STREAMING GIRLS AND WOMEN INTO STEAM EDUCATION, INNOVATION AND RESEARCH

STREAM IT

D2.3 Research Report on obstacles and supports for gender equality and inclusiveness in STEM Education, R&I

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STREAM IT

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STREAMING GIRLS AND WOMEN INTO STEAM EDUCATION, INNOVATION AND RESEARCH

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List of abbreviations

HE	Higher Education
HEIs	Higher Education Institutions
STEM	Science, Technology, Engineering and Mathematics
STEAM	Science, Technology, Engineering, Arts and Mathematics
WP	Work Package
BA	Bachelor of Arts
BSc	Bachelor of Science
MA	Master of Arts
MSc	Master of Science
PhD	Doctoral Studies

Executive summary

This research report presents the findings of a sociological study conducted as part of **Work Package 2** of the "STREAM IT" project. The study's primary objective was to provide a **foundation** for the project's programs and initiatives aimed at encouraging girls and young women to pursue education in chosen STEAM fields. Designed to offer a current and comprehensive view, the research examines **women's status** in STEAM domains across Europe, pinpointing key points in girls' educational paths where targeted interventions could be impactful.

The research methodology was organised around three primary tasks. Task 2.1 involved a thorough review of existing sociological literature to highlight key findings and concepts that could inform the project's approach. Task 2.2 focused on exploring female students' experiences and perspectives, while Task 2.3 involved interviews with experts from formal (secondary and tertiary) and non-formal educational institutions to gather insights into current practices and perspectives in STEAM education. The analysis also aimed to assess institutional awareness of gender barriers and the support provided to girls/young women/women in ECR in the STEAM fields.

The data collection took place between **March and May 2024** across 15 European countries, with **online and in-person** methods. Anonymity was provided to all participants who consented by signing an informed consent form. In total, the literature review examined **346 sources**, while **97 female students** participated in semi-structured interviews, and **85 teachers and professionals** involved in STEAM education and outreach contributed through expert interviews.

Literature review

A diverse array of methodologies are employed in studying girls and women in STEM education and professions; although quantitative approaches get the lion's share of scholarly attention, qualitative and mixed-methods research are also present and complement the former quite well. In terms of geographical coverage of populations studied, a wide majority of publications cover Western perspectives (mostly U.S.), but one can also identify studies focusing on the Global South or Eastern Europe, which enables a more nuanced understanding and shows efforts to decolonize scholarship. Most research covers the experiences and situations of students enrolled in undergraduate studies, and the educational experiences from early childhood to pre-university are documented to a lesser extent; overall, studies reveal that there is no specific time when we start losing girls from a STEM track, that this leak happens throughout the pipeline - due to individual,

institutional, and cultural factors -, substantiating the idea that efforts to close the gender gap need to be made throughout their education.

Interviews with female students

The semi-structured interviews conducted with students across all three degree levels provided a nuanced view of the social realities young women face in STEAM fields. This report focuses on their motivations, as well as the challenges and opportunities they encounter. One of the main *motivations* for choosing studies in science, mathematics, or technology is personal interest and aptitude, although influences from family and school also play a significant role. Additionally, STEAM programs' strong social reputation and promising career opportunities make these fields attractive to young women.

Among the key challenges these students face, gender stereotypes and expectations were noted as primary obstacles. These stereotypes reinforce the notion of a disconnect between women's traditional social roles and the ideal image of a STEAM professional. Common forms of exclusion and discrimination stem from culturally ingrained concepts of "masculine" and "feminine" traits. Furthermore, a lack of supportive social relationships and an often unwelcoming, predominantly male environment in classrooms and faculties contribute to a diminished sense of belonging among female students. Finally, concerns about balancing work and family expectations frequently lead women to question their place in STEAM fields.

Despite these challenges, we identified three main sources of satisfaction for female students. A welcoming, inclusive environment with supportive social and professional relationships provides strong motivation to persist in their studies. Surprisingly, social norms that alleviate pressure on women to achieve high financial success allow many to choose careers aligned with their passions rather than financial needs. Lastly, the perception that gender inequalities are gradually diminishing, following a "natural" path of positive progress, reinforces women's sense of legitimacy in pursuing STEAM education and careers.

Expert interviews

The first subchapter explores perspectives from higher and secondary education representatives regarding increasing women's participation in STEM. It was revealed that opinions vary on whether targeted interventions, especially in fields with already high

female representation, are needed. Perspectives on the means of achieving gender balance are also diverse: only a few respondents advocate structural changes, many see women's inclusion as vital for diverse leadership and innovation, although essentialist views on the gendered contributions to team dynamics could be detected.

The second subchapter explores the institutional view and understanding on the obstacles girls and young women encounter in STEM education from primary school through professional career stages. Key findings reveal that, despite progress in gender equality in the fields of STEAM, many barriers persist including that societal stereotypes and family expectations discouraging girls' STEM career aspirations, educators may unconsciously reinforce biases at primary and secondary level, there are insufficient institutional support at tertiary level and university students often experience subtle exclusionary behaviours from peers and faculty. Societal expectations and institutional policies often lack adequate family support systems, creating barriers in hiring, advancement, and re-entry post-maternity for women researchers.

The third subchapter examines the strategies and approaches educational institutions employ and advise to support girls and young women in STEM fields. It reveals that while some institutions recognize the need for dedicated support (e.g., policy reforms, inclusive learning environment), there is limited formal commitment to institutional reforms, especially at the tertiary level. The interviewees highlighted the importance of individual empowerment through self-confidence building, mentorship, role models. Challenges in supporting girls and women in STEM education includes the limited formal support at senior management levels within universities and the reliance on volunteer-driven initiatives rather than systematic programs.Despite differing views on the necessity of gender-specific support, there is consensus on the role of supportive school environments and innovative methodologies that align with girls' interests to bridge the gender gap in STEM.

The fourth subchapter presents a series of expert recommendations aimed at increasing girls' participation in STEM fields. The following main recommendations for the area in need of intervention emerged: 1) Experts emphasised the value of early development of critical skills, such as problem-solving, research abilities, and leadership, as essential for building a solid STEM foundation and bolstering girls' confidence and interest. 2) The findings indicate that gender-sensitive training for educators is necessary to prevent the unintentional reinforcement of gender stereotypes that may deter girls from pursuing STEM careers. 3) Innovative, experiential learning approaches that prioritise real-world applications and creativity were frequently recommended. 4) Role models provide girls

with relatable examples of success in STEM, helping them visualise their potential paths in these fields. 5) The application of gender sensitive methodologies in early education is a necessity. 6) Financial barriers remain a limiting factor for many girls, particularly those from underprivileged backgrounds. 7) Community programs and parental support are seen as vital in breaking down societal barriers and sustaining interest in STEM.

I. Introduction

Despite growing attention, numerous studies, and various institutional and national programs aimed at addressing the underrepresentation of women in STEAM[2] fields, many disciplines within STEAM still experience significant gender imbalances among students, researchers, and faculty. The factors contributing to this disparity are complex and influence women's access to STEAM across all stages of education, from primary school to postgraduate studies. Cultural and social factors—such as gender roles, norms, and expectations—alongside structural barriers, play crucial roles in shaping women's aspirations, experiences, and decisions to pursue further studies in science, technology, engineering, arts, and mathematics.

The "STREAM-IT" project, as a European initiative, was designed to raise awareness about this issue and to encourage girls and young women across various age groups to pursue education in these traditionally male-dominated fields. To make these actions effective and address the challenges accurately, we conducted an in-depth sociological study engaging two key stakeholder groups: female students and educational experts, including STEAM teachers in both formal and informal education, faculty members, and policymakers. Additionally, we conducted a comprehensive literature review to map the primary sociological perspectives and research efforts that have sought to understand the gender imbalance in STEAM fields. The following research report summarises the results of the three studies carried out within Work Package 2.

II. Objectives and research questions

The objectives of the present Research report are, thus, to provide a point of departure for the future actions of the "STREAM IT" project through exploring on the one hand the status-quo in the scientific literature and on the other the most defining particularities of the present situation in Europe regarding women's access to STEAM. The systematic literature review aimed to identify those facts and processes of women's evolving status in STEAM, as well as its most significant determining factors that have already been

[2] Although STEM is more widely known, and for a while A (standing for Arts) has been put in brackets, in the present research report we will use no brackets to emphasise the importance of the inclusion of Arts as a male-dominated domain, and the relevance of the artistic approach in improving women's participation in the STEM fields.

demonstrated and which can serve both as a point of departure and which may reveal major gaps in the current knowledge. However, given the complexity and wide geographic coverage we also aimed at exploring the social realities and experience of female students, as well as, experts' practices and thoughts on integrating women into the STEAM fields.
Our study searched to answer the following research questions:

Literature review

RQ1: What is the current knowledge about girls and women in STEM education and professions?
RQ2: Which methodological approaches are employed in studying girls and women in STEM?
RQ3: Who are the main target populations of research on girls and women in STEM?
RQ4: How do diversity and inclusion emerge in studies on girls and women in STEM?

Semi-structured interviews with female students

RQ5: What are girls' and young women's main motivations for opting to pursue studies in a STEAM field?
RQ6: What are the patterns of difficulties they encounter during their studies?
RQ7: What are the main opportunities they identify during their studies?

Expert interviews

RQ8: What are the educational institutions' perceptions of gender equality in STEAM?
RQ9: What are the answers and strategies institutions employ to overcome barriers and gender-based inequalities in STEAM education?

III. Methodology

In order to understand the status-quo regarding women's situation in the STEAM fields and based on that to be able to design the best possible actions of STREAM IT in terms of adequately targeting girls and young women, most activities of Work Package 2 (titled "Capitalization and Needs-Based Methodology) were dedicated to exploring their current situation, the obstacles and possibilities they encounter during their studies, as well as to collecting thoughts, experiences and interpretations of all possible kinds of experts who work with girls in STEAM education or who are involved

in improving their opportunities. This two-stream empirical qualitative research was complemented by a thorough literature review to map all the relevant sociological studies that have been carried out in the past decade worldwide. In the following we provide the most important methodological details of the three studies that have been conducted.

1. Systematic literature review

The professional literature review (Task 2.2) aimed to explore existing social scientific knowledge on women's status in STEAM domains, and as such, it meant to serve as a point of departure for the project's own study, as it provides us with theoretical frameworks, concepts, methodological approaches, geographical and thematic coverage, and importantly, the most significant results and gaps that will inform our own research. In order to map the current knowledge on the topic of girls and women in STE(A)M education and professions, a research framework was developed and presented in D2.5 Concept Note for Implementing Work Package 2, which represented the overarching approach of the present systematic literature review.

For a comprehensive overview of research on the topic of this project, the systematic literature review followed a threefold approach: 1. a **state-of-the-art** approach, meant to provide a summary of the latest research (for 2023) indexed in Web of Science and SCOPUS[3], 2 trusted research databases that cover peer-reviewed journals, books, and conference papers/proceedings; 2. a **longitudinal** approach, designed to provide a wide perspective on influential research from Web of Science between 2014 and 2022, through its 10 most cited publications on the topic for every year under consideration; 3. a **local** approach, aimed to decolonize the knowledge on the subject matter, through peer-reviewed research published in 2023 and indexed in Google Scholar, written either in the national languages or in English, in journals from the participant countries[4] or other international journals. Thus, the three source databases to search and identify relevant literature are Web of Science, SCOPUS, and Google Scholar. The search protocol included using the keywords *girls* AND/OR *women* AND *STEM education*, to identify publications such as journal articles, book chapters, and articles in conference proceedings volumes based on title, abstract, and keyword search (*see Figure 1*). Search

[3] The publications considered for this section were those included in Web of Science and SCOPUS by May 31st, 2024, the date by which all resulting papers were identified in these databases and downloaded via the Babeș-Bolyai University subscription, due to the *Open Access* features of the articles, or following a request to the authors on ResearchGate. Thus, papers published in 2023 and indexed in the two databases after the mentioned cut-off date were not included in the present analysis.

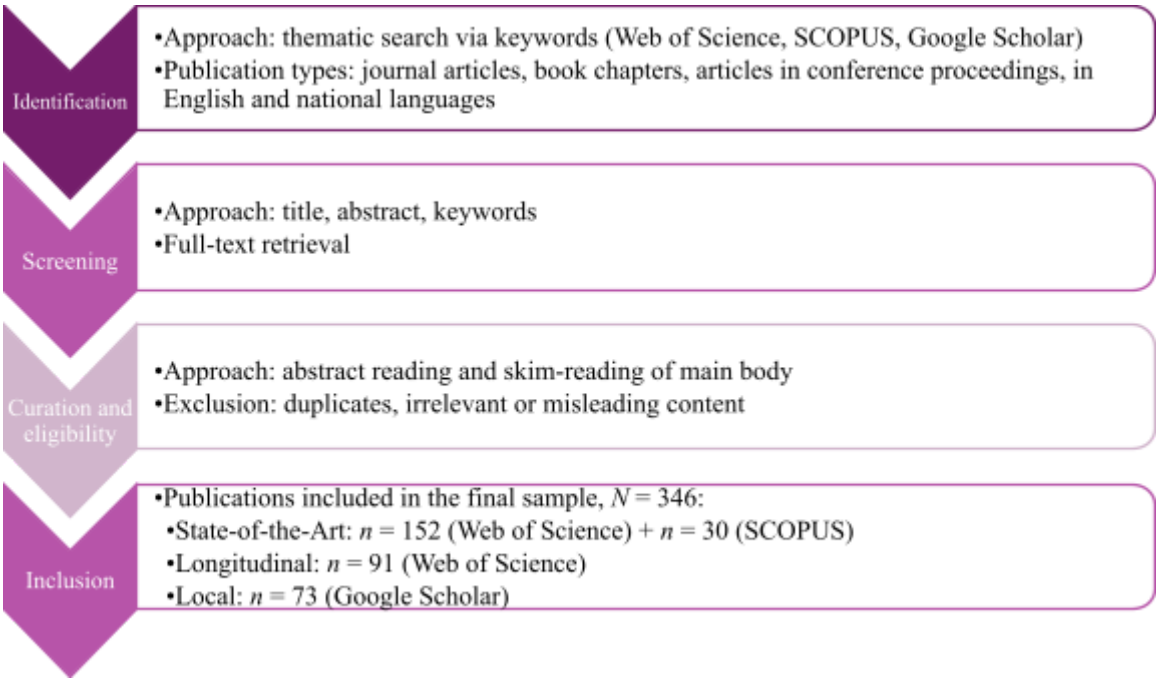
[4] The participant countries for this task are, in alphabetical order, Bulgaria, Hungary, Italy, Lithuania, North Macedonia, Poland, Romania, Serbia, Slovenia, Spain, and Ukraine.

results were then screened to identify relevant publications; full-text versions of the publications were then looked up via database links or via ResearchGate, where some authors were contacted directly to request the needed materials. Not all authors addressed these requests, but some did. Most publications included in the analysis come from *Open Access* publications, but due to our aim to include all relevant knowledge, even that restricted behind publishers' paywalls, we tried to retrieve as many publications as possible. For the longitudinal approach, search results for every year were ranked by citations and screened through title and abstract reading to assess relevance, and the 10 most cited articles for every year were then downloaded[5]. After downloading the papers, they were organised into folders and duplicates were eliminated. To further curate the final corpus of publications to be investigated, we needed to establish their eligibility, for which we employed abstract reading and skim-reading of the main body of the materials. We eliminated opinion-type articles and a few publications whose results were not gender-segregated, as they would not allow us to extract relevant data. We kept articles presenting biographies of women in STEM; our argument for this choice is that even if they represent case studies, they constitute celebrations of these women's work and may enhance awareness of women's achievements, making the case for increasing their representation in STEM. Systematic literature reviews also remained in the final corpus, as they allowed us to assess the interest in the topic and evaluate other similar approaches. For the local approach, all partners involved in this task were asked to identify eligible publications and extract the relevant data for further analysis. *What is also essential to note as a disclaimer is that*, for some of the publications, from their retrieval from Web of Science and SCOPUS and the elaboration of this analytical work, changes might have occurred in terms of year of publication, due to journal policy (i.e. the year of online first publication might differ from the year of publication of the full journal issue[6]), but we decided to keep these articles, as they meet our criteria. Thus, the final sample of publications in this analysis consists of ***N = 346*** materials, divided as follows: for the state-of-the-art approach, *n* = 152 publications from Web of Science and *n* = 30 from SCOPUS were selected for 2023; for the longitudinal approach, *n* = 91 articles from 2014-2022 were selected; and for the local approach, the final sample consists of *n* = 73 publications from Google Scholar (each country's contribution is discussed in the analysis section). All publications included in the corpus of analysis for the systematic literature review underwent reading for data extraction and data analysis.

[5] For 2021 there were 11 articles, as 2 of them had the same number of citations.

[6] For instance, among the publications indexed with their 2023 versions rank articles such as a later version of Hardtke et al., published online at the end of 2022, as well as earlier versions by Buenestado-Fernández et al., Chiang et al., Cyr et al., Gladstone et al., Henry et al., Lee & Riach, Reggiani et al., Sultan et al., whose final versions are indexed with the year 2024.

Figure 1. *(Re)search framework for the systematic literature review*



2. Semi-structured interviews with female students from STEAM domains

For every project that wishes to engage with and address the problems and difficulties of any "minority" group within a segment of society or a community, it is crucial that we understand the daily reality and experience of that group, as well as its members' interpretation of their situation. Whether we are focusing on the lack or restricted access of girls and young women to STEAM fields or the challenges they encounter during their studies and afterwards when trying to find employment, collecting those women's views who have pursued their studies in such an educational programme allows us to better fit our project to their real needs. This is the reason why one of the main methodological pillars of Work Package 2 was a qualitative study among current and former female students enrolled in one of the STEAM domains.

The study population

Our qualitative research targeted *all those women who at the time of our data collection were studying on either of the three degree levels defined in the European higher education (BSc/BA, MSc/MA and PhD), and it also included those who have opted out from either of these study levels up to five years prior to the data collection, again.* We decided not to use any age limits in the definition of the population. Geographically, it included the

participating countries of our project: Hungary, Romania, Bulgaria, Croatia, North-Macedonia, Slovenia, Serbia, Poland, Slovakia, Ukraine, Lithuania, Sweden, Spain, Italy and Iceland.

Sampling

Taking into consideration that the sample has been used for qualitative research purposes, the basic requirement it needs to meet is to "thematically" represent the study population. This means that during fieldwork researchers were asked to ensure the internal diversity of each country sample by selecting potential interviewees of different age, degree level, field of study, and if possible to take into consideration other possibly relevant variables, such as sexual orientation, family status and economic situation. In addition to current students we aimed to include opt-outs into the sample, but this was not a compulsory requirement from partners. However, we considered that by collecting the stories of those who decided to interrupt their STEAM-studies we can grasp some of the most problematic aspects of women's integration into a male dominated field, not denying of course the existence of other possible factors that could lead to opting out. Thus, the *convenience sampling* that we applied in this research allows for thematic instead of statistical generalisation, which means the analysis does not focus on the relative occurrence or the share of certain characteristics, neither makes it possible to observe correlations between variables or to provide statistical explanations. Instead, it aims to identify major patterns of experience and interpretation, as well as their internal structure which characterise women in STEAM. As one can observe in the table below, the most relevant variables which we have taken into account when making sure the qualitative sample was sufficiently varied, were, beyond the country where interviewees were pursuing their studies, the field of study and the level of degree.

