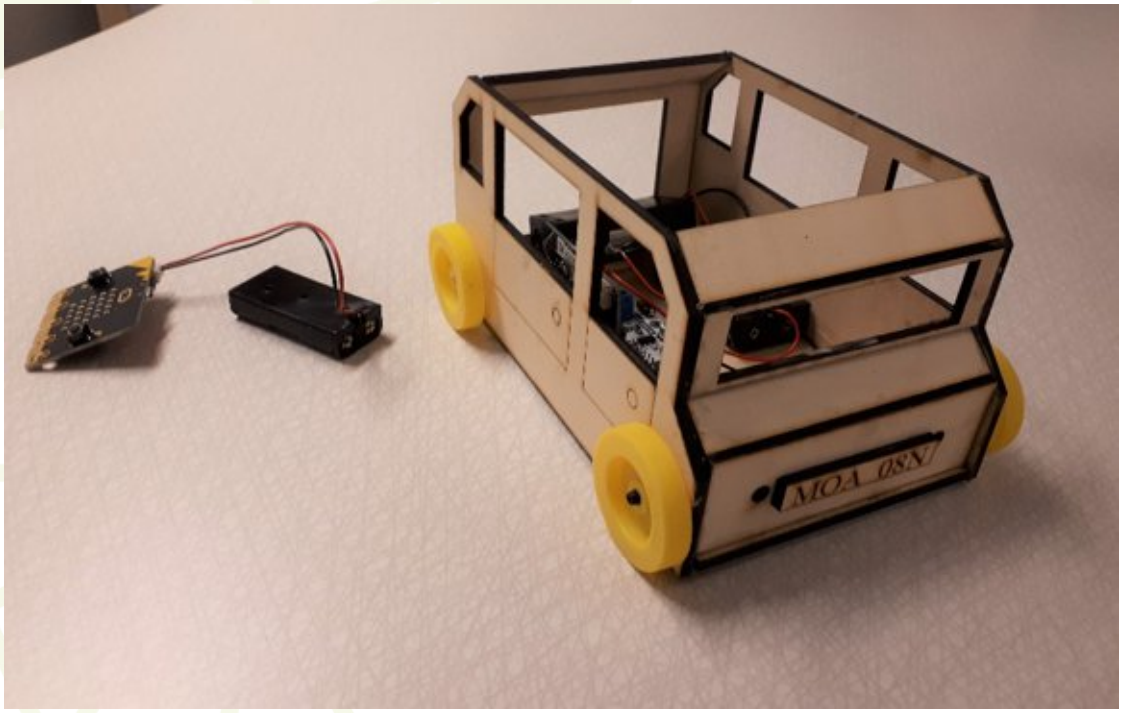
12. Recommendations related to the organization of out of school events for girls

(Include any recommendations such as recommendations for policy makers)

The main take away message to a policy level would be that we now do have appropriate formats for arranging summer schools, summer schools that we know do make a difference in that we see that it increases interest among those who participated in STEM subject. The students experiences things that are not that common in the ordinary schools. So what we need is funding to be able to carry on with these camps.

13. Photos and other evidence

(Include here)



ICSE
International Centre for STEM Education

GEM
Empower Girls to Embrace their Digital and Entrepreneurial Potential

Appendices: Evaluation instruments

The evaluation was based on the experience of the girls who participated but also their educators and the partners organising the events. A pre- and post- questionnaire were used to evaluate students' experiences of the summer camps. A short reflective questionnaire was prepared to obtain feedback from educators leading sessions with the students. A template with questions to be answered by partners helped the development of a case study report for each country.

Co-funded by the European Union

Dear students,

Through this questionnaire we would like to get to know how you feel about science and related subjects.

By filling this questionnaire you are giving your consent to participate in this survey. Please answer all questions. This questionnaire is anonymous, please do not write your name. Your answers will remain confidential.

To match your answers with your evaluation of the summer camp, we would like you to fill in the following code.

Mark the <u>first</u> letter of your mother's first name.																										
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	
Mark the <u>second</u> letter of your mother's first name.																										
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	
Mark the <u>day</u> of your mother's birthday.																										
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31

Section 1

1. Age _____ years

2. Which of the following subjects do you study at school? Mark each subject by circling a Y (yes) or N (no).

Subjects studied	Yes	No
Biology	Y	N
Chemistry	Y	N
Computing or IT	Y	N
Engineering	Y	N
Integrated Science	Y	N
Mathematics	Y	N
Physics	Y	N
Technology	Y	N

3. What job would you like to have in the future? _____

Section 2

This section of the questionnaire is interested in your perceptions of scientific disciplines. Usually it is best to respond with your first impression, without giving a question much thought. Choose one number between each adjective pair to indicate how you feel about the subject.

To me **SCIENCE**:

means nothing	1	2	3	4	5	6	7	means a lot
is boring	1	2	3	4	5	6	7	is interesting

To me **MATHEMATICS**:

means nothing	1	2	3	4	5	6	7	means a lot
is boring	1	2	3	4	5	6	7	is interesting

To me **BIOLOGY**:

means nothing	1	2	3	4	5	6	7	means a lot
is boring	1	2	3	4	5	6	7	is interesting

To me **CHEMISTRY**:

means nothing	1	2	3	4	5	6	7	means a lot
is boring	1	2	3	4	5	6	7	is interesting

To me **PHYSICS**:

means nothing	1	2	3	4	5	6	7	means a lot
is boring	1	2	3	4	5	6	7	is interesting

To me **FURTHER STUDIES in STEM** (the term STEM refers to scientific disciplines and includes Science, Technology, Engineering and Mathematics):

is ordinary	1	2	3	4	5	6	7	is fascinating
is unappealing	1	2	3	4	5	6	7	is appealing

Section 3 This section is about your feelings about school STEM subjects and studying STEM subjects. The term STEM refers to scientific disciplines and includes Science, Technology, Engineering and Mathematics. Use the given scale to show how much you agree or disagree with each statement. Mark your preference with a **X**.

		Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1	I am interested in learning about STEM.					
2	I generally have fun when I am learning STEM topics.					
3	Making an effort in my STEM subject(s) is worth it because this will help me in the work I want to do later on.					
4	What I learn in my STEM subject(s) is worthwhile for me because I need this for what I want to study later on.					
5	STEM is useful in helping to solve the problems of everyday life.					
6	STEM is easy for me.					
7	STEM is helpful in understanding today's world.					
8	It is important to know STEM in order to get a good job.					

Thank you for filling in the questionnaire.

Dear students,

Through this evaluation questionnaire we would like to get to know how you feel about the summer camp and the activities of the summer camp.

By filling this questionnaire you are giving your consent to participate in this evaluation. Please answer all questions. This questionnaire is anonymous, please do not write your name. Your answers will remain confidential.

To match your answers with the questionnaire you filled earlier, we would like you to fill in the following code.

Mark the <u>first</u> letter of your mother's first name.																										
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	
Mark the <u>second</u> letter of your mother's first name.																										
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	
Mark the <u>day</u> of your mother's birthday.																										
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31

Section 1: Use the given scale to show how much you agree or disagree with each statement. Mark your preference with a **X**.

	Following the summer camp:	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1	I can mention ICT-related uses and applications.					
2	I am aware of gender stereotypes.					
3	I am aware of the relevance of digital technologies in my life.					
4	I am ready to engage in science.					
5	I am ready to engage in ICT.					
6	I can imagine myself working in a science-related job.					
7	I can imagine myself working in an ICT-related job.					

Section 2: This section is about your feelings about STEM subjects **following the summer camp**. The term STEM refers to scientific disciplines and includes Science, Technology, Engineering and Mathematics. Use the given scale to show how much you agree or disagree with each statement. Mark your preference with a **X**.

		Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1	I am interested in learning about STEM.					
2	I enjoyed learning STEM topics.					
3	Making an effort in my STEM subject(s) is worth it because this will help me in the work I want to do later on.					
4	What I learn in my STEM subject(s) is worthwhile for me because I need this for what I want to study later on.					
5	STEM is useful in helping to solve the problems of everyday life.					
6	STEM is easy for me.					
7	STEM is helpful in understanding today's world.					
8	It is important to know STEM in order to get a good job.					

Section 3: Answer each question by selecting answers and/or writing explanations where necessary.

1. How did you learn/hear about the summer camp?

   a. From my friends
   b. From my teacher
   c. From my parents
   d. Through social media
   e. Through a school advertisement
   f. Other, explain: _____

2. Why did you participate in the summer camp?

   a. My friends were attending
   b. I am interested in science
   c. My parent(s) thought it would be good for me
   d. My teacher recommended it
   e. Other, explain: _____

3. Did you enjoy the summer camp programme?

   a. No, hardly ever
   b. Sometimes
   c. Most times
   d. Yes, almost always

4. Did you feel comfortable during the summer camp?

   a. No, hardly ever
   b. Sometimes
   c. Most times
   d. Yes, almost always

5. Do you think differently about science since attending the summer camp?

   a. No
   b. A little
   c. Quite a lot
   d. Yes definitely

Please explain your answer. _____

6. Which summer camp activity was your favourite? _____

Why? _____

7. Which summer camp activity was your least favourite? _____

Why? _____

8. Would you encourage other students to participate in the summer camp next year?

a. No, not at all
b. Probably not
c. Probably yes,
d. Definitely yes

Why? _____

9. Do you have any ideas how to make the summer camp programme better?

_____

_____

10. Do you have any ideas that can be used in another summer camp?

_____

_____

Thank you for providing feedback.

Evaluation of Summer Camp by Educators

Dear colleagues,

Thank you for your contribution in the GEM summer camp. Through this evaluation questionnaire we would like to get to know how you feel about the summer camp and in what way we may improve it.

By filling this questionnaire you are giving your consent to participate in this evaluation. Please answer all questions. This questionnaire is anonymous. Your answers will remain confidential.