Table 1. The composition of the convenience sample for the study of female students

Name of category	Categories	No of interviewees
Study field	Medicine	5
	Engineering	28
	Mathematics and data science	4
	Physics	5
	Architecture	5
	Pharmaceutics	3
	Biology and ecology	14
	Chemistry	6
	Computer science and Information Technology	14
	Agriculture and Forestry	3

	Arts, Design, Media Technology, Organisational Sciences	8
	Geography	1
	Geology	2
Total		**97**
Level of degree	BSc/BA	37
	MSc/MA	28
	PhD	30
	Opted out	2
Total		**97**
Age	18–21	19
	22–24	27
	24–26	38
	27–30	18
	31–46	10
Total		**97**
Country (in which the interviewee pursued her studies)	Ukraine	8
	Sweden	4
	Italy	6
	Poland	6
	Hungary	8
	Romania	12
	Serbia	5
	Iceland	2
	United Kingdom	1
	North-Macedonia	7
	Bulgaria	8
	Slovakia	2
	Slovenia	6
	Croatia	4
	Spain	8
	Lithuania	10
Total		**97**

For this study, interviews have been carried out in the first half of 2024, both in person and online. Before each discussion, interviewees were informed about the research and their role in it, and all of them gave their consent by signing an informed consent form which all partners are storing. In all cases, these interviews were recorded and afterwards, transcribed and translated into English for thematic analysis. Due to the internal logic and division of tasks within the project, among partners, there were several countries which although were included in the sample, participating institutions from those countries were not involved directly in the data collection. That is why the interviews from these countries have been conducted by other partners, across boundaries, mainly in English.

Nevertheless, the recruitment of interviewees was done by the non-data collecting domestic partners, based on pre-set criteria.

The interview guide was designed in such a way that it allowed for a rather unstructured discussion, although it contained predefined topics that were supposed to be touched upon in a more or less fixed order. First, in order to grasp current or former female students' most defining, essential and uninfluenced experience and interpretation of their studies all interviews were started with the same question: *"Please tell me about your journey to this STEAM field of study."* Identical openings of interviews in which interviewees are asked to answer a question as neutrally formulated as possible and which they are required to share their story of becoming whatever they were doing or being at the moment of the study is a means to allow them to construct their own narratives of reality, to – often unintentionally – select those topics that they consider the most important. In other words, these primary narratives which open up most of these interviews convey interviewees' own agendas of what really matters for them in the topic we study, of what the most important problems and issues are that affect them. In our case, given that in most of the cases being a member of a minority group (i.e. women) in a study programme, a class or a research group is usually likely to affect one's identity and feeling of self and also to impose a series of challenges in their everyday lives, we expected to record relatively long and detailed narratives of what it means to be a girl in a STEAM university programme.

This opening question was followed by a series of questions that addressed the major decisions and turning points in their lives: decisions regarding high school, tertiary and whenever it was the case, postgraduate education. Recurring themes that were brought into discussion by the interviewer – if the interviewee herself had not discussed it already – were the existence and role of significant others or role models who had had an impact on the young women's advancement in their field of study, e.g. teachers or parents. The interviews also included questions regarding interviewees' experience of school competitions, classmates' attitudes, friends' school choices. Regarding their experience in the university, interactions and relations with classmates and colleagues were scrutinised, learning habits, collaborations, aspirations, research activities, financial aspects were among the most important topics that were dealt with in order to grasp the complexity of experience. Additionally, women were asked to give us evaluations of what they liked and disliked about certain stages of their lives or programs they attended, what their expectations were and to what extent they felt these expectations were met. Interviews were closed with a question regarding future plans and aspirations.

The analysis if the interviews

The analysis of the interviews was carried out with the program Atlas.ti, using a mix of inductive and deductive approaches, after a careful first reading of the entire corpus and intensive note taking. In line with the deductive approach, we defined a list of codes (themes) that in the second stage of the analysis were purposefully searched, identified and marked throughout the empirical data corpus. Among the most important deductive codes were: motivation, difficulties or challenges, opportunities, influence from others, parents, teachers, relations with colleagues, research activities, aspirations, plans for the future. During the second phase of the analysis we identified additional codes that have emerged from the empirical data. Among these the most important are: the feeling of belonging or definitions/the ideal of the researcher.

3. Expert interviews

The expert interviews intended to explore how institutions support young talents - with focus on girls and young women - in their career plans and contribute to maintaining or counteracting gender inequalities in STEAM education (secondary and tertiary) and career support. With our findings we want to contribute to the deeper understanding of how educational stakeholders' current view, policies, and initiatives on gender equality shapes girls' and young women's participation, opportunities, and progression in their STEAM education and careers. This focused research topic emphasises the meso-level institutional factors (such as organisational processes and mechanisms, perceptions, meanings, values) that influence girls and young women's engagement in STEAM education and their subsequent career prospects.

The study population and Sampling for Expert Interviewees

As in the case of most qualitative studies, the recruitment of expert interviewees based on the so-called *convenience sampling technique*. The partners involved in conducting the interviews covered 14 European countries: Hungary, Romania, Bulgaria, Croatia, North-Macedonia, Slovenia, Serbia, Poland, Slovakia, Ukraine, Lithuania, Spain, Italy and Iceland. In order to ensure that the sample is diverse enough but each country sample is shaped by the same principles, we have defined the following criteria for the sample selection:

- It was important to recruit *both male and female respondents*, as they are likely have different opinions based on their experiences, position, and the year they

spend in their position, as it is important to see that various factors can contribute to the perspectives (hence the differences in perspectives) of the respondents;

- It was highly recommended to select secondary/university teachers who are *involved in the teaching of technical subjects in STEAM* and who have years of experience in teaching the subject;
- It was highly recommended to recruit experts who *have an overview of more than one STEAM field*, as we are interested in institutional functioning of education and the perspectives the institutions represents;
- In the case of this research, the diversity of experts' sample was suggested to be ensured through their recruitment from the following stakeholders: universities, secondary schools, NGOs, state programmes and institutes, ministries, see Table 2.

Table 2: Experts' target for interview research

Experts and relevant stakeholders, of whom	No. of interviewees/country
Representative of Higher Education Institution/Research Organisation at the decision-making level, department head, or gender officer.	at least 1
Representative of Secondary schools, Vocational schools, After-school program at the decision-making level.	at least 1
Representative of Policy-making (national, regional level), e.g., ministry of education, head of methodology centre.	at least 1
Teachers/Researchers in STEAM at Higher Education Institution.	at least 1
Teachers from any field of STEAM at secondary school, vocational school.	at least 2
Educator/trainer/museum pedagogist working in non-formal education.	at least 1
TOTAL No. of INTERVIEWS	Min. 7 - Max. 10

In total, 85 expert interviews were conducted in 14 countries: Hungary, Bulgaria, Romania, Spain, Poland, Ukraine, Iceland, Slovenia, Slovakia, Italy, North Macedonia, Croatia, Lithuania, Serbia. A majority (69%) of the interviewees were women, with men comprising the remaining 39%.

The interviewees have a diverse professional background and cover all areas of STEAM, which is complemented by Educational Management. More than one third of the

interviewees came from Science and Technology. The remaining one third represented the fields of Mathematics, Engineering, Education Management, and the Arts. Additionally, the interviewees had various backgrounds in terms of their areas of expertise. More than 3 interviews were conducted with representatives from Computer Science, Chemistry, Mathematics, Physics, Biology and Educational Management. In the 'Other' category, 1-3 interviewees were selected from the following fields: Thermal Engineering, Multimedia, Engineering, Economics, Vehicle Engineer, Electrical Engineer, Robotics, Architecture, Ergonomics, Mechatronics, Film Studies, Materials Science, Visual Arts, Telecommunication, Earth Sciences, Biotechnology, Mechanical Engineer, and Sociology.

The interviewees represented different levels of education and decision making. Most interviewees came from higher education, while policy-making and non-formal education were represented at around 10%. At least half of the interviewees are at the decision-maker level.

Table 3. The composition of the experts' sample

Name of categories	Categories	Number of interviewees
Countries represented by the interviewees	Hungary	14
	Bulgaria	9
	Romania	9
	Spain	8
	Poland	7
	Ukraine	6
	Iceland	5
	Slovenia	5
	Slovakia	5
	Italy	4
	North Macedonia	4
	Croatia	3
	Lithuania	3
	Serbia	3
Total		***85***
Area of expertise	Informatics	23
	Biotechnology	2
	Chemistry	13
	Earth Sciences	2
	Mathematics	8
	Thermal Engineering	1
	Physics	7
	Mechanical Engineer	3

	Multimedia	1
	Engineer	1
	Economics	1
	Biology	4
	Vehicle Engineer	1
	Electrical Engineer	1
	Robotics	1
	Architecture	1
	Education Management	6
	Sociology	3
	Ergonomics	1
	Mechatronics	1
	Film Studies	1
	Materials Science	1
	Visual Arts	1
	Telecommunication	1
Total		***85***
Area of expertise	Science	31
	Technology	30
	Mathematics	8
	Engineer	7
	Education Management	6
	Arts	3
Total		***85***
Institutional representation	Representative of Higher Education Institution at the decision-making level, department head, or gender officer.	22
	Representative of Secondary schools, Vocational schools, After-school program at the decision-making level.	13
	Representative of Policy-making (national, regional level), e.g., ministry of education, head of methodology centre.	8
	Teachers in STEAM at Higher Education Institution.	19
	Teachers from any field of STEAM at secondary school, vocational school.	15
	Educator/trainer/museum pedagogist working in non-formal education.	8
Total		***85***

Analytical Focus for the interview questions

Based on the concept of the inequality regime, we looked for "loosely interrelated practices, processes, actions and meaning that result in and maintain class, gender, and

racial inequalities within particular organisations" (Acker, 2009, p. 201). Specifically, this research aimed to explore:

1) How institutional processes, practices, and values might define, shape, and influence the conditions, opportunities, and resources available to girls and young women. This includes:
    - Examining prevailing attitudes towards gender equality in STEAM education.
    - Assessing perceptions regarding the opportunities and needs to support girls and young women in STEAM and attitudes towards increasing or the need to increase female enrollment, participation in STEAM.
2) Institutional efforts to promote and ensure gender equality in STEAM:
    - Investigating institutional strategies and mechanisms aimed at improving gender equality/inclusivity.
    - Identifying supportive tools, initiatives, and incentives considered effective in increasing female representation and supporting their career advancement in STEAM fields.
    - Exploring the role of secondary education in motivating girls to enter STEAM education.

We looked for how institutional processes, practices, and values might define, shape, and influence the conditions, opportunities, and resources available to girls and young women. In our interview questions, first we inquired about the relevance of increasing the number of women in STEAM education, the knowledge and perception of the obstacles girls/young women face when studying in secondary education, when entering tertiary education, and studying in tertiary education in any of the STEAM fields. The second part of the interview focused on what the interviewees think of how young girls should be encouraged to develop an interest in STEM fields? Should there be dedicated support for girls in this regard at all? What should be done at the level of the secondary education and at the level of the tertiary education? Who should be the key players in enhancing gender equality and inclusivity? As an additional focus, we also asked about the concrete institutional actions and intentions, the efforts and steps the institutions make to achieve greater gender equality and inclusivity in STEM education.

In our analysis, for exploring the institutional context in particular how it shapes and define the gender inequalities in STEAM educations, we will looked for:

- Systematic processes, structures, institutional arrangement, strategies and actions in regards of supporting intentions;

- Perceptions, views, attitudes represented in the institutions in regards of girls/women's opportunities;
- How institutional decisions, strategies, interventions are explained and interpreted.

IV. Systematic literature review

The following sequences of this section cover the results obtained via the three distinctive yet complementary approaches of the systematic literature review, each presenting an overview of the research under examination and the corresponding findings, in an in-depth analysis structured to address the research questions..

All publications included and discussed across the systematic literature review are found in the *References* section, organised in alphabetical order and structured into the three research approaches.

1. State-of-the-Art Approach: Overview of 2023 Research

In the overview of research for all three approaches of the present analysis, we take into account a series of variables regarding the publications consulted, to be able to address the research questions. To this end, we systematise in a series of tables the methodological approaches and the populations and samples included in the studies. Moreover, we are interested in the subject areas of the journals that publish research on the topic, as well as the extent of the geographical coverage of the research.

We organised the **methodological approaches** based on quantitative, qualitative, and mixed-methods research, and studies based on panel surveys from secondary sources are included here in the longitudinal survey research rather than in the secondary data section, to distinguish between survey data and enrollment and/or administrative data. As *Table 1* illustrates, quantitative and qualitative studies constitute core approaches in the 2023 research on girls and/or women in STEM education. Quantitative studies were developed mostly on survey research, as well as on experimental designs or secondary data; moreover, qualitative research mostly employed individual interviews and content analyses, as well as a variety of ethnographic studies. In the case of mixed-methods research, we have variations of mixed quantitative and qualitative approaches, as well as quantitative or qualitative approaches focusing on several techniques. But overall, methodologies in studying the topic are quite diverse and complex, thus enabling enhanced and varied understandings of the phenomenon.

Table 4. Mapping of methodological approaches employed in the 2023 Web of Science and SCOPUS publications

Methodological approaches		
Quantitative	*Qualitative*	*Mixed-methods*
Survey research ***Cross-sectional***: Achtzehn et al., 2023; Bahr & Zinn, 2023; Balta et al., 2023; Beaudry et al., 2023; Bhore & Tapas, 2023; Birney & McNamara, 2023; Borgonovi et al., 2023; Bourabain & Verhaeghe, 2023; Budgea et al., 2023; Caspi et al., 2023; De Wit et al., 2023; Du et al., 2023; Endendijk, 2023; Folberg et al., 2023; Galano et al., 2023; Glass et al., 2023; Kang, 2023; Lawson et al., 2023; Martínez et al., 2023; McMaster et al., 2023; Mouton et al., 2023; Mujtaba et al., 2023; Mulvey et al., 2023; Myint & Robnett, 2023; Rodríguez-Abitia et al., 2023; Schwinghammer et al., 2023; Sellami et al., 2023; Dolores Serrano et al., 2023; Siani & Harris, 2023; Soto-Solier et al., 2023; Stevens et al., 2023; Tellhed et al., 2023; Uunk, 2023; Wang et al., 2023; Wu et al., 2023; Yepes Zuluaga & Granada, 2023; Zhan et al., 2023; Zheng & Weeden, 2023. ***Longitudinal***: Bachmann & Hertweck, 2023; Chen et al.,	**Interview research** **Individual interviews:** Almukhamvetova et al., 2023; Buenestado-Fernández et al., 2023; Chiang et al., 2023; Fox-Turnbull et al., 2023; Garcia et al., 2023; Hardtke et al., 2023; Hu & Stahl, 2023; Jaumot-Pascual et al., 2023; Johnson et al., 2023; Kemechian et al., 2023; Lee & Riach, 2023; Luthi & Kosloski, 2023 (*Delphi method*); McGee et al., 2023; Mkhize, 2023; Qadhi et al., 2023; Salehjee & Watts, 2023; Sikhosana et al., 2023. **Focus group interviews**: Kaplan-Sayı et al., 2023. **Interviews & focus groups:** Reggiani et al., 2023. **Content analysis:** Balasubramanian et al., 2023; Bharadwaj et al., 2023; Cutrupi et al., 2023; Eizmendi-Iraola & Peña-Fernández, 2023; Freedman et al., 2023; Gipson, 2023; Guinot-Reina	**Quantitative & Qualitative variations** **Survey & focus group interviews:** Ananthram et al., 2023; Drew et al., 2023; Wen et al., 2023. **Survey & interviews**: Breen et al., 2023; Burt et al., 2023; Wao et al., 2023; Yoel & Dori, 2023. **Survey & content analysis:** Babalola et al., 2023; Compeau et al., 2023; Verdugo-Castro et al., 2023. **Survey & observation & interview**: Vossen et al., 2023. **Survey, focus groups, & interviews**: Casey et al., 2023; Edwards & King, 2023; Reznik et al., 2023. **Quantitative approaches** **Survey & observation:** Fernandez et al., 2023. **Case study & secondary data analysis**: Stoop et al., 2023.

2023; Cukrowska-Torzewska, 2023; Edwards et al., 2023; Henry et al., 2023; Hernandez et al., 2023; Lubinski et al., 2023; Malespina & Singh, 2023; Sassler & Meyerhofer, 2023; Sevilla et al., 2023; Sharma, 2023; Starr et al., 2023; Stoeger et al., 2023; Wan et al., 2023. **Experimental research:** Arpaci et al., 2023; Bliss et al., 2023; Broder et al., 2023; Callejas et al., 2023; Cyr et al., 2023; Duraku et al., 2023; Gkiolnta et al., 2023; Gladstone et al., 2023; Idrizi et al., 2023; Kumar et al., 2023; Midgley et al., 2023; Reisel & Seehus, 2023; Sunasee, 2023; Sung et al., 2023; Tarrés-Puertas et al., 2023; Van Wassenaer et al., 2023; Vergara, 2023; Wu & Cai, 2023. **Quasi-experimental studies (survey-based):** Andersen, 2023; Bailey et al., 2023; Copur-Gencturk et al., 2023; Hewes et al., 2023; Merayo & Ayuso, 2023; Potvin et al., 2023; Uebler et al., 2023. **Secondary data analyses (administrative/ enrollment records):** Amirtham & Kumar, 2023; Corrigan et al., 2023;	& De la Torre-Sierra, 2023; Gürkan & Echazarreta-Soler, 2023; Hailu et al., 2023; Huber & Baena, 2023; King et al., 2023; Leavy et al., 2023; Ross et al., 2023; Soucy-Humphreys et al., 2023; Steele & Challis, 2023; Tomás et al., 2023; Ward, 2023, Wells, 2023. **Case studies:** Arada et al., 2023; Cisneros et al., 2023; Davis & Wilson-Kennedy, 2023; Kirk et al., 2023; María-Antonia Serrano et al., 2023; Travers et al., 2023; Velasquez et al., 2023; Wang, 2023. **Systematic literature reviews:** Cherney, 2023; Çolakoğlu et al., 2023; De Gioannis et al., 2023; Fàbregues et al., 2023; Ha et al., 2023; Kowalski et al., 2023; López et al., 2023; Monteiro et al., 2023; Palid et al., 2023; Schmader, 2023. **Ethnography** **Postqualitative vignettes study:** Lemieux, 2023. **Observations & focus groups**: Sultan et al., 2023.	**Survey & secondary data analysis**: French et al., 2023; Gottfried et al., 2023, Granato, 2023; Ortiz-Martínez et al., 2023. **Field experiment & document analysis:** Breda et al., 2023. **Qualitative approaches** **Interview & secondary data analysis & systematic lit review**: Jantz et al., 2023. **Interview & focus group & secondary data analysis**: Quarshie et al., 2023. **Interviews & self-portrait & participative observation**: Ruiz-Bartolomé & Greca, 2023.

Costello et al., 2023; Gallego & Casadiego, 2023; Grunwald & Daroub, 2023; McLean et al., 2023; Mueller, 2023; Narh & Buzzelli, 2023; Samaniego et al., 2023; Sánchez-Jiménez et al., 2023; Sarabi & Smith, 2023; Speer, 2023.	**Workshop-based participatory method:** Lee, 2023. **Interview & ethnographic data**: Benavides et al., 2023 (*critical participatory ethnography*); Milton et al., 2023; Tofel-Grehl, 2023; Wong & Copsey-Blake, 2023. **Autoethnography**: Miller et al., 2023; Pierre & Coleman-King, 2023.	

Regarding the **types of data** used in empirical studies, about ¾ of publications indexed in Web of Science and SCOPUS for the 2023 research stream rely on primary data, collected by the authors, while ¼ use secondary data, such as enrollment records or extensive datasets from PISA, the Programme for International Students Assessment.

The following tables illustrate the **diversity of the population and samples** included in the research under analysis. *Table 4* represents a systematised version of the education levels of students involved in the studies, clearly showing a diversity of approaches, but a clear majority of studies focus on the situation and experience of undergraduate students, followed by high school students and middle or secondary school students. To clarify the classification we used, we must specify that we are aware of the diversity of educational systems and their organisation, but to be consistent throughout this analysis, we divided the education levels into early years and elementary or primary school (so pre-school and grades 1 to 4, young children), then we considered middle and secondary school as education including grades 5 to 8 (although some systems classify high school as secondary school) – and hence included studies focusing on populations of students of 15 and above into the high school category, even if some studies defined it as secondary school, based on the system they analysed –, then high school, undergraduate school, and graduate or PhD level. Some studies included mixed student populations or relied on longitudinal samples tracking students over time, so they were assigned to a different category.

Table 5. Education level of participants studied in 2023 Web of Science and SCOPUS publications

Education level of participants					
Early years and Elementary/ Primary school	*Middle/ Secondary school*	*High school*	*Undergraduate students*	*Graduate/ Ph.D. students*	*Mixed/ Longitudinal*
Cutrupi et al., 2023; Gkiolnta et al., 2023; Gladstone et al., 2023; Kumar et al., 2023; Leavy et al., 2023; Ruiz-Bartolomé & Greca, 2023; Schwinghammer et al., 2023; Sung et al., 2023; Wang, 2023.	Arada et al., 2023; Arpaci et al., 2023; Bailey et al., 2023; Benavides et al., 2023; Boyle et al., 2023; Broder et al., 2023; Cyr et al., 2023; Duraku et al., 2023; Edwards & King, 2023; King et al., 2023; McMaster et al., 2023; Milton et al., 2023; Siani & Harris, 2023; Tellhed et al., 2023; Van Wassenaer	Bahr & Zinn, 2023; Birney & McNamara, 2023; Borgonovi et al., 2023; Breda et al., 2023; Budgea et al. 2023; Casey et al., 2023; Corrigan et al., 2023; Galano et al., 2023; Garcia et al., 2023; Johnson et al., 2023; Kang, 2023; Mulvey et al., 2023; Potvin et al., 2023; Reisel & Seehus, 2023; Sellami et al., 2023;	Almukhamvetova et al., 2023; Amirtham & Kumar, 2023; Ananthram et al., 2023; Balasubramanian et al., 2023; Bliss et al., 2023; Callejas et al., 2023; Costello et al., 2023; Davis & Wilson-Kennedy, 2023; Du et al., 2023; Endendijk, 2023; Fernandez et al., 2023; Freedman et al., 2023; French et al., 2023; Gallego & Casadiego, 2023; Glass et al., 2023; Hardtke et al., 2023; Hernandez et al., 2023; Hu & Stahl, 2023; Jaumot-Pascual et al., 2023; Malespina & Singh, 2023; Mouton et al., 2023; Mujtaba et al., 2023; Narh & Buzzelli, 2023; Quarshie et al., 2023; Rodríguez-Abitia et al., 2023; María-Antonia	Burt et al., 2023; Granato, 2023; Henry et al., 2023; Mkhize, 2023; Ortiz-Martínez et al., 2023; Reggiani et al., 2023; Sánchez-Jiménez et al., 2023; Stevens et al., 2023; Yepes Zuluaga & Granada, 2023.	**Pupils to adults**: Bachmann & Hertweck, 2023; Edwards et al., 2023; Gottfried et al., 2023; Kirk et al., 2023; Lubinski et al., 2023; Speer, 2023. **Various educational groups:** Balta et al., 2023; Myint & Robnett, 2023; Uebler et al., 2023; Buenestado-Fernández et al., 2023; Chen et al., 2023; Wao et al., 2023; Wu & Cai, 2023; De Wit et al., 2023; Martínez et

	et al., 2023; Vergara, 2023; Vossen et al., 2023.	Starr et al., 2023; Uunk, 2023; Wan et al., 2023; Wang et al., 2023; Zhao et al., 2023.	Serrano et al., 2023; Sevilla et al., 2023; Sikhosana et al., 2023; Soto-Solier et al., 2023; Stoeger et al., 2023; Sunasee, 2023; Travers et al., 2023; Wen et al., 2023; Wong & Copsey-Blake, 2023; Yepes Zuluaga & Granada, 2023.		al., 2023; Reznik et al., 2023; Sultan et al., 2023; Tarrés-Puertas et al., 2023.

Table 6. Role of participants in 2023 Web of Science and SCOPUS publications

Role of participants			
Students	*Teachers*	*STEM professionals*	Mixed/ Other
Almukhamvetova et al., 2023; Amirtham & Kumar, 2023; Ananthram et al., 2023; Arada et al., 2023; Arpaci et al., 2023; Bahr & Zinn, 2023; Bailey et al., 2023; Balasubramanian et al., 2023; Balta et al., 2023; Benavides et al., 2023; Birney & McNamara, 2023; Bliss et al., 2023; Borgonovi et al., 2023; Boyle et al., 2023; Breda et al., 2023; Broder et al., 2023; Budgea et al., 2023; Buenestado-Fernández et al., 2023; Callejas et al., 2023; Casey et al., 2023; Chen et al., 2023; Chiang et al., 2023; Corrigan et al., 2023; Costello et al., 2023; Cutrupi et al., 2023; Cyr et al., 2023; Davis & Wilson-Kennedy, 2023; De Wit et al., 2023; Du et al., 2023; Duraku et al., 2023; Edwards & King, 2023; Endendijk, 2023; Fernandez et al., 2023; Freedman et al., 2023; French et al., 2023; Garcia et al., 2023; Galano et al., 2023; Gallego & Casadiego, 2023; GkioInta et al., 2023; Gladstone et al., 2023; Glass et al.,	Amirtham & Kumar, 2023; Andersen, 2023; Bourabain & Verhaeghe, 2023; Copur-Genctürk et al., 2023; Drew et al., 2023; Dutz et al., 2023; Fox-Turnbull et al., 2023; Kaplan-Sayı et al., 2023; Lawson et al., 2023; Martínez et al., 2023; McGee et al., 2023; Merayo & Ayuso,	**Researchers**: Achtzehn et al., 2023; Beaudry et al., 2023; Samaniego et al., 2023; Dolores Serrano et al., 2023; Stoop et al., 2023. **Academic leadership**: Babalola et al., 2023; Luthi & Kosloski, 2023; Qadhi et al., 2023; Wu et al., 2023. **Bios of women leaders in STEM**: Bharadwaj et al., 2023; Chinunga et	**Student to employment :** Bachmann & Hertweck, 2023; Edwards et al., 2023; Gottfried et al., 2023; Henry et al., 2023; Lubinski et al., 2023; Speer, 2023. **Parents**: Chiang et al., 2023; Zhan et al., 2023. **Unemployed individuals:** Cukrowska-Torzewska, 2023.

2023; Granato, 2023; Hardtke et al., 2023; Hernandez et al., 2023; Hu & Stahl, 2023; Jaumot-Pascual et al., 2023; Johnson et al., 2023; Kang, 2023; King et al., 2023; Kirk et al., 2023; Kumar et al., 2023; Leavy et al., 2023; Lemieux, 2023; Malespina & Singh, 2023; Martínez et al., 2023; McMaster et al., 2023; Merayo & Ayuso, 2023; Milton et al., 2023; Mkhize, 2023; Mouton et al., 2023; Mujtaba et al., 2023; Mulvey et al., 2023; Myint & Robnett, 2023; Narh & Buzzelli, 2023; Ortiz-Martínez et al., 2023; Potvin et al., 2023; Quarshie et al., 2023; Reggiani et al., 2023; Reisel & Seehus, 2023; Reznik et al., 2023; Rodríguez-Abitia et al., 2023; Ruiz-Bartolomé & Greca, 2023; Schwinghammer et al., 2023; Sellami et al., 2023; Sevilla et al., 2023; Siani & Harris, 2023; Sikhosana et al., 2023; Soto-Solier et al., 2023; Stevens et al., 2023; Stoeger et al., 2023; Sultan et al., 2023; Sunasee, 2023; Sung et al., 2023; Tarrés-Puertas et al., 2023; Tellhed et al., 2023; Tofel-Grehl, 2023; Travers et al., 2023; Uebler et al., 2023; Uunk, 2023; Van Wassenaer et al., 2023; Vergara, 2023; Vossen et al., 2023; Wan et al., 2023; Wang et al., 2023; Wao, 2023; Wen et al., 2023; Wong & Copsey-Blake, 2023; Wu & Cai, 2023; Yepes Zuluaga & Granada, 2023, Zhao et al., 2023.	2023; Miller et al., 2023; Potvin et al., 2023; Tellhed et al., 2023; Velasquez et al., 2023; Wang, 2023; Wu et al., 2023. **Coaches**: Chiang et al., 2023. **Mentors**: Yoel & Dori, 2023.	al., 2023; Steele & Challis, 2023. **STEM professionals**: Bhore & Tapas, 2023; Jantz et al., 2023; Kemechian et al., 2023; Lee & Riach, 2023; Midgley et al., 2023; Salehjee & Watts, 2023; Sassler & Meyerhofer, 2023; Zheng & Weeden, 2023. **Aspiring entrepreneurs**: Folberg et al., 2023.	

Table 7. Gender of participants in 2023 Web of Science and SCOPUS publications

Gender of participants		
All-female	*Female and male*	*Beyond binary/ inclusive approaches*
Almukhamvetova et al., 2023; Arada et al.,	Achtzehn et al., 2023; Andersen, 2023; Amirtham & Kumar, 2023; Ananthram et al.,	French et al., 2023;

2023; Babalola et al., 2023; Bailey et al., 2023; Balta et al., 2023; Benavides et al., 2023; Bharadwaj et al., 2023; Bhore & Tapas, 2023; Boyle et al., 2023; Broder et al., 2023; Chinunga et al., 2023; Du et al., 2023; Edwards & King, 2023; Freedman et al., 2023; Garcia et al., 2023; Gladstone et al., 2023; Hardtke et al., 2023; Hernandez et al., 2023; Hu & Stahl, 2023; Jantz et al., 2023; Kemechian et al., 2023; King et al., 2023; Kirk et al., 2023; Lee & Riach, 2023; McGee et al., 2023; Milton et al., 2023; Mkhize, 2023; Mujtaba et al., 2023; Pierre & Coleman-King, 2023; Qadhi et al., 2023; Reznik et al., 2023; Ruiz-Bartolomé & Greca, 2023; Schwinghammer et al., 2023; Siani & Harris, 2023; Sikhosana et al., 2023; Steele & Challis, 2023; Stoeger et al., 2023; Sultan et al., 2023; Tofel-Grehl, 2023; Travers et al., 2023; Uebler et al., 2023; Vergara, 2023; Wong & Copsey-Blake, 2023; Zhao et al., 2023.	2023; Arpaci et al., 2023; Bachmann & Hertweck, 2023; Bahr & Zinn, 2023; Beaudry et al., 2023; Birney & McNamara, 2023; Bliss et al., 2023; Borgonovi et al., 2023; Bourabain & Verhaeghe, 2023; Breda et al., 2023; Budgea et al., 2023; Buenestado-Fernández et al., 2023; Callejas et al., 2023; Casey et al., 2023; Chen et al., 2023; Chiang et al., 2023; Copur-Gencturk et al., 2023; Corrigan et al., 2023; Costello et al., 2023; Cukrowska-Torzewska, 2023; Cutrupi et al., 2023; Cyr et al., 2023; Davis & Wilson-Kennedy, 2023; De Wit et al., 2023; Drew et al., 2023; Duraku et al., 2023; Dutz et al., 2023; Edwards et al., 2023; Endendijk, 2023; Fernandez et al., 2023; Folberg et al., 2023; Fox-Turnbull et al., 2023; Galano et al., 2023; Gallego & Casadiego, 2023; GkioInta et al., 2023; Glass et al., 2023; Gottfried et al., 2023; Granato, 2023; Henry et al., 2023; Kang, 2023; Kaplan-Sayı et al., 2023; Kumar et al., 2023; Lawson et al., 2023; Leavy et al., 2023; Lubinski et al., 2023; Malespina & Singh, 2023; Martínez et al., 2023; McMaster et al., 2023; Merayo & Ayuso, 2023; Midgley et al., 2023; Miller et al., 2023; Mouton et al., 2023; Mulvey et al., 2023; Myint & Robnett, 2023; Narh & Buzzelli, 2023; Potvin et al., 2023; Quarshie et al., 2023; Reisel & Seehus, 2023; Rodríguez-Abitia et al., 2023; Samaniego et al., 2023; Sánchez-Jiménez et al., 2023; Sassler & Meyerhofer, 2023; Sellami et al., 2023; María-Antonia Serrano et al., 2023; Sevilla et al., 2023; Soto-Solier et al., 2023; Speer, 2023; Starr et al., 2023; Stoop et al., 2023; Sung et al., 2023; Tarrés-Puertas et al., 2023; Tellhed et al., 2023; Uunk, 2023; Van Wassenaer et al., 2023; Vossen et al., 2023; Wan et al., 2023; Wang et al., 2023; Wao et al., 2023; Wen et al., 2023; Wu et al., 2023; Wu & Cai, 2023; Yepes Zuluaga & Granada, 2023; Yoel & Dori, 2023; Zhan et al., 2023; Zheng & Weeden, 2023.	Jaumot-Pascual et al., 2023; Johnson et al., 2023; Luthi & Kosloski, 2023; Ortiz-Martínez et al., 2023; Reggiani et al., 2023; Stevens et al., 2023; Velasquez et al., 2023; Verdugo-Castro et al., 2023; Wao et al., 2023.

Table 8. Number of participants/ observations/ case studies in 2023 Web of Science and SCOPUS publications

Number of participants/ observations/ cases studied			
Small sample (under 30)	*Large sample*		
	100 and under	*Between 101 and 1,000*	*Over 1,000*
Almukhamvetova et al., 2023; Arada et al., 2023; Benavides et al., 2023; Bharadwaj et al., 2023; Broder et al., 2023; Buenestado-Fernández et al., 2023; Burt et al., 2023; Chinunga et al., 2023; Davis & Wilson-Kennedy, 2023; Edwards & King, 2023; Fox-Turnbull et al., 2023; Gkiolnta et al., 2023; Hardtke et al., 2023; Hu & Stahl, 2023; Jantz et al., 2023; Jaumot-Pascual et al., 2023; Johnson et al., 2023; Kemechian et al., 2023; King et al., 2023; Kirk et al., 2023; Lee & Riach, 2023; Lemieux, 2023; Luthi & Kosloski, 2023; Miller et al., 2023; Ortiz-Martínez et al., 2023; Qadhi et al., 2023; Reggiani et al., 2023;	Babalola et al., 2023; Bailey et al., 2023; Chiang et al., 2023; Dutz et al., 2023; Freedman et al., 2023; Garcia et al., 2023; Kaplan-Sayı et al., 2023; McGee et al., 2023; Milton et al., 2023; Mkhize, 2023; Quarshie et al., 2023; Siani & Harris, 2023; Sultan et al., 2023; Vergara, 2023; Vossen et al., 2023; Wao et al., 2023.	Achtzehn et al., 2023; Andersen, 2023; Arpaci et al., 2023; Bahr & Zinn, 2023; Balta et al., 2023; Bhore & Tapas, 2023; Birney & McNamara, 2023; Bliss et al., 2023; Bourabain & Verhaeghe, 2023; Boyle et al., 2023; Breen et al., 2023; Budgea et al., 2023; Callejas et al., 2023; Casey et al., 2023; Copur-Gencturk et al., 2023; Corrigan et al., 2023; Cutrupi et al., 2023; Cyr et al., 2023; De Wit et al., 2023; Drew et al., 2023; Du et al., 2023; Duraku et al., 2023; Endendijk, 2023; Fernandez et al., 2023; Folberg et al., 2023; French et al., 2023; Gladstone et al., 2023; Glass et al., 2023; Hernandez et al., 2023; Kumar et al., 2023; Lawson et al., 2023; Leavy et al., 2023; Lubinski et	Ananthram et al., 2023; Bachmann & Hertweck, 2023; Beaudry et al., 2023; Borgonovi et al., 2023; Breda et al., 2023; Chen et al., 2023; Costello et al., 2023; Cukrowska-Torzewska, 2023; Edwards et al., 2023; Galano et al., 2023; Gallego & Casadiego, 2023; Gottfried et al., 2023; Granato, 2023; Henry et al., 2023; Kang, 2023; Malespina & Singh, 2023; Merayo & Ayuso, 2023; Mouton et al., 2023; Narh et al, 2023; Potvin et al., 2023; Samaniego et al., 2023; Sánchez-Jiménez et al., 2023; Sassler & Meyerhofer, 2023; Sellami et al., 2023; Sevilla et al., 2023; Sharma, 2023; Speer, 2023; Starr et al., 2023; Stevens et al., 2023; Stoop et al., 2023; Uunk,

Ruiz-Bartolomé & Greca, 2023; Salehjee & Watts, 2023; Schwinghammer et al., 2023; Dolores Serrano et al., 2023; Sikhosana et al., 2023; Steele & Challis, 2023; Tofel-Grehl, 2023; Velasquez et al., 2023; Wong & Copsey-Blake, 2023.		al., 2023; Martínez et al., 2023; McMaster et al., 2023; Midgley et al., 2023; Mujtaba et al., 2023; Mulvey et al., 2023; Myint & Robnett, 2023; Reisel & Seehus, 2023; Rodríguez-Abitia et al., 2023; María-Antonia Serrano et al., 2023; Soto-Solier et al., 2023; Stoeger et al., 2023; Sung et al., 2023; Tarrés-Puertas et al., 2023; Tellhed et al., 2023; Uebler et al., 2023; Van Wassenaer et al., 2023; Wu et al., 2023; Yepes Zuluaga & Granada, 2023; Yoel & Dori, 2023; Zhan et al., 2023, Zhao et al., 2023.	2023; Verdugo-Castro et al., 2023; Wan et al., 2023; Wang et al., 2023; Wao et al., 2023; Wen et al., 2023; Wu & Cai, 2023; Zheng & Weeden, 2023.