1. **What was your role in the summer camp? Circle the appropriate letter.**
   a. GEM mentor
   b. Session leader
   c. Teacher from participating schools

2. **The summer camp was aimed at achieving a series of outcomes. Which of the outcomes) were targeted by your session/s? Please choose one or more as appropriate and mark with a X.**

Girls will acquire scientific knowledge.	
Girls will have increased interest in STEM/digital disciplines.	
Girls will want to know more about STEM.	
Girls will want to be involved in STEM.	
Girls will have a better insight into ICT sectors	
Girls will have a better understanding of topics such as stereotypes, including gender stereotypes	
Girls will be encouraged to study or pursue careers in STEM/digital sectors.	
Girls will become aware of their own potential.	
Girls will have the confidence to consider leadership positions in STEM/digital sectors.	

3. **In your opinion, to what extent were these outcomes reached? Please mark your preference from 1 to 5 if applicable.**

Outcome	**n/a** not applicable	**1** Small extent	**2**	**3**	**4**	**5** High extent
Girls will acquire scientific knowledge.						
Girls will have increased interest in STEM/digital disciplines.						
Girls will want to know more about STEM.						
Girls will want to be involved in STEM.						
Girls will have a better insight into ICT sectors.						
Girls will have a better understanding of topics such as stereotypes, including gender stereotypes.						
Girls will be encouraged to study or pursue careers in STEM/digital sectors.						
Girls will become aware of their own potential.						
Girls will have the confidence to consider leadership positions in STEM/digital sectors.						

Please comment to support the preferences you marked above including any observations or other evidence.

_____

_____

_____

_____

_____

_____

_____

_____

4. **What did you like about the summer camp and/or activity?**

_____

_____

_____

5. **What would you change from the summer camp and/or activity?**

_____

_____

_____

6. **Do you have any suggestions for improving the summer camp programme?**

_____

_____

_____

7. **Do you have any ideas that can be used in another summer camp?**

_____

_____

_____

Thank you for providing feedback.

GEM Summer Camp 2022 – [insert Country Name]

1. The Context

(Provide some background information on the educational context including for example ages of compulsory education, subjects taught (especially whether STEM, entrepreneurship and ICT are compulsory), age when students make subject choices, if any etc.)

Insert text here

2. Recruitment

(Provide information about the advertising and recruitment campaign, what worked and what was less successful. Describe activities, tools, materials used in the advertising strategy.)

Insert text here

3. Summer camp support site

(Provide brief information and link to the summer camp support site.)

Insert text here

Insert link here

Link to the summer camp support site:

4. The Plan

(Give a description of the ideas behind the learning plan; people supporting the plan such as any companies e.g. ICT or software companies. You may include copies of adverts, posters etc. Describe your plans. What did it involve? (How many days and how many hours in each day? Where were the sessions held? What kind of activities have you planned? Did you organise trips? Who was involved? What is the agenda?)

Insert text here

(a) Pedagogy

(Include a description of the pedagogy employed in the activities, giving examples.)

Insert text here

(b) Focus on entrepreneurship

(How was the focus on entrepreneurship achieved?)

Insert text here

(c) Technology

(How was technology incorporated to enhance girls' digital competences?)

Insert text here

5. The learning plan for the summer camp

(Include a copy of your learning plan.)

Insert text here

6. Learning Outcomes

(List the learning outcomes targeted.)

Insert text here

7. Mentors

(Describe the involvement of mentors, how they were recruited, the number, their STEM backgrounds, how they were trained/prepared for the summer camp.)

Insert text here

8. Evaluation data collection

(Describe the preparation related to data collection such as obtaining permissions, consents.)

Insert text here

9. Challenges encountered

(Describe challenges encountered and how these were tackled.)

Insert text here

10. Other

(In this section you may include other relevant points not included above.)

Insert text here

11. Evaluation of the summer camp

(a) Quantitative

(In this section provide a quantitative evaluation of the summer camp, reporting changes related to how they perceive STEM, if any).

(i) Pre-summer camp

Who are the students participating in the summer camp? Number of participants, ages, subjects studied, career aspirations.

What are their attitudes towards science and STEM?

Insert text, tables and charts here

(ii) Post-summer camp

Did their views and attitudes change after participating in the summer camp?

What do students have to say about their experience in the summer camp? Activities preferred or least preferred.
Educators' views.

Insert text, tables and charts here

(b) Qualitative

(In this section provide a qualitative evaluation of the summer camp, emphasizing good practices that worked and practices that could be improved. Include quotations from the students' and educators' feedback and other observations and comments collected. Include information related to specific activities or events.)

Insert text here

12. Lessons learnt

(Include a description of what you have learnt from the organization of summer camps for girls. This may refer to content, organization and other matters.)

Insert text here

13. Recommendations related to the organization of out of school events for girls

(Include any recommendations such as recommendations for policy makers)

Insert text here

14. Photos and other evidence

(Include here)