As the subject of our project goes beyond girls of different school ages, we aimed to capture all populations studied in the 2023 research; thus, although a majority of studies do focus on student populations, *Table 3* illustrates the diversity of **roles participants hold** in the publications under analysis: students, teachers (pre-university or university), STEM professionals of various sorts, as well as a range of mixed populations. The analysis of findings in the next section follows the logic of *Table 2* and *Table 3*, being structured into the categories illustrated here, to illustrate the knowledge generated for these specific populations and samples. What is more, *Table 4* encompasses the **distribution of genders** included in the research, showing that most approaches focused on a binary comparison, many of them had all-female populations, and just a few of them went beyond the binary approach.

In mapping the approaches in the most current research on girls and/or women in STEM education, we also factored in the issue of **intersectionality**, and we aimed to see how this concept was tackled in recent literature; overall, beyond gender, the most prominent **identities** were **race/ ethnicity** (studied in Arada et al., 2023; Bailey et al., 2023; Edwards & King, 2023; Garcia et al., 2023; Jaumot-Pascual et al., 2023; Luthi & Kosloski, 2023; McGee et al., 2023; Mkhize, 2023; Myint & Robnett, 2023; Pierre & Coleman-King, 2023; Tofel-Grehl, 2023; Wong & Copsey-Blake, 2023); **income and ethnicity** (studied in Broder et al., 2023; Reznik et al., 2023); **immigrant status & ethnicity**, as shown in Salehjee & Watts, 2023 and Sellami et al., 2023; and **neurodiversity**, in the study by GkioInta et al., 2023.

And finally, as *Table 5* shows, in terms of assessing the populations and samples from a numerical standpoint, the least frequent category is that of populations between 31 and 100, and the most represented categories analysed between 101 and 1000 individuals, observations, cases (in quantitative or mixed-methods approaches), and under 30 individuals, in qualitative approaches.

Journal research area: Most publications from Web of Science and SCOPUS examined in the present analysis for 2023 are journal articles, and just a few of them are book chapters and articles in conference proceedings: Cutrupi et al., 2023; De Wit et al., 2023; Johnson et al., 2023; Schwinghammer et al., 2023; Travers et al., 2023; Vergara, 2023; Wells, 2023. To establish which subject areas are most populated by articles on girls and/or women in STEM education, journals are classified into research areas based on their primary focus. Although most of the 113 journals that published the research investigated here only published 1 article in 2023 on our topic, several journals showed more preoccupation for the topic, publishing more than 1 article, as follows: *Education Sciences* (11), *International Journal of STEM Education* (10 articles), *Frontiers in Education* (7), *International Journal of*

Science Education (6), *Heliyon* (5), *Frontiers in Psychology* and *International Journal of Technology and Design Education* with 4 articles each, *Cultural Studies of Science Education*, *Higher Education*, *PloS One*, and *Sustainability* with 3 articles each, and finally, *Applied Economics Letters*, *Canadian Journal of Science, Mathematics and Technology Education*, *Cogent Education*, *Frontiers in Communication*, *Humanities and Social Sciences Communications*, *Journal of Biomechanics*, *Journal of Chemical Education*, *Physical Review: Physics Education Research*, *Psychology of Women Quarterly*, *Scientometrics*, and *Sex Roles* with 2 articles each. Among all the journals taken into account for 2023 research, 4 have an explicit thematic focus on gender topics: *Psychology of Women Quarterly*, *Journal of Women and Minorities in Science and Engineering*, *Sex Roles*, and *Sexuality and Culture*. Moreover, according to the article distribution according to journal subject areas (*Figure 2*), most research was published in journals focusing on **education**, followed by **multidisciplinary** journals, then **sociology and social sciences**, **psychology** journals, and **engineering, technology, and neuroscience** journals.

Figure 2. Distribution of subject areas of WoS and SCOPUS journals publishing articles on girls and/or women in STEM in 2023

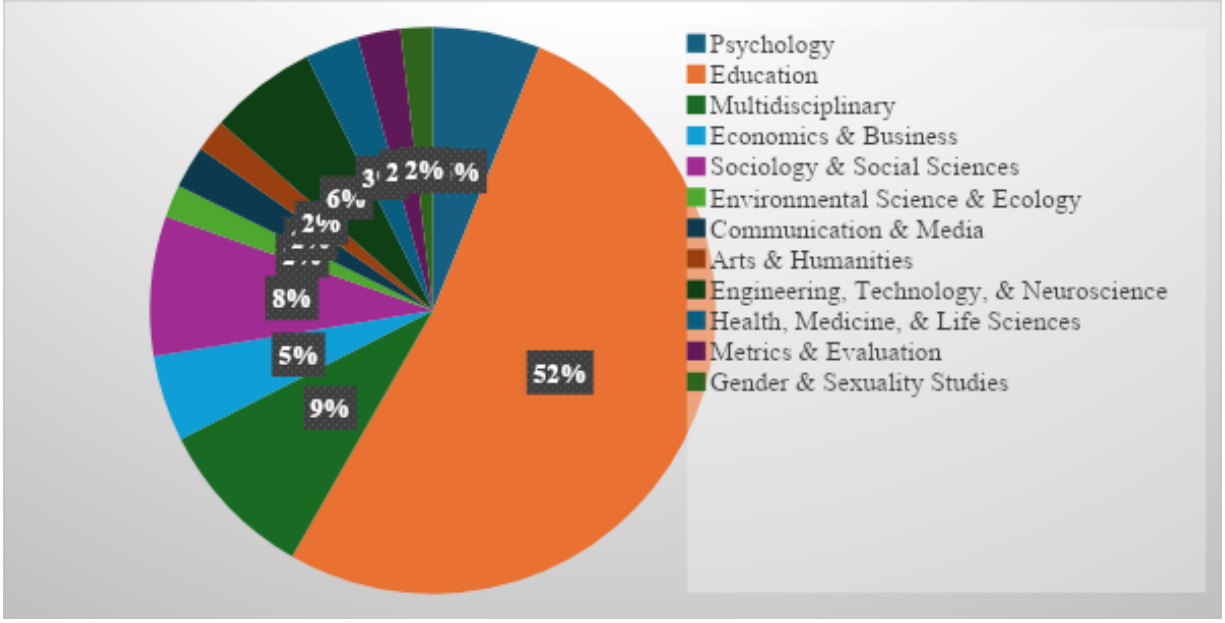
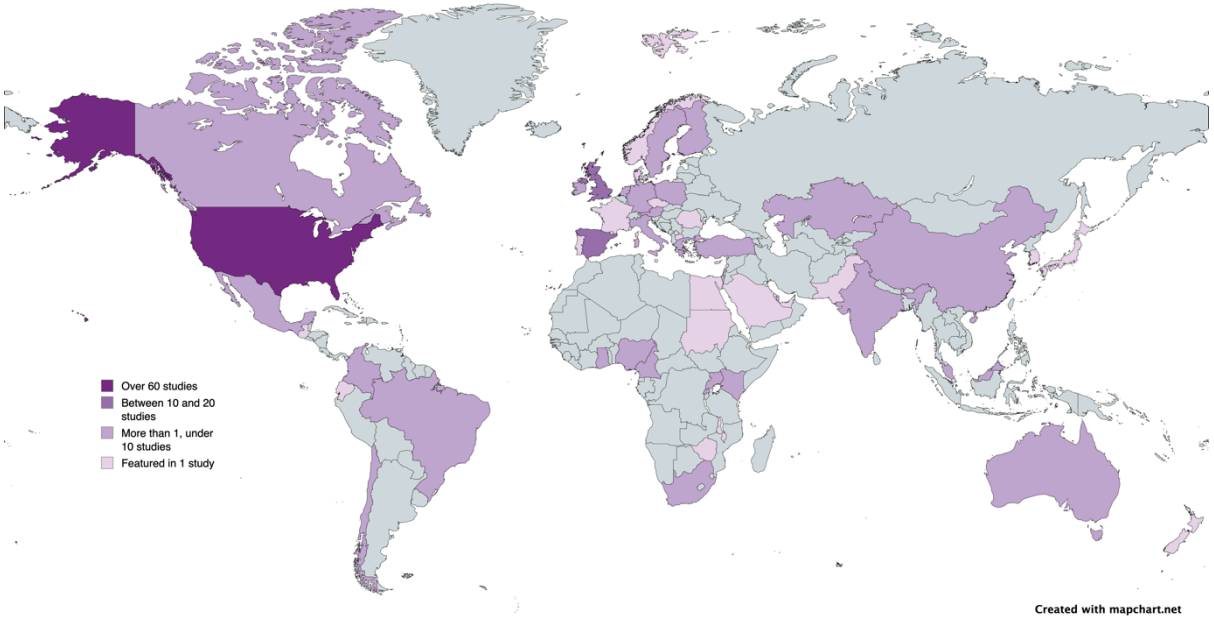


Figure 3. Geographical distribution of populations included in the 2023 studies



To assess **geographical coverage** based on countries covered by the research published in 2023, a map was created that includes single-country studies and 10 cross-national studies where countries are specified, to create a more accurate coverage of research endeavours[7]. Moreover, among cross-country publications, there are 6 studies with multiple countries involved that are not named and thus are not included on the map[8]; similarly, the study published by Velasquez et al. (2023) was carried out in Scotland and does not show separately on the map, it is included in the United Kingdom count. As shown in *Figure 3,* research published in 2023 focused to a great extent on data from the United States of America (63 studies), and Spain and the United Kingdom are present in over 10 studies (Spain in 13, the UK in 12). To a significantly lower extent, research also documented the cases of countries in Europe (Austria, Czechia, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Kosovo, the Netherlands, North Macedonia, Norway, Poland, Portugal, Romania, and Sweden), Africa (Cameroon, Egypt, Ghana, Kenya, Malawi, Nigeria, Rwanda, South Africa, Sudan, Uganda, and Zimbabwe), Asia (China, India, Israel, Japan, Kazakhstan, Lebanon, Malaysia, Pakistan, Qatar, Saudi Arabia, South Korea, Turkey, and the United Arab Emirates), North America (Canada and Mexico), South America (Brazil, Chile, Colombia, and Ecuador), Central America (Guatemala), and Oceania (Australia and New Zealand). This shows an overwhelmingly Western domination of narratives in the studies, but progress is also present through a shy, yet relevant coverage of the Global South experiences, as well as Eastern Europe or other areas.

[7] Babalola et al., 2023; Chiang et al., 2023; Chinunga et al., 2023; Hailu et al., 2023; Kaplan-Sayı et al., 2023; Lee & Riach, 2023; Martínez et al., 2023; Midgley et al., 2023; Rodríguez-Abitia et al., 2023; Zhao et al., 2023.
[8] Borgonovi et al., 2023; Uunk, 2023; Wan et al., 2023.

As for theoretical frameworks, many studies relied on theories such as the Social Cognitive Career Theory (SCCT), Social Identity Theory (SIT) or, to a lesser extent, the Expectancy-Value Theory (EVT), but most relied on a well-documented framing of the gender gap in STEM, frameworks that they then operationalized through specific variables (mostly to measure gender, STEM identity, career, and interest), as shown in *Figure 4* and *Figure 5*.

Figure 4**.** Visual representation of most frequent terms among concepts and theories in the studies

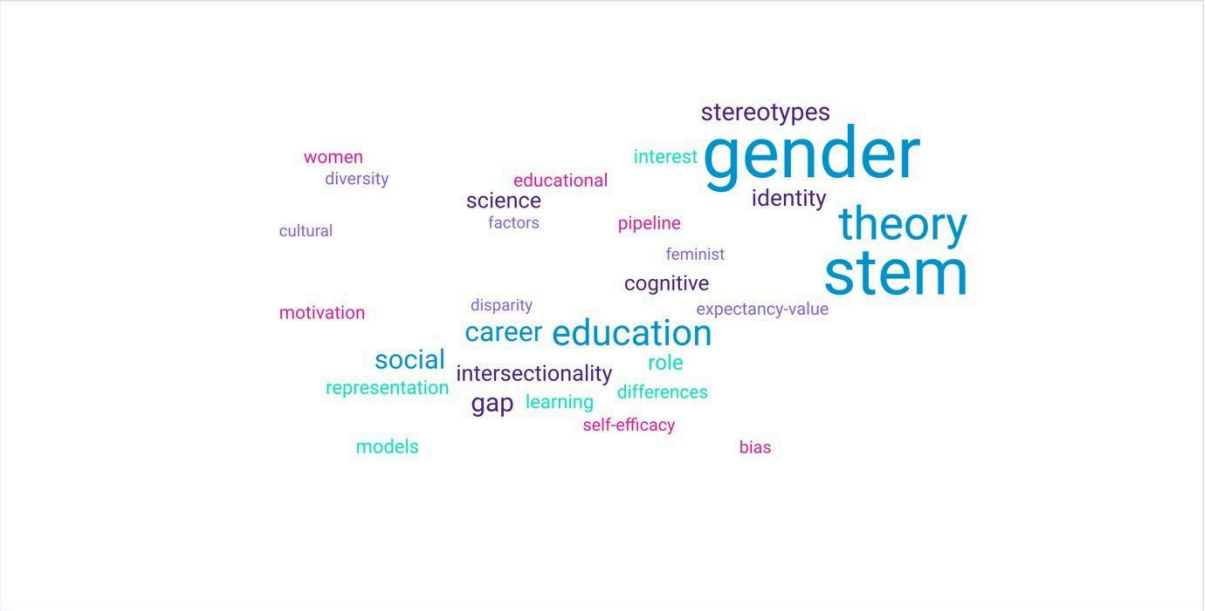
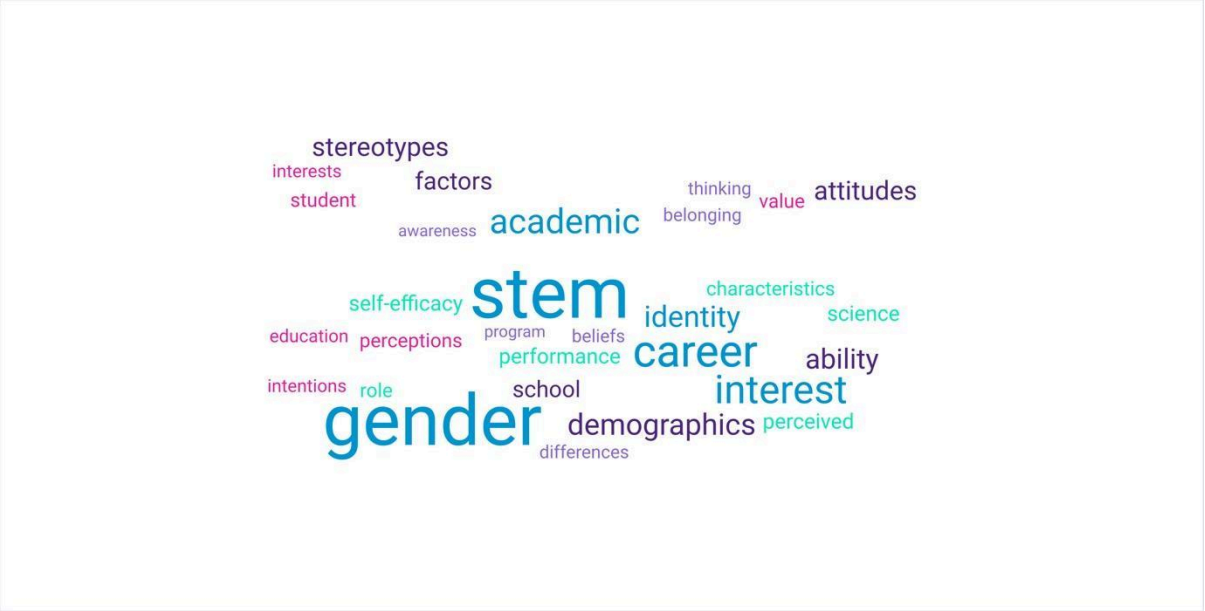


Figure 5 Visual representation of most frequent terms among variables measured in the studies



2. State-of-the-Art Approach: Findings

This section presents the findings collected and summarised from the 2023 research selected for this analysis, structured according to the role of the participants in STEM education and professions included in the publications, namely **students** across educational levels, **teachers**, and **professionals**.

STE(A)M students:

Early years and elementary/ primary school students: Studies focused on children's perceptions of scientists in relation to stereotypes and found a **favourable gender balance** in the way children perceive and represent software engineers (Cutrupi et al., 2023) and a **same-sex preference** for girls (Leavy et al., 2023). Children see female scientists as *smart* when they are portrayed operating alone or in a group of all-male scientists and as *hardworking* when they are portrayed in all-female settings (Kumar et al., 2023). Findings are also consistent with the idea that **stereotypes come with age**, and older children – especially girls - are more aware of stereotypes than younger ones (Cutrupi et al., 2023; Leavy et al., 2023). Thus, research poses concerns that, as girls get older, they are less likely to **aspire** to science careers and to **believe** in their ability to associate themselves with such career choices. Exposure to **role models** can do the trick in keeping girls interested and motivated: for girls of colour, for instance, women role models who communicate a growth mindset about their ability in science seem to have a motivational effect (Gladstone et al., 2023). In terms of STEAM education in this early educational phase, **exposure** to computer science can increase **interest** and nurture girls' **eagerness** to learn (Schwinghammer et al., 2023), while they also tend to increase their self-regulation and social behaviour, as opposed to their male counterparts' higher scores and improvements in computational thinking (Sung et al., 2023). Extracurricular activities targeting young girls generate a positive influence on their skills and their **self-concept** about science and technology (Ruiz-Bartolomé & Greca, 2023).

Middle/ Secondary school students: Students' interest in STEM-related subjects, studies, and subsequent careers is strongly linked to self-belief; expectancy for success in mathematics and science and attitude towards engineering and technology tend to be lower among girls, which may impact their future trajectories (McMaster et al., 2023; Van Wassenaer et al., 2023). Learning mathematical and scientific concepts needs to be doubled by learning their practical applications and the career opportunities they facilitate, for the effective promotion of engagement with STEM careers among girls (Siani & Harris, 2023). Based on STEM- and STEAM-designed learning programs, studies substantiate female students' learning outcomes and interest in these fields (Arpaci et al., 2023; Bailey et al., 2023; Benavides et al., 2023; Vergara, 2023), in some cases superior to those of

their male counterparts (Arpaci et al., 2023; Vossen et al., 2023). Mindfulness meditation training was found effective in tackling test anxiety among girls, by increasing self-esteem (Duraku et al., 2023).

Implicit gender stereotypes and endorsement of explicit gender stereotypes such as men handling technology better than women and women outperforming men in caregiving may be strong among young students and may be associated with less interest in tech education among girls (Tellhed et al., 2023). Representation seems to be essential in enhancing STEM self-concept among girls, as the presence of female role models in educational settings might increase their STEM self-confidence (Vossen et al., 2023). Some interventions were designed specifically to target boys by enhancing their perceptions of girls' STEM-related abilities, which showed promising effects, especially at young ages (Cyr et al., 2023).

Class also factors into girls' educational experiences, as girls coming from working-class backgrounds display lower levels of confidence, interest, and self-confidence in pursuing science than girls who come from upper socio-economic classes (Boyle et al., 2023). However, STEM programs – even informal ones – may be pivotal to minoritized girls, generating positive changes in their scientific self-efficacy, the number of girls able to name a living scientist, and their awareness of doing science daily (Broder et al., 2023). Single-gender learning environments focused on STEM, led by Black women, also show promise for minoritised girls' STEM engagement, through developing the social bonds needed to cultivate their sense of belonging and boost their confidence in science (Edwards & King, 2023). Creating such spaces for the affirmation of minoritized girls' identities is vital for STEM engagement and belonging, as they get to leverage their assets for educational purposes (King et al., 2023; Milton et al., 2023).

High school students: STEM education in relation to the gender gap should not be treated as a monolith, as studies show diverse trends across disciplines, education levels, and contexts. The gender gap in physics may see less progress than in other fields, while biology also faces a widening gender gap (Corrigan et al., 2023). However, physics and biology are both more severely influenced by the endorsement of gender stereotypes than chemistry (Galano et al., 2023). Research results are mixed: some find no significant gender differences in students' interest in informatics, mathematics, and physics subjects (Bahr & Zinn, 2023), while others do find gender gaps in such aspirations, such as tech career aspirations in Israel (Budgea et al., 2023) or STEM interest favourable to female students or to expatriate students that is detrimental to male or nationals, in a study on Qatari education (Sellami et al., 2023). Some studies find girls to be less engaged in formal STEM classes (Mulvey et al., 2023), while others show that interdisciplinarity may be more

appealing to girls (Bahr & Zinn, 2023). Gender differences were found in educational choices deemed appropriate for boys and girls, as work deemed feminine can be underestimated among boys, while those holding gender essentialist beliefs are likely to advise girls against masculine work (Reisel & Seehus, 2023). The education environment is key in students' decisions to pursue STEM careers, and boys' self-concept is superior to that of girls, deeming themselves better at tasks considered masculine, which seems to attenuate by high school (Martínez et al., 2023).

Under certain circumstances, teachers may be more prone to undervalue girls' performances in science than boys' and to offer them less feedback (Kang, 2023), which may influence girls' learning outcomes in a negative manner. Parental education is also a variable to be considered, as it was found to decrease girls' maths intentions (Uunk, 2023). In line with a later discussion on the negative influences of family support on girls' self-concept, Zhan et al. (2023) found that fathers tend to have higher expectations for their daughters than their sons in terms of most competencies, such as concentration, memorising, and taking examinations, while sons are socialised and deemed to be better and hands-on competencies; despite supporting competencies in both girls and boys, these findings reflect gendered expectations that are enforced upon children and might steer them towards different fields of study and then careers. STEM self-efficacy is vital for female students to nurture interest in STEM careers, and environmental factors such as social support and media could affect girls' interest in STEM careers through their weight on self-efficacy (Wang et al., 2023). There are STEM-related skills for which girls outperform boys, such as collaborative problem-solving (Borgonovi et al., 2023) or inquiry-based learning, which increases girls' science motivations more than it does for their male counterparts (Kang, 2023). However, girls' comparative advantage in reading explains only a minority of the gender gap in maths educational and career choices, but explanations must also rely on the cumulative effects of other structural and psychological factors (Wan et al., 2023). Digital competencies are relevant to the discussion of STEM, as a gender gap starts to emerge as teenagers transition towards high school; digital literacy of female students seems to be negatively associated with a migration background, and nurturing these competencies is positively linked to further studies and careers in STEM fields (Bachmann & Hertweck, 2023).

At the beginning of high school, female students hold higher levels of self-efficacy and motivation for STEM subjects than later (Birney & McNamara, 2023). Early adolescents seem to be more gender egalitarian or to favour their gender more, later shifting to a more traditional view (Starr et al., 2023). In order to decrease the perception of femininity being incompatible with STEM identity, a deconstruction of the masculine view of self-efficacy

and academic control is needed (Galano et al., 2023). Female role models play an important role in leading girls towards STEM fields, reducing stereotypical views of science jobs and the gender gap in self-concept in terms of abilities (Breda et al., 2023). But for girls' identities to fit into STEM culture and consolidate their perceived self-efficacy, they need to reject hostile gender stereotypes and male norms and focus on their perception of competency (Galano et al., 2023). Exposure to counternarratives in educational settings is crucial in developing career interests, especially for women and minoritized groups (Potvin et al., 2023).

Education programs designed to foster sociopolitical agency can support (especially minority) girls' development by integrating learning opportunities that positively influence their perceived ability to change their STEM educational conditions (Garcia et al., 2023). All-female structures have some advantages in terms of communication, presentation, and collaboration skills, yet those involved in STEM competitions should provide girls with more support, exposure, and opportunities to nurture their STEM-related abilities (Chiang et al., 2023). For girls who are already enrolled in STEM programs, self-efficacy in science and STEM identity are mutually influential and can be nurtured to promote their interests in scientific careers (Zhao et al., 2023). Gender-inclusive STEM instruction can draw girls towards these fields without being detrimental to boys' engagement, by enhancing the girls' awareness and motivation to use science for real-world problems (Casey et al., 2023). Studies also warn that interventions enhancing favourable perceptions of STEM careers without necessarily dwelling on women's underrepresentation are more effective (Breda et al., 2023). This may be because perceptions of barriers can lead to disengagement (Mulvey et al., 2023).

Undergraduate students: Overall, women are less likely to graduate with STEM degrees because they pursue STEM degrees to a lower extent than their male counterparts or non-STEM degrees (Costello et al., 2023), so there is a gender aspiration gap. Despite their high academic performance coupled with a strong school background, some women have a low level of confidence in their STEM abilities (Almukhamvetova et al., 2023). Some higher education settings favour behaviours that are incompatible with female students' learner identities, so they require adjustment (Hu & Stahl, 2023); they thus engage in significant efforts to develop their resumes through extracurriculars and prove their capabilities, illustrating their awareness of their disadvantages, especially when they are not enrolled in the most prestigious STEM programs (Wen et al., 2023). Performance gaps detrimental to women were found in mathematics and quantitative reasoning in higher education, which may be attributed to anxiety, but women tend to score higher in terms of improvement in college (Gallego & Casadiego, 2023). Exceptions are also studied, such as

Mexico, where women may score higher than their male counterparts in scientific and innovative thinking (Rodríguez-Abitia et al., 2023). Under conditions of similar interest in STEM, women might exhibit greater utility value, attainment value, and greater confidence about performance (French et al., 2023). Similarly, female students in STEM are found to hold higher confidence in their career identity, commitment, and relevance of learning than their male counterparts, and foster even better employability beliefs compared to non-STEM students (Ananthram et al., 2023). Also, women pursuing STEM degrees display a great level of mobility (Narh & Buzzelli) and are driven by different motivations than their male colleagues, seeking to help others and improve their communities (Merayo & Ayuso, 2023). Transitioning from school to work, women appear to be more likely to have a job; better grades tend to lead to early job offers for female students (Glass et al., 2023).

An intersectional lens might provide a more nuanced understanding of women in STEM, as white women might not acknowledge their whiteness as salient when navigating educational spaces, while Black women might encounter more inequality (Davis & Wilson-Kennedy, 2023). Experiences of minority ethnic women in STEM higher education reveal pragmatic, persistent, and precarious pathways, calling for a commitment from universities to addressing the inequalities and finding the support much needed by underrepresented students (Wong & Copsey-Blake, 2023). Moreover, intersectional identities enable STEM students from underrepresented or marginalised communities to place importance on *giving back*, through teaching and tutoring, creating counterspaces, mentoring, and serving as role models for others (Jaumot-Pascual et al., 2023). Women who are future teachers hold more positive perceptions towards including creative robotics in the curriculum than their male counterparts, for instance (Soto-Solier et al., 2023), which might generate better STEAM outcomes for girls in early education.

Having female faculty **instructors** is pivotal to female students' experience in STEM education, thus the lack of female professors and instructors might affect their engagement in STEM (Almukhamvetova et al., 2023; Sikhosana et al., 2023). Students with diverse mentor **networks** experience belonging to academic spaces to a higher extent, which might prove especially effective for students from underrepresented backgrounds (Du et al., 2023). Participation in mentoring programs can contribute to talent development in STEM, especially in fields with low female representation (Stoeger et al., 2023). Beyond networking and a sense of community, role models and family support are crucial to enhancing academic performance (Freedman et al., 2023). Belonging to mentorship networks offers the social capital needed to foster women's social integration into scientific careers, developing a solid long-term science identity and a sense of belonging

(Hernandez et al., 2023). Oftentimes, female students do have support networks and perceive themselves as fit for engineering, thus proving self-confidence (Hardtke et al., 2023; Mujtaba et al., 2023).

Female students are also treated differently, devalued, and not expected to work in the field in the future (Almukhamvetova et al., 2023), thus there can be an investment gap on behalf of their professors, which is detrimental to female students. One factor that might affect women's decisions to pursue STEM careers is self-concept, which may be negatively influenced by grade penalties: in a study of grade penalties in STEM classes, women were found to be more severely penalised than their male counterparts in most science classes (Malespina & Singh, 2023). Under certain STEM teaching circumstances (online/remote modules, such as the case of Bliss et al., 2023; Callejas et al., 2023; Travers et al., 2023), there can be favourable gender gaps in terms of learning, confidence, and STEM identity for female-identifying students and other underrepresented minorities. Adding diversity, equity, and inclusion features to STEM courses may also be effective in promoting inclusive classrooms (Sunasee, 2023). Other settings, such as laboratory activities, may lead to women receiving reduced utility from their STEM programs and that universities do not actually ensure equal access to resources and opportunities, as Fernandez et al. (2023) found that women occupy stereotypically gendered roles in STEM labs, which reduces the time possibly spent on key activities for their professional development.

Traditional gender roles, stereotypes and expectations transfer through STEM faculty and male peers, and then emerge in girls' beliefs about themselves and their belonging to STEM (Almukhamvetova et al., 2023). These misperceptions may create systemic barriers in their future careers, as they cause female students to feel out of place and doubt their own abilities (Hardtke et al., 2023). **Stereotypes** influence gender segregation in education, as emerging adults identifying as women who hold strong gender-science stereotypes show more interest in liberal arts occupations and those with more interest in science-related occupations hold less strong gender-science stereotypes (Endendijk, 2023). However, women are more willing to perform counter-stereotypical work than their male counterparts (Mouton et al., 2023). Thus, one's exposure to counter-stereotypical role models might prove effective in reducing stereotypes and increasing self-identification with counter-stereotypical occupations and education.

Graduate students and PhD students: Among STEM college graduates in Italy, young girls are found less likely to **choose** tracks that focus on maths and technical skills, suggesting that high school choices heavily impact their future educational trajectories (Granato, 2023). For choosing STEM fields as university majors, the German case illustrates a

gender-specific cost that tends to be high for low-income women and for high-income people in general, where there are few women in STEM academia, so a low feminization of STEM (Henry et al., 2023). Moreover, the South African case shows that equity through sole access to education does not engender transformation, as women who are graduate students still encounter oppression in STEM universities (Mkhize, 2023). Similarly, in Mexico, school achievement is not linked to female graduates' dropout from STEM careers, but rather the **difficulties** posed by less empathetic faculty and competitiveness; conversely, **mentoring** by inspiring faculty, **awareness** activities, and **networking** with women in STEM are pointed out as policies that would enhance the retention of women who are already enrolled in STEM programs (Ortiz-Martínez et al., 2023). Gender differences in the **employability** of engineering graduates are also found, as Yepez Zuluaga and Granada (2023) identified differences in terms of career resilience and optimism at work. The **leaky pipeline** theory holds worldwide, despite improvements in the number of women graduating in STEM fields, which does not automatically and proportionally translate into women's STEM careers (Amirtham & Kumar, 2023; Balasubramanian et al., 2023). As Speer (2023) warns, there is no single educational stage that we can focus on in order to understand, address, and fix the gender gap in STEM careers, as female talent seems to be overlooked and thus lost before college, during college, and after graduating from college.

The STEM educational system shows a leaky pipeline in terms of doctoral studies, as the gender gap has not decreased at the same pace as in other disciplines, yet ***gender assortativity*** emerges as a positive trend in Spain, with increasing female PhD supervisors, as well as gender relations between supervisors and candidates and supervisors and committee chairs (Sánchez-Jiménez et al., 2023). A case study of a course developed to educate and empower graduate students to be **diversity champions** in STEM found some support that participants experienced positive outcomes in their levels of comfort and confidence in those fields (Burt et al., 2023). Psychological profiles of doctoral students show that women are more likely to face **social identity threat**, as well as students who have queer identities, who tend to be overrepresented in this profile (Stevens et al., 2023). This is particularly important in light of what Reggiani et al. (2023) found about LGBT+ academics and PhD students in STEM, whose **visibility** might expose them to harassment and discrimination, while in some cases it might lead to affirming experiences, through authenticity, connections, and meaningful action to foster inclusion and equity in the academia.

Teachers and professionals:

STEM teachers and faculty: Women are underrepresented at the top of many STEM professions, which is owed in part to being more heavily engaged in family and community activities, rated as more important than in the case of men (Lubinski et al., 2023). Being a woman in a male-dominated STEM field puts them at increased risk for turnover especially due to the pandemic context, which generated uneven increases in work-family conflict, burnout at work, and reduction of job satisfaction, all at higher rates than for male faculty (Lawson et al., 2023). Coupled with racial identities, the wage gap also influences women's experiences in STEM academic jobs; although they do acknowledge and understand the persistent wage differences, they avoid the emotional and psychological costs of addressing the issue and choose to avoid, disengage, and reframe the issue (McGee et al., 2023). There is also gender bias in STEM faculty recruitment, substantiated by findings of gendered arguments, such as questioning women and the perceived self-questioning of female applicants (Dutz et al., 2023). Female faculty seem to navigate gendered experiences in traditionally male-dominated fields such as engineering, facing attempted diminishment of gendered issues at work, and struggling between hypervisibility – as being rare or the only woman there – and invisibility, not being heard or recognized as an expert (Miller et al., 2023). Motivations to pursue STEM careers may also illustrate gender gaps, as women were found more influenced by external motivation, such as status and prestige, than their male counterparts (Yoel & Dori, 2023), which might suggest increased sensitivity and previous experience of stigmatisation. Women faculty show higher support for equal opportunity measures in academia than their male counterparts, who see these policies as threatening to their privileged status (Bourabain & Verhaeghe, 2023). Women also deem the ability to implement inclusive teaching strategies as an important feature of their academic role (Wu et al., 2023).

Gender bias among pre-university teachers still exists: although some tend to deny that gender differences in society are still in place, they are also particularly likely to underestimate their female students' abilities; even if they do not seem to grade them any lower than their male colleagues, they do doubt their STEM-related abilities (Copur-Gencturk et al., 2023). Many times, they tend to blame external factors and peer influence for gender disparities (Wang, 2023). Similarly, gender bias was also studied in relation to teachers' likelihood of recommending STEM programs to their students as they transition into college, and it seems that some demographic characteristics and superior levels of cultural capital among teachers correlate with fighting gender bias, compensating for negative stereotyping of women in STEM (Andersen, 2023). There is a common understanding, however, that the number of women in STEM is not sufficient, and teachers

tend to assess negatively the situation of women's visibility, gender equality, and traditional gender roles, pleading for the need to encourage female students towards STEM via appropriate role models and influencers and mindset-changing through campaigns (Kaplan-Sayı et al., 2023; Merayo & Ayuso, 2023).

STEM researchers and academic leaders: When women are able to dedicate equal time to their male counterparts to academic workload and research funding endeavours, they are just as prolific (Beaudry et al., 2023). Educational funding programs for female faculty can enhance women's grant success (Stoop et al., 2023), so they could be adopted by universities wishing to accelerate women's careers. Among factors hindering women's scientific publication productivity stand care work, household chores, reduced mobility, and teaching workload (Beaudry et al., 2023). This weighs on pay inequity, as research productivity exacerbates the gender wage gap even in STEM; the paradox consists in conditions of equal productivity, such as an identical h-index for women and men, which still generate less compensation for women (Samaniego et al., 2023). Thus, the road towards academic performance is more difficult for women, and rewards are not as significant as for their male peers, which might negatively influence their leadership perspectives (Luthi & Kosloski, 2023). However, care-related orientations in serving as leaders influence women's leadership identities, who approach this role by fostering support and providing motivation to their peers (Qadhi et al., 2023). Lack of role-model awareness may increase with age, as women come to realise that they would help alleviate gender barriers in STEM, such as perceptions of stereotype threat and childcare-work conflict (Achtzehn et al., 2023).

Studies also relied on representation theories to argue for the influence of media on female publics, by studying how female scientists are presented and represented across media: news media (Eizmendi-Iraola & Peña-Fernández, 2023), entertainment media (Gipson, 2023; Gürkan & Echazarreta-Soler, 2023; Soucy-Humphreys et al., 2023), and social media (Huber & Baena, 2023). Women scientists' and researchers' voices are barely represented across news media, and the presence of stereotypes in news content associated with women scientists is significantly increased in the case of hard sciences, women thus being framed in narratives of singularity and difficulty (Eizmendi-Iraola & Peña-Fernández, 2023). When they, however, present themselves via social media, female scholars on TikTok use this media platform to explain scientific facts and concepts by showing science in the making and to share their experiences of being (female) scholars (Huber & Baena, 2023). As the movie industry has started to engage in more diverse strategies, movies portraying female scientists represent them in a way that relies on authenticity, thus showing promise in changing the stereotypes related to women in STEM,

against the dominant gender ideology (Gürkan & Echazarreta-Soler, 2023). On the other hand, the representation of female scientists in animated TV comedies targeting children (such as *Spongebob Squarepants* or *Adventure Time*) is infused with stereotypes, and the humour is rather associated with the science, not with the scientists (Soucy-Humphreys et al., 2023).

STEM professionals: For Gen Z women who study and work in data science, exposure to role models, technical education, opportunities, and a stereotype-free environment play a vital role in their career choices (Bhore & Tapas, 2023). In terms of role models, women are as motivated as men by personally known role models who are women or men, which may mean that STEM fields are less likely to facilitate same-gender encounters on educational and professional paths due to their scarcity (Midgley et al., 2023). Fostering a sense of belonging and diminishing biases in how they and their work are perceived are reported as solutions for women-friendly STEM work environments (Jantz et al., 2023). Conversely, traditional cultural models, lack of flexibility in work arrangements, and the scarcity of gender-sensitive organisational policies constitute obstacles for women in STEM jobs (Kemechian et al., 2023). Family attributes, such as marriage and parenthood, may engender discrimination that affects women and accumulates over their work lives (Sassler & Meyerhofer, 2023). For women overcoming burnout in STEM, a lack of alternative career trajectories can steer them towards dropping out of the field or resenting their jobs and career choices (Lee & Riach, 2023).

3. Longitudinal Approach: Overview of 2014-2022 Influential Research

The methodological approaches employed across the 2014-2022 most cited publications retrieved from Web of Science also feature some diversity, but not as strong as in the case of the state-of-the-art analysis. As such, *Table 6* shows a tendency in favour of quantitative approaches, including cross-sectional and longitudinal survey studies, meta-analyses, experimental and quasi-experimental research, as well as secondary data analyses. Compared to these quantitative studies, qualitative approaches and mixed-methods approaches are rather underrepresented in the sample of studies analysed, showing that over the years under analysis, the most influential studies were those with quantitative research designs. Last but not least, research based on primary data, collected by the authors, was primordial here as well, in 2/3 of the studies, while the other ones operated with secondary data.

Table 9. Methodological approaches employed in the 2014-2022 most cited publications

Methodological approaches		
Quantitative	*Qualitative*	*Mixed-methods*
Survey research ***Cross-sectional***: Andrews et al., 2021; Ayuso et al., 2021; Barthelemy et al., 2015; Bloodhart et al., 2020; Chan, 2022; Contini et al., 2017; Dabney & Tai, 2014; De la Cuevas et al., 2022; Dökme et al., 2022; Dou & Cian, 2021; Ellis et al., 2016; Ertl et al., 2017; Fisher et al., 2019; Goldman & Penner, 2016; Hill et al., 2014; Lewis et al., 2017; Makarova et al., 2019; Mann et al., 2015; Mann & DiPrete, 2016; Mulvey et al., 2022; Nissen et al., 2021; Stoet & Geary, 2018; Tellhed et al., 2017; Vázquez-Alonso & Manassero-Mas, 2015. ***Longitudinal***: Cotner et al., 2020; Hughes, 2018; Legewie & DiPrete, 2014; Maloy et al., 2022; Marshman et al., 2018; Miller & Wai, 2015; Nix et al., 2015; Perez-Felkner et al., 2014; Riegle-Crumb & Moore, 2014; Sax et al., 2016. **Experience Sampling Method:** Nissen & Shemwell, 2016. **Meta-analysis:** Su & Rounds, 2015; Tran et al., 2014.	**Interview research** **Individual interviews:** Archer et al., 2017; Gazley et al., 2014; King & Pringle, 2019; Makarova et al., 2016; Ong et al., 2018; Puccia et al., 2021. **Content analysis:** Mansfield et al., 2014; Park & Lee, 2014. **Case study:** Botella et al., 2019; López-Iñesta et al., 2020. **Systematic literature reviews:** Alfred et al., 2019; Charlesworth & Banaji, 2019; Hinojo-Lucena et al., 2020; Ireland et al., 2018; Olsson & Martiny, 2018; Reinking & Martin, 2018; Steinke, 2017; Tselegkaridis & Sapounidis, 2022; Verdugo-Castro et al., 2022. **Ethnography:** Sengupta-Irving & Vossoughi, 2019.	**Quantitative & Qualitative variations** **Survey & focus group interviews:** Trott & Weinberg, 2020. **Survey & interviews**: García-Holgado et al., 2019; Kijima et al., 2021 (*mixed-methods sequential explanatory design approach*). **Quantitative approaches** **Survey & observation:** Ballen et al., 2019. **Survey-based longitudinal data & secondary data analysis**: Main et al., 2020; Seyranian et al., 2018. **Qualitative approaches** **Content analysis (***mainly of ethnographic data***) & interview:** Seron et al., 2018; King & Pringle, 2019; Morton, 2021. **Interviews & observation**: Wieselmann et al., 2020.

Experimental research: August et al., 2016; Dasgupta et al., 2015; Dennehy & Dasgupta, 2017; Handley et al., 2015; Master et al., 2017; Moss-Racusin et al., 2016; Smith et al., 2015. **Quasi-experimental studies (survey-based):** Shahin et al., 2021; Toven-Lindsey et al., 2015. **Secondary data analyses (administrative/ enrollment records):** Delaney & Devereux, 2019; Dilli & Westerhuis, 2018; Kugler et al., 2021; Kwiek & Roszka, 2022; Pilotti, 2021; Toven-Lindsey et al., 2015; Vooren et al., 2022.		

As for the population and sample analysis carried out in this stream of research portraying the most cited literature on the topic over a decade, consistent with the 2023 findings, the most studied **population** among students is that of undergraduate students (*Table 7*), followed by high school students, showing that most research focuses on emerging adults and their STEM experiences and identities, rather than that of younger students. Going beyond the student populations included in these studies, *Table 8* illustrates a focus on teachers, STEM professionals, and mixed or other types of populations, which similarly to the previous part of the analysis, shows that scholars are interested in more than just students' experiences. Also similar to the previous sections, in terms of gender, most research focuses on a binary approach, a comparative perspective between female and male students, followed by a lower interest in all-female samples, and a marginal preoccupation with more inclusive approaches (*Table 9*).

In terms of **intersectionality,** we can find some scholarship that focuses on more than gender, and investigates **race/ethnicity**: Alfred et al., 2019; Andrews et al., 2023; Gazley et al., 2014; King & Pringle, 2019; Madkins & Morton, 2021; Main et al., 2020; Morton, 2021;

Nissen et al., 2021; Ong et al., 2018; Sengupta-Irving & Vossoughi, 2019, or **race/ethnicity and income**, such as the studies by Mulvey et al., 2022; Puccia et al., 2021; Trott & Weinberg, 2020.

Regarding the **size of the populations** or samples included in the analyses selected for this particular study (*Table 10*), most research focused on the experiences and situations of over 100 and over 1000 participants or observations, and samples under 100 were marginal, which is consistent with the overwhelming representation of quantitative studies across the sample of research included.

Table 10. Distribution of education level of participants across the 2014-2022 most cited publications

Education level of participants					
Early years and Elementary/ Primary school	*Middle/ Secondary school*	*High school*	*Undergraduate students*	*Graduate/ Ph.D. students*	*Mixed/ Longitudinal*
Ayuso et al., 2021; Master et al., 2017; Park & Lee, 2014; Wieselmann et al., 2020.	Archer et al., 2017; Delaney & Devereux, 2019; Goldman & Penner, 2016; King & Pringle, 2019; Trott & Weinberg, 2020.	Chan, 2022; De la Cuevas et al., 2022; Legewie & DiPrete, 2014a; Makarova et al., 2016, 2019; Mann et al., 2015; Mann & DiPrete, 2016; Mulvey et al., 2022; Nix et al., 2015; Riegle-Crumb &	Andrews et al., 2021; Bailey et al., 2020; Bloodhart et al., 2020; Botella et al., 2019; Cotner et al., 2020; Dasgupta et al., 2015; Dennehy & Dasgupta, 2017; Dökme et al., 2022; Dou & Cian, 2021; Ellis et al., 2016; Ertl et al., 2017; García-Holgado et al., 2019; Hughes, 2018; Kugler et al., 2021; López-Iñesta et al., 2020; Maloy	Barthelemy et al., 2015; Dabney & Tai, 2014; Fisher et al., 2019; Gazley et al., 2014; Miller & Wai, 2015; Pilotti, 2021.	Contini et al., 2017; Kijima et al., 2021; Legewie & DiPrete, 2014b; Lewis et al., 2017; Ong et al., 2018; Perez-Felkner et al., 2014; Su & Rounds, 2015.

		Moore, 2014; Shahin et al., 2021; Stoet & Geary, 2018; Tellhed et al., 2017; Tran et al., 2014; Vooren et al., 2022.	et al., 2022; Marshman et al., 2018; Morton, 2021; Nichols et al., 2022; Nissen & Shemwell, 2016; Nissen et al., 2021; Puccia et al., 2021; Sax et al., 2016; Seron et al., 2018; Seyranian et al., 2018; Toven-Lindsey et al., 2015; Vázquez-Alonso & Manassero-Mas, 2015.		

Table 11. Roles of participants across the 2014-2022 most cited publications

Role of participants			
Students	*Teachers*	*STEM professionals*	*Mixed/ Other*
Andrews et al., 2021; Archer et al., 2017; Bailey et al., 2020; Barthelemy et al., 2015; Bloodhart et al., 2020; Chan, 2022; Contini et al., 2017; Cotner et al., 2020; Dabney & Tai, 2014; Dasgupta et al., 2015; De la Cuevas et al., 2022; Delaney & Devereux, 2019; Dennehy & Dasgupta, 2017; Dökme et al., 2022; Dou & Cian, 2021; Ellis et al., 2016; Ertl et al., 2017; Fisher et al., 2019; Gazley et al., 2014; Goldman & Penner, 2016; Hughes, 2018; Kijima et al., 2021; Kugler et al., 2021; Legewie & DiPrete, 2014a; Legewie	**Faculty**: Handley et al., 2015; Hill et al., 2014; Main et al., 2020; Smith et al., 2015. **Instructors**: Ballen et al., 2019; Moss-Racusin et al., 2016.	**Employees**: Dabney & Tai, 2014. **Researchers**: Hinsley et al., 2017; Kwiek & Roszka, 2022. **Entrepreneurs**: Dilli & Westerhuis, 2018.	**Faculty & general public**: Handley et al., 2015. **Students & professionals**: Ong et al., 2018. **Students & teachers**: Ayuso et al., 2021; Nichols et al., 2022.

& DiPrete, 2014b; Lewis et al., 2017; López-Iñesta et al., 2020; Makarova et al., 2016, 2019; Mann et al., 2015; Mann & DiPrete, 2016; Maloy et al., 2022; Marshman et al., 2018; Master et al., 2017; Miller & Wai, 2015; Morton, 2021; Mulvey et al., 2022; Nissen & Shemwell, 2016; Nissen et al., 2021; Nix et al., 2015; Park & Lee, 2014; Perez-Felkner et al., 2014; Pilotti, 2021; Puccia et al., 2021; Riegle-Crumb & Moore, 2014; Sax et al., 2016; Seron et al., 2018; Seyranian et al., 2018; Shahin et al., 2021; Stoet & Geary, 2018; Su & Rounds, 2015; Tellhed et al., 2017; Toven-Lindsey et al., 2015; Tran et al., 2014; Trott & Weinberg, 2020; Vázquez-Alonso & Manassero-Mas, 2015; Vooren et al., 2022; Wieselmann et al., 2020.			**Parents & children**: Thippana et al., 2020.

Table 12. Distribution of genders of participants included in the 2014-2022 most cited publications

Gender of participants		
All-female	*Female and male*	*Beyond binary/ inclusive approaches*
Archer et al., 2017; Dabney & Tai, 2014; Dasgupta et al., 2015; Dennehy & Dasgupta, 2017; Dökme et al., 2022; Ertl et al., 2017; García-Holgado et al., 2019; Kijima et al., 2021; King & Pringle, 2019; López-Iñesta et al., 2020; Makarova et al., 2016; Morton, 2021; Ong et al., 2018; Sax et al., 2016; Shahin et al., 2021; Wieselmann et al., 2020.	Andrews et al., 2021; Ayuso et al., 2021; Bailey et al., 2020; Ballen et al., 2019; Barthelemy et al., 2015; Bloodhart et al., 2020; Chan, 2022; Contini et al., 2017; Cotner et al., 2020; De la Cuevas et al., 2022; Delaney & Devereux, 2019; Dilli & Westerhuis, 2018; Dou & Cian, 2021; Ellis et al., 2016; Fisher et al., 2019; Gazley et al., 2014; Goldman & Penner, 2016; Handley et al., 2015; Hill et	Hughes, 2018; Maloy et al., 2022.

	al., 2014; Hinsley et al., 2017; Kugler et al., 2021; Kwiek & Roszka, 2022; Legewie & DiPrete, 2014a; Legewie & DiPrete, 2014b; Lewis et al., 2017; Main et al., 2020; Marakova et al., 2019; Mann et al., 2015; Mann & DiPrete, 2016; Marshman et al., 2018; Miller & Wai, 2015; Moss-Racusin et al., 2016; Nichols et al., 2022; Nissen & Shemwell, 2016; Nissen et al., 2021; Nix et al., 2015; Mulvey et al., 2022; Park & Lee, 2014; Perez-Felkner et al., 2014; Pilotti, 2021; Puccia et al., 2021; Riegle-Crumb & Moore, 2014; Seron et al., 2018; Seyranian et al., 2018; Smith et al., 2015; Stoet & Geary, 2018; Su & Rounds, 2015; Tellhed et al., 2017; Toven-Lindsey et al., 2015; Tran et al., 2014; Trott & Weinberg, 2020; Vázquez-Alonso & Manassero-Mas, 2015; Vooren et al., 2022.	

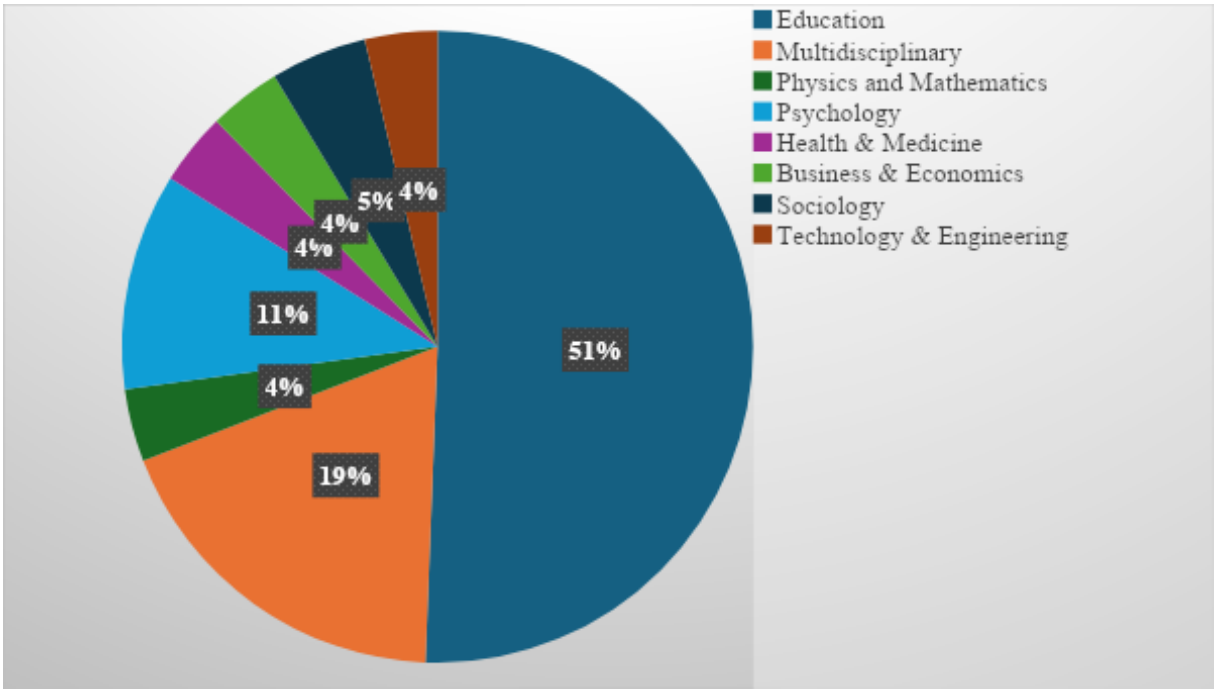
Table 13. Distribution of number of participants/ observations/ cases studied in the 2014-2022 most cited publications

Number of participants/ observations/ cases studied			
Small sample (under 30)	*Large sample*		
	100 and under	*Between 101 and 1,000*	*Over 1,000*
King & Pringle, 2019; Morton, 2021; Sengupta-Irving &	Gazley et al., 2014; Makarova et al., 2016; Master et al.,	Andrews et al., 2021; Archer et al., 2017; Barthelemy et	Ayuso et al., 2021; Bailey et al., 2020; Ballen et al., 2019;

Vossoughi, 2019; Wieselmann et al., 2020.	2017; Ong et al., 2018; Puccia et al., 2021.	al., 2015; Bloodhart et al., 2020; Cotner et al., 2020; Dasgupta et al., 2015; De la Cuevas et al., 2022; Dennehy & Dasgupta, 2017; Dökme et al., 2022; Dou & Cian, 2021; Ertl et al., 2017; Fisher et al., 2019; Handley et al., 2015; Hill et al., 2014; Kijima et al., 2021; Moss-Racusin et al., 2016; Nissen & Shemwell, 2016; Park & Lee, 2014; Riegle-Crumb & Moore, 2014; Seron et al., 2018; Seyranian et al., 2018; Shahin et al., 2021; Smith et al., 2015; Thippana et al., 2020; Toven-Lindsey et al., 2015; Trott & Weinberg, 2020.	Chan, 2022; Contini et al., 2017; Dabney & Tai, 2014; Delaney & Devereux, 2019; Dilli & Westerhuis, 2018; Ellis et al., 2016; Goldman & Penner, 2016; Hughes, 2018; Kugler et al., 2021; Kwiek & Roszka, 2022; Legewie & DiPrete, 2014a; Legewie & DiPrete, 2014b; Lewis et al., 2017; Marakova et al., 2019; Mann et al., 2015; Mann & DiPrete, 2016; Maloy et al., 2022; Marshman et al., 2018; Miller & Wai, 2015; Mulvey et al., 2022; Nissen et al., 2021; Nix et al., 2015; Perez-Felkner et al., 2014; Pilotti, 2021; Sax et al., 2016; Stoet & Geary, 2018; Su & Rounds, 2015; Tellhed et al., 2017; Tran et al., 2014; Vázquez-Alonso & Manassero-Mas, 2015; Vooren et al., 2022.

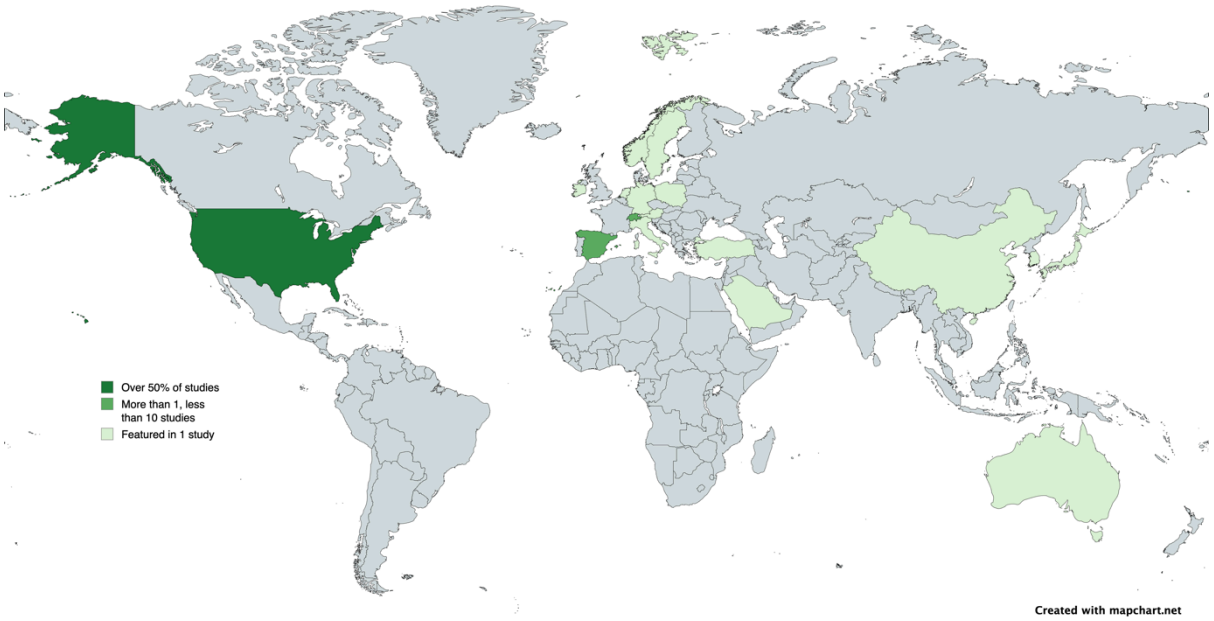
Journal research areas: The publications selected from 2014 to 2022 mostly included journal articles, and a few were book chapters and articles in conference proceedings: García-Holgado et al., 2019; Hill et al., 2014; Perez-Felkner et al., 2014. Most journals included in this analysis only featured 1 of the selected articles, yet some published several: *International Journal of STEM Education* (8 articles), *Frontiers in Psychology* (7), *Physical Review Special Topics – Physics Education Research* (6), *PLOS One* (5), *CBE – Life Sciences Education* (4), *Journal of Research in Science Teaching* (4), *Proceedings of the National Academy of Sciences of the United States of America* (*PNAS* – 3 articles), *Economics of Education Review* (3), *Sustainability* (3), and *Sociological Science* (2). All the journals are further organised into categories showing their primary subject area, to illustrate the salience of our topic across disciplines[9] (*Figure 6*). As the figure clearly shows, most articles on girls and women in STEM were published in journals focusing on **education research**, followed by **multidisciplinary** journals and **psychology**. Among all the journals included, only 2 focus primordially on gender topics: *Psychology of Women Quarterly* and *Sex Roles*.

Figure 6. Distribution of subject areas of journals publishing the most influential articles between 2014 and 2022



[9] Some journals can be classified into more than one category, but they are classified in this analysis based on their primary focus.

Figure 7. Geographical distribution of participants featured in the 2014-2022 most cited publications



Studies featuring **single-country cases** are shown in *Figure 7*, illustrating a high density of research in the United States of America (over 50%), 4 studies focusing on Spain, 2 on Switzerland, and 1 study featuring each of the following countries, across various continents: Europe (Austria, the Netherlands, Germany, Ireland, Italy, Norway, Poland, and Sweden), Asia (China, Japan, Saudi Arabia, South Korea, and Turkey), and Oceania (Australia). Cross-national approaches are not featured on the map that illustrates single-country cases. Yet, there are 12 studies carried out in cross-country settings, among which 2 focus on Latin American countries, and 1 on countries across Africa.

As for the main theoretical frameworks and variables included in the studies, similar to the previous analysis, as *Figure 8* and *Figure 9* illustrate, many studies were designed around the Social Cognitive Career Theory (SCCT), Social Role Theory (SRT), or Critical Race Theory (CRT), but most of them heavily relied on well-framed presentations of the gender gap in STEM, and measured gender and STEM via participants' identity-related measures.

Figure 8. Visual representation of most frequent terms used among concepts and theories in the 2014-2022 Web of Science publications

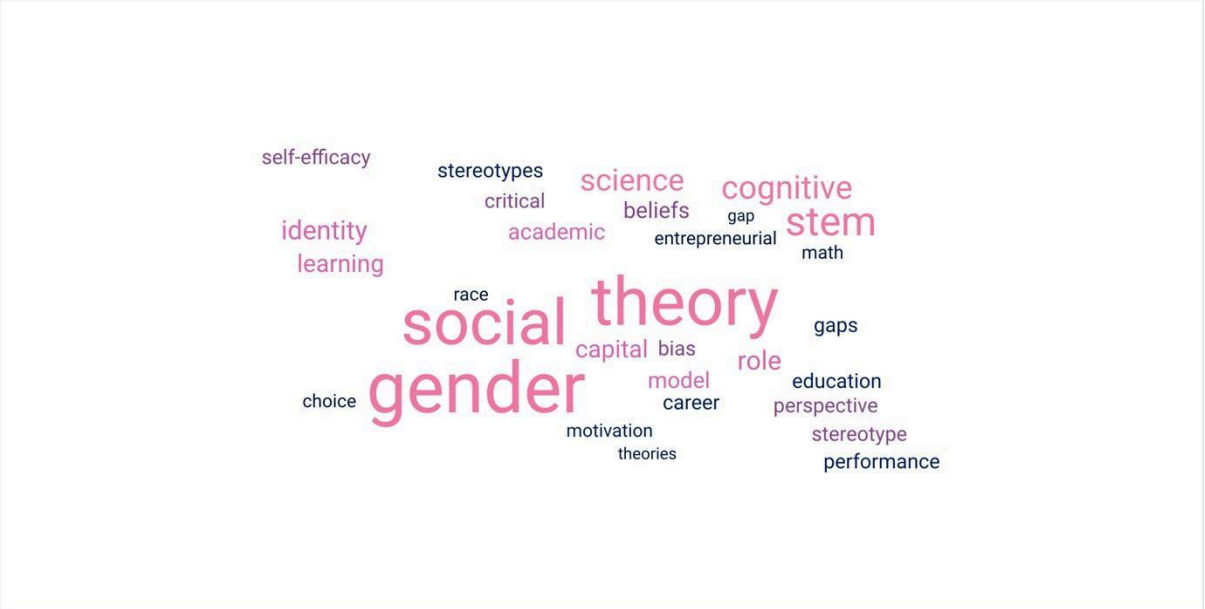
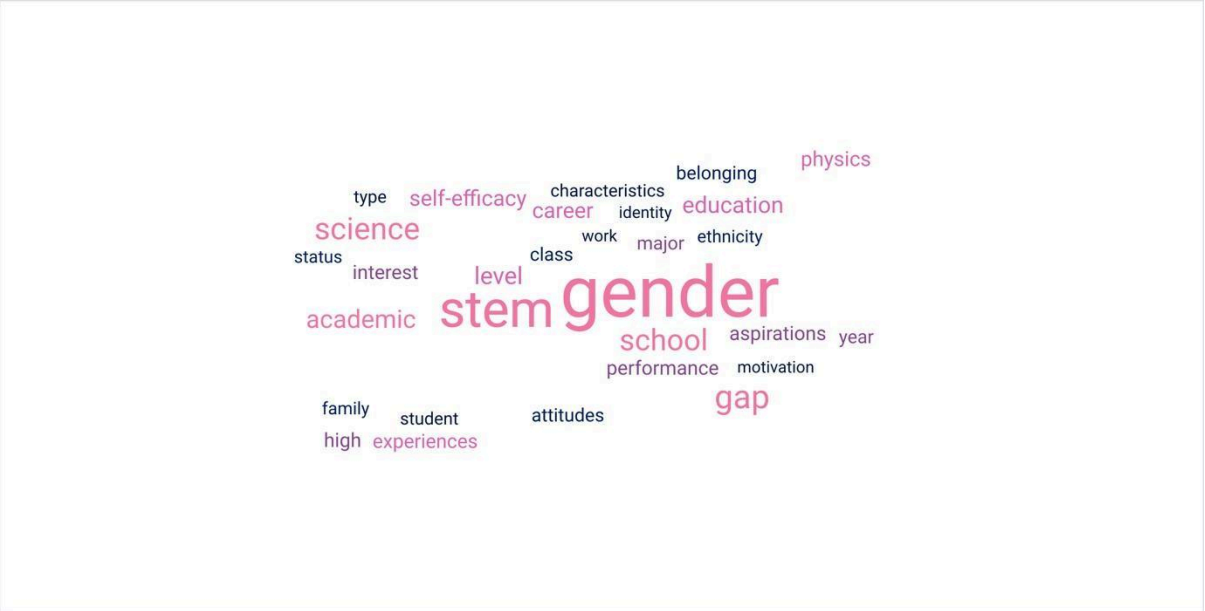


Figure 9. Visual representation of most frequent terms used among variables in the 2014-2022 Web of Science publications



4. Longitudinal Approach: Findings

The findings discussed below are structured into the main stakeholder categories identified in the studies, namely **students**, **teachers**, and **professionals** engaged in STEM education and professions, to illustrate a diversity of results to inform future research and policy.

STE(A)M students:

Early years and elementary/ primary school students: Studies on early education focused on the gender gap in students' perception of self-efficacy and perception of people in science occupations. Both positive and negative results are featured: girls see themselves as worse in mathematics and perceive boys are better equipped for STEM (Ayuso et al., 2021; Wieselmann et al., 2020), and report test anxiety to higher degrees than their male counterparts (Ayuso et al., 2021), whereas experiencing technological activities increases their technology interest and self-efficacy (Master et al., 2017). However, these gendered differences in self-efficacy in maths are not perceived by teachers (Ayuso et al., 2021), which may suggest that teachers' unawareness of the girls' situation translates into them not addressing it and thus not looking for solutions, which is problematic due to girls' perception of mathematics as a gatekeeper for STEM interest and success (Wieselmann et al., 2020). Moreover, views of engineers are somewhat gendered, as girls are more likely to portray women engineers than boys are (Park & Lee, 2014).

Middle/ Secondary school students: STEM definitions are important in assessing gender gaps, and science fares significantly more equally than engineering and technology (Delaney & Devereux, 2019). Country contexts make interesting case studies, as countries with smaller gender gaps have fewer students interested in maths-based careers overall (Goldman & Penner, 2016). Informal STEM programs are found particularly meaningful for minoritised girls, who create holistic understandings of STEM and continue their engagement post-program (King & Pringle, 2019). Moreover, understanding the social dimensions of scientific phenomena makes science more interesting and important, increasing interest and participation (Trott & Weinberg, 2020). Agency alone, however, cannot guarantee a successful pursuit of STEM aspirations for girls; inequalities and cultural perspectives of certain sciences may not only discourage girls but may actively restrict them from pursuing such educational or career paths (Archer et al., 2017).

High school students: Girls are found to be more likely to manifest lower levels of self-efficacy than boys, which is doubled by lower interest in STEM and lower motivation to pursue such careers (Chan et al., 2022; Tellhed et al., 2017); what is more, girls are more likely to feel unequipped to pursue STEM education than boys (De la Cuevas et al., 2022) and hold lower social belongingness expectations with students in STEM (Tellhed et

al., 2017). The school environment also factors into STEM aspirations: girls in high-performing schools tend to behave more like boys in terms of building their aspirations (Mann et al., 2015). Moreover, life quality pressures in countries with less gender equality enhance girls' and women's engagement with STEM, while in general girls perform the same or better than boys and appear as capable of STEM higher education as boys (Stoet & Geary, 2018). However, girls hold themselves to a higher performance standard than their male counterparts even before forming STEM orientations (Mann & DiPrete, 2016). Girls' 12th-grade perceptions of their maths ability potentially increase the probability of selecting undergraduate STEM degrees (Nix et al., 2015). Thus, the high school experience can be decisive for the gender gap, as studies show that the same orientation and preparation for STEM for girls and boys would nearly close the gender gap (Legewie & DiPrete, 2014b).

Girls' academic achievement in STEM does not, however, guarantee the pursuit of higher STEM degrees (De la Cuevas et al., 2022; Mann & DiPrete, 2016). Yet, when they do enrol for those types of degrees, they perform equally well in the long run (Vooren et al., 2022). Among female students, gender-science stereotypes of STEM subjects can influence their aspirations to enrol in STEM majors; through de-masculinizing the image of science among girls, there's a potential to enhance their career aspirations (Makarova et al., 2019). However, traditional gender role beliefs enhance gender disparities (Chan et al., 2022; Tellhed et al., 2017). Young women engaged in vocational education and training in traditionally male-dominated STEM fields disclose experiences of being treated as 'second-class' professionals (Makarova et al., 2016), showing that despite increasing participation of women in these areas, masculine cultures are thriving and need to be challenged to create an inclusive professional environment for women in gender-atypical careers. Work environments weigh on women's interests and pursuit of STEM fields, a people-centric approach being such a factor (Su & Rounds, 2015). Perceptions of inclusion positively influence feelings of belonging and STEM engagement and orientation (Mulvey et al., 2022). This is substantiated by research on students' local communities, showing that the gender gap in physics varies based on the number of women employed in STEM occupations within communities (Riegle-Crumb & Moore, 2014). Female-focused programs also constitute good practices for STEM engagement, by fostering the development of required skills, as well as by showing the importance of meaningful human connections, same-gender role modelling, and peer-to-peer learning (Shahin et al., 2021).

Graduate students: The participation gap in STEM classes offers nuanced understandings: while men are more likely to participate in class overall, women participated more than their male counterparts in classes where instructors called on most raised hands or with

increased female presence attending (Bailey et al., 2020). In remote STEM teaching settings, women participated less than their male colleagues both verbally and in the chat, which might also translate into their comments being more acknowledged than women's contributions by peers (Nichols et al., 2022). Male students – White ones – also tend to display more expertlike attitudes than any other student groups (Nissen et al., 2021).

Academic performance may also be higher where same-gender settings are facilitated: for instance, with female instructors or with a female student majority (Bailey et al., 2020). Women's experiences are found to be more positive in groups with female majorities, as they tend to feel less threatened and challenged positively (Dasgupta et al., 2015). Exploring the gender gap in belonging contributes to our understanding of STEM intentions and actual persistence, as women experience such a feeling less than their male counterparts (Lewis et al., 2017). Women being comfortable around other women seems to be a constant in research focusing on undergraduate experiences, as they deflect stereotypes, speak more, and express confidence and career aspirations (Dasgupta et al., 2015), so microenvironments with female majorities or equal gender design to say the least tend to foster women's affirmation. Moreover, female students display more test anxiety than their male peers, and this anxiety negatively predicts their performance (Cotner et al., 2020). But even in mixed STEM settings where women outperform men, their male peers continue to see them as less able, contributing to their gendered educational experiences (Bloodhart et al., 2020; Nichols et al., 2022).

Women are more likely to be dissuaded from continuing in mathematics majors than their male peers and experience lower mathematical confidence, suggesting that it is confidence, and not ability or academic preparedness per se, which bears the responsibility for women's early departure from this area of STEM (Ellis et al., 2016). However, overlapping signals of being misfits, such as poor performance and male-dominated fields lead to switching out of STEM majors to a larger extent in the case of female students than male students (Kugler et al., 2021). Additionally, there are family-related influences that may corrupt women's self-concept, such as direct support from parents, which might backfire and attribute girls' performance to tenacity rather than aptitude (Ertl et al., 2017). Conversely, expressive support from their parents, especially during their first year of the engineering major, could aid female students in transitioning to adulthood more smoothly (Puccia et al., 2021). Among high-achieving girls, it is not enough to take STEM courses to remain in the pipeline; math orientation coupled with support from their family, school staff, and friends is likely to contribute to their engagement (Perez-Felkner et al., 2014).

Same-gender peer mentoring generates lasting positive effects on women's educational experiences and retention in STEM studies, protecting their belonging, self-efficacy, motivation, and career aspirations (Dennehy & Dasgupta, 2017). Similarly, role model interventions and STEM training and activities in education college programs enhance the motivation of female students to include STEM as a future career perspective (Dökme et al., 2022). Gender gaps detrimental to women in terms of self-efficacy are consistent in innovative teaching designs (Andrews et al., 2021) and traditional educational settings (Marshman et al., 2018; Nissen & Shemwell, 2016; Seyranian et al., 2018). In other gendered contexts, innovative methods can positively influence young women's mindsets, self-concept, and perceptions of STEM (Kijima et al., 2021). Female students report lower levels of self-efficacy, fascination with physics and value, and express a more fixed view of intelligence in physics courses than their male colleagues; their competitive advantage might, however, be grit (Marshman et al., 2018). Women who do plan to go for a physics major hold a distinctive profile than women in other STEM fields, being confident in their maths abilities, valuing college as a learning opportunity, and considering the perspective of making theoretical contributions to science (Sax et al., 2016). The opportunity to pursue a meaningful career in a male-dominated STEM field is fuel enough for female students in engineering to stay on track, for instance (Seron et al., 2018).

Graduates and PhD students: A case study on physics education research shows a more balanced gender representation than the broad field, partially due to the importance of the positive community it entails, as well as the content of the subfield (Barthelemy et al., 2015). In terms of publication rates, women in doctoral programs experience higher levels of distress, yet this can be alleviated by expectations management and perception of preparedness, coupled with feeling accepted by their peers; this particular mix enhances women's likelihood to publish at rates comparable to their male counterparts (Fisher et al., 2019). Transitioning from undergraduate to graduate studies, classroom experiences of women in physics and chemistry courses are likely to influence their pursuit of physics rather than chemistry for a PhD (Dabney & Tai, 2014), thus more focus needs to be placed on classroom experiences to bridge the gender gap in STEM.

Teachers and professionals:

STEM faculty: To increase women's representation within the STEM faculty, an intervention was designed to fight biases in recruitment: although the meritocracy myth emerged as a concern of some faculty, the intervention that focused on raising awareness of bias, diversity, and work-life balance among search committees managed to increase gender diversity (Smith et al., 2015). A relationship was also found between the demographic composition of undergraduate students and demographic representation

among faculty, as engineering departments with more minoritized women as graduates tend to employ more minoritized female faculty (Main et al., 2020). Assessing how faculty relate to scholarship demonstrating bias (or the lack of it) against women in STEM, it seems that there is a gender bias that affects their judgment of research: men tend to dislike research demonstrating a gender bias, while women tend to like this said research and men favour research that shows no gender bias in STEM, while women disfavour it (Handley et al., 2015).

STEM instructors: Like research discussed before, microenvironments increase female students' class participation, as women are more likely to engage in class after small-group discussions; conversely, increasing class size inhibits female participation most (Ballen et al., 2019). Moreover, educational interventions on diversity manage to enhance awareness of gender bias, reduce gender bias, and increase participants' willingness to engage in such actions in the future (Moss-Racusin et al., 2016). This is particularly important as primary school teachers tend not to perceive differences in self-efficacy in STEM subjects, while girls experience these detrimental differences (Ayuso et al., 2021).

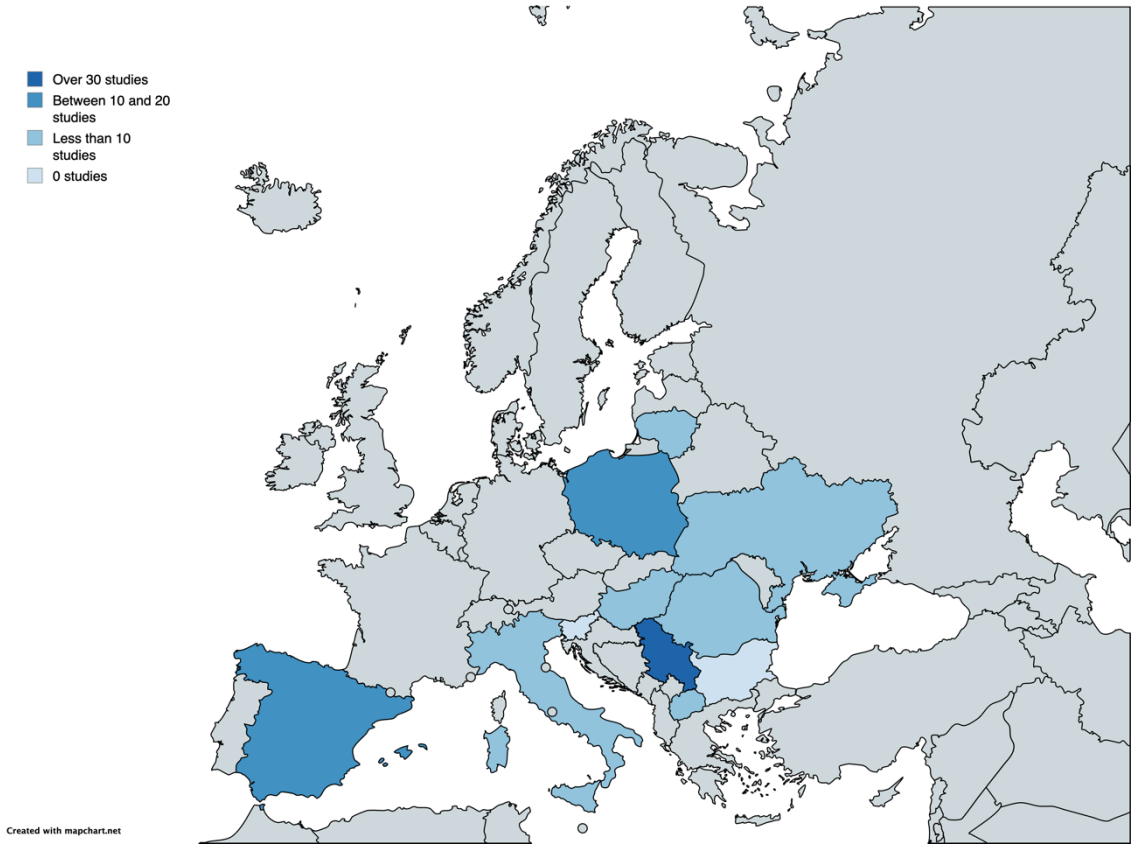
STEM professionals: Women in STEM face a 'chilly' climate (Hinsley et al., 2017), reflecting experiences of discrimination encountered across their educational and professional paths, enabling an inhibited behaviour shown in conferences: male researchers tend to ask significantly more questions than their female counterparts. In terms of publishing solo, gender differences are lower than expected, due to a general trend toward team research and international research which negatively influences solo publishing across genders (Kwiek & Roszka, 2022).

5. Local Approach: Overview of 2023 Research

The situation of publications identified by partner countries on Google Scholar that were eligible for the present analysis is detailed as follows: Serbia featured 32 articles (4 of which are duplicates, some also used for the case of North Macedonia), Spain featured 15, and Poland 10, followed by Ukraine and North Macedonia with 7 articles each (in the case of North Macedonia, 1 extra article is a duplicate and was already included in the state-of-the-art analysis, namely Idrizi et al., 2023), Italy with 4 articles (among which 2 are duplicates and were already analysed, namely López et al., 2023; Schmader, 2023), Lithuania with 2 relevant articles, and Hungary and Romania with 1 article each; in the case of Bulgaria and Slovenia, there were zero publications identified as eligible for this stream

of analysis (as shown in *Figure 10*). In total, we rely on a total of 73 unique publications for the study of literature provided by the partners in this task.

Figure 10. Heatmap of scholarship in national languages and/or national journals, by partner country[10]



In the analysis, we work with data extracted by partners, based on the research framework established among the consortium. Thus, the analysis relies on partners' expertise to assess the eligibility and suitability of publications for the present analysis, as well as to extract and offer the data. In the analysis of findings, we summarise the gender-segregated findings provided by the partners, as selected from the publications.

Table 11 illustrates the methodological approaches present in the publications included in this research stream; as expected and somewhat in line with the Web of Science and SCOPUS corpus for 2023, the approaches employed in these publications are, to a similar extent, made of quantitative and qualitative endeavours. Mixed-methods approaches are

[10] In the case of the Local approach included in this analysis, the map does not reflect the countries featured in the research, but the countries in which it was published: for instance, research published in Spanish journals or the Spanish language go beyond the Spanish case regarding girls and/or women in STEM, but also the Mexican case or the Colombian case.

less frequent across the studies identified by partners. Moreover, 2/3 of the studies rely on primary data, collected by the authors of those articles and other types of publications included, while the rest of them analyse secondary data.

Table 14. Methodological approaches employed in the publications identified in the partner countries

Methodological approaches		
Quantitative	*Qualitative*	*Mixed-methods*
Survey research ***Cross-sectional***: Adžić et al., 2023; Cekić-Jovanović & Gajić, 2023; Chmura-Rutkowska & Kozłowska, 2023; Dašić et al., 2023; Gašić et al., 2023; Horvat et al., 2023; Ilić & Novaković, 2023; Ivković Hodžić et al., 2023; Lara et al., 2023; Lazić et al., 2023; Medeiros et al., 2023; Mejía et al., 2023; Ognjenović, 2023; Osuna & Ruiz, 2023; Piekarski, 2023; Stanek & Palankiewicz-Mitrut, 2023; Šuvaković et al., 2023; Tandzegolskienė-Bielaglovė et al., 2023; Villa et al., 2023. ***Longitudinal***: Perišić & Miljković, 2023. **Meta-analysis:** Baysal et al., 2023. **Experimental research:** Radulović et al., 2023. **Quasi-experimental studies (survey-based):** Aleksić & Dionysios, 2023;	**Interview research** **Individual interviews:** Buelvas-Bardiris et al., 2023; Durán & Bustamante, 2023; Hernández Herrera & Hernández Herrera, 2023; Lendák-Kabók, 2023. **Group interviews:** Stavrevska et al., 2023. **Content analysis:** Aleksandra et al., 2023; Bogetic, 2023; Ćeriman et al., 2023; Martyniuk et al., 2023; Montenegro, 2023; Sharova et al., 2023; Torbus & Półtorak, 2023. **Case study:** Devedzic et al., 2023; Milanovic et al., 2023; Müller, 2023. **Systematic literature reviews:** Dabić et al., 2023; Ferati et al., 2023; Gmurek et al., 2023; Jefferson & Ángel, 2023; León et al., 2023; Mora-Santos, 2023; Moreno et al., 2023; Nagy et al., 2023; Tereshchenko et al., 2023.	**Quantitative & Qualitative variations** **Secondary data analysis, survey, & interview:** Vulović et al., 2023. **Survey & interviews**: Radovic et al., 2023. **Qualitative approaches** **Interviews & focus groups**: Paksi & Tardos, 2023. **Interview & ethnographic data**: Stošić & Marinković, 2023.

Romero-Rodríguez et al., 2023. **Secondary data analyses:** Gulczyński, 2023; Knapińska, 2023; Kwieciński, 2023; Kwiek & Szymula, 2023; Lalić-Vučetić & Mirkov, 2023; Lazarević-Moravčević et al., 2023; Martínez-Cantos, 2023; Sharlamamov et al., 2023; Todorović et al., 2023. **Observation:** Kramarenko, 2023.		

As for the level of diversity among the populations and samples from the studies included here, *Table 12* shows that most studies focus on student populations, and the rest of them include teachers' experiences, as well as STEM professionals and other, mixed categories of samples. Interestingly, all-female studies and comparative studies between female and male populations are present to quite similar extents in the corpus of analysis (*see Table 13*), and more inclusive approaches are marginal, like in the previous analyses. **Intersectionality** is present in these publications as well through focusing on women in rural areas (Devedzic et al., 2023; Pata et al., 2023) and people with disabilities (Lazić et al., 2023), as well as the representation of the Roma in school textbooks (Aleksandra et al., 2023). In terms of sample sizes, the most frequent category is above 100 participants, but the category under 30 is also recurrent across qualitative approaches (*Table 14*).

Table 15. Distribution of roles of participants featured in the publications identified in the partner countries

Role of participants			
Students	*Teachers*	*STEM professionals*	*Mixed/ Other*
Adžić et al., 2023; Aleksić & Dionysios, 2023; Ilić & Novaković, 2023; Lalić-Vučetić & Mirkov, 2023; Lara et al., 2023; Martínez-Cantos,	Cekić-Jovanović & Gajić, 2023; Horvat et al., 2023; Ivković	**Professionals**: Chmura-Rutkowska & Kozłowska, 2023; Dašić et al., 2023; Gašić et al., 2023; Hernández Herrera & Hernández Herrera,	**Students & specialists**: Martínez-Cantos, 2023.

2023; Medeiros et al., 2023; Mejía et al., 2023; Osuna & Ruiz, 2023; Perišić & Miljković, 2023; Piekarski, 2023; Radulović et al., 2023; Romero-Rodríguez et al., 2023; Sharlamamov et al., 2023; Stanek & Palankiewicz-Mitrut, 2023; Šuvaković et al., 2023; Vulović et al., 2023.	Hodžić et al., 2023; Tandzegolskienė-Bielaglovė et al., 2023.	2023; Stošić & Marinković, 2023. **Researchers & academics**: Agarwal et al., 2023; Knapińska, 2023; Paksi & Tardos, 2023; Stavrevska et al., 2023. **Leaders:** Buelvas-Bardiris et al., 2023. **Bios of STEM women**: Anghelache & Boștenaru-Dan, 2023. **Entrepreneurs**: Ognjenović, 2023; Zlatkovski et al., 2023.	**Students & teachers**: Lendák-Kabók, 2023; Milanovic et al., 2023; Sharlamamov et al., 2023; Villa et al., 2023. **Students & mentors**: Pata et al., 2023.

Table 16. Distribution of genders of participants in the publications identified in the partner countries

Gender of participants		
All-female	*Female and male*	*Beyond binary/ inclusive approaches*
Agarwal et al., 2023; Anghelache & Boștenaru-Dan, 2023; Buelvas-Bardiris et al., 2023; Devedzic et al., 2023; Durán & Bustamante, 2023; Hernández Herrera & Hernández Herrera, 2023; Knapińska, 2023; Lendák-Kabók, 2023; Mejía et al., 2023; Ognjenović, 2023; Paksi & Tardos, 2023; Stavrevska et al., 2023; Stošić & Marinković, 2023; Šuvaković et al., 2023; Zlatkovski et al., 2023.	Aleksić & Dionysios, 2023; Dašić et al., 2023; Gašić et al., 2023; Ilić & Novaković, 2023; Lalić-Vučetić & Mirkov, 2023; Lara et al., 2023; Martínez-Cantos, 2023; Perišić & Miljković, 2023; Radulović et al., 2023; Sharlamamov et al., 2023; Tandzegolskienė-Bielaglovė et al., 2023; Vulović et al., 2023.	Adžić et al., 2023; Chmura-Rutkowska & Kozłowska, 2023.

Table 17. Distribution of number of participants/ observations/ cases studied in the publications identified in partner countries

Number of participants/ observations/ cases studied			
Small sample (under 30)	*Large sample*		
	100 and under	*Between 101 and 1,000*	*Over 1,000*
Anghelache & Boștenaru-Dan, 2023; Buelvas-Bardiris et al., 2023; Durán & Bustamante, 2023; Hernández Herrera & Hernández Herrera, 2023; Stavrevska et al., 2023.	Lara et al., 2023; Osuna & Ruiz, 2023; Paksi & Tardos, 2023.	Adžić et al., 2023; Aleksić & Dionysios, 2023; Cekić-Jovanović & Gajić, 2023; Chmura-Rutkowska & Dašić et al., 2023; Gašić et al., 2023; Kozłowska, 2023; Perišić & Miljković, 2023; Piekarski, 2023; Stanek & Palankiewicz-Mitrut, 2023; Šuvaković et al., 2023; Tandzegolskienė-Bielaglovė et al., 2023.	Ilić & Novaković, 2023; Kwiek & Szymula, 2023; Mejía et al., 2023; Vulović et al., 2023.

6. Local Approach: Findings

Students and teachers: The gender gap in digital skills is not automatically diminished with increasing penetration of information and communication technologies, nor with generational evolutions; apparently, most countries have low female representation in this field, and it is not a high level of gender equality which guarantees better representation (Martínez-Cantos, 2023). In fact, no model cases were identified to generate more balanced results in terms of women's ICT participation. Studying gender differences in students' leisure activities during exam periods, Adžić et al. (2023) found that female students spend more time studying and less time playing video games than their male or non-binary counterparts, thus achieving higher grades. Gender differences were found among medical students concerning their public health actions, with women who study medicine being more engaged in informing about health over the internet than their male counterparts, and indicating more intensive use of mobile apps to improve their lifestyle (Ilić & Novaković, 2023).

There is progress in terms of women's representation among faculty in traditionally male areas, but not proportional to the presence of female graduates; persistent gender segregation detrimental to women has been found horizontally, as women's representation is higher in certain areas of knowledge, and vertically, as they tend to be better represented in lower academic positions (Medeiros et al., 2023). For instance, the portrait of school chemistry teachers in Serbia exhibits a woman aged between 36 and 55, with over a decade of experience in teaching, holding adequate education and competencies, who enjoys working with children as the main advantage of their job (Horvat et al., 2023). On the other hand, there are gender differences favouring male students in the participation rates and performance outcomes in mathematical competitions (Vulović et al., 2023). Women's presence in engineering education is deemed rare, and a majority of women are unaware of women-dedicated organisations designed to increase women's representation in STEM education (Mejía et al., 2023). In STEM academia, ethnic minority students frequently face othering by majority academia, the lack of language proficiency limiting their sense of belonging and academic success; at the same time, the female academics from the majority academics may host biases and face challenges in interacting with these students (Lendák-Kabók, 2023). Among multidisciplinary research networks, female-run groups tend to get more consolidated than those with female majorities, yet some behaviours of male colleagues may be deemed detrimental to their female counterparts' performance in such settings (Lara et al., 2023); thus, female leadership in STEM is found to ensure solid teams. Certain educational settings, such as the blended learning approach, are found to increase motivation to learn among women

who are physics students (Radulović et al., 2023). Moreover, hands-on learning of STEM subjects promotes the inclusion of female students and can reduce the gender gap, and it is important that this approach can foster motivation and vocation among its beneficiaries, training female teachers to incorporate these activities into their classroom experiences (Romero-Rodríguez et al., 2023). For inclusive STEM educational settings, studies recommend customised strategies for students, teacher training programmes on inclusivity, actions to eliminate gender-driven barriers, and involving parents and communities (Milanovic et al., 2023). Finally, to reduce the gender gap in STEM, projects and interventions need to be designed that encourage girls and young women to learn about women who have paved the way for other women in STEM, through their scientific outputs (Villa et al., 2023).

STEM professionals: Women in STEM continue to struggle with reality in their professional lives, where they have to navigate sexism, which generates a sense of resistance and frustration (Hernández Herrera & Hernández Herrera, 2023). Female employees seem to be more dissatisfied with their jobs (Dašić et al., 2023), and in designing interventions or policies aimed at tackling this issue, aspects such as organisational culture or work-life balance need to be considered. The case of female leaders in STEM shows one such solution, that of co-responsibility at home and clear boundaries between their work and their personal lives, which enables them to pursue their goals without having to compromise their motherhood (Buelvas-Bardiris et al., 2023). Women from Generation Z were also studied in research consulted for this section: among Gen Z professionals in STEM, women foster more environmental awareness than their male counterparts, have more knowledge on the topic, a greater sense of influence on fighting the ecological crisis, more trust in the effectiveness of institutional activities on the topic, and manifest greener behaviour in their private lives (Chmura-Rutkowska & Kozłowska, 2023).

About the gender gap among STEM researchers and academics, findings inform gender disparities in research proposal submissions and approvals, the effectiveness of women-centric schemes, and solutions for encouraging women researchers' participation in the field (Agarwal et al., 2023). In the specific STEM fields, there is a noticeable decline in female students' participation, and academic jobs display a large gender gap in terms of professorship, the situation asking for more gender-disaggregated data to design evidence-based policies and for more interdisciplinary programmes, to enhance representation (Knapińska, 2023). Female researchers face various dimensions of uncertainty or precariousness when it comes to their career trajectories, which are the types of employment contracts (short-term and non-tenure-track are more recurrent among female researchers), low incomes generating financial insecurities, and the

contract conditions and career development specific to STEM careers, shown to be linked to gender discriminatory practices (Paksi & Tardos, 2023).

In terms of female leaders in STEAM, their career paths involve access to quality tertiary education, personal motivations, family influence, and cultural factors; the common path informing their decision to embark on such a career trajectory would include a close role model and early validation of attitudes and performance, and a drive to challenge stereotypes, achieve high standards, and make a positive impact (Buelvas-Bardiris et al., 2023). About STEM entrepreneurship, there is interest from women to be self-employed, yet there is a substantial gender difference in this activity (Ognjenović, 2023). But to create an ecosystem that fosters women's development in this area, sustained effort is needed to provide institutional and social support, continuous evaluation and monitoring, data literacy education and training opportunities, and networking and communication activities (Zlatkovski et al., 2023).

Conclusions

The previous sections of the current report illustrate research approaches and findings from a corpus of nearly 350 publications of various types, from various databases, using multiple approaches, populations, and data, to inform the scientific knowledge on girls and/or women in STEM education and professions. Based on the content provided and thoroughly discussed so far, we can address the research questions posited at the beginning of the systematic literature review. In what follows, we will address RQ2, RQ3, and RQ1, and the amplest question undergirding this endeavour, RQ1, will be tackled afterwards, synthesising what we know of the barriers and opportunities facing girls and/or women in STEM education and professions.

RQ2: Which methodological approaches are employed in studying girls and women in STEM? Organising the approaches employed in the publications identified and selected for the analysis allowed us to map the trends in terms of methodological preferences. Although over time quantitative approaches have been most influential in studying this topic, the census of publications carried out for 2023 substantiates a diversification of methods and techniques, illustrating a variety of quantitative, qualitative, and mixed-methods empirical outputs that inform our knowledge of the topic. Additionally, most methodologies rely on primary data, but secondary data are not neglected but capitalised on for further analyses to shed light on the underrepresentation of girls and women in STEM. Different research goals call for various methodologies, techniques, and datasets, to create an elaborate perspective on this phenomenon.

RQ3: Who are the main target populations of research on girls and women in STEM? Most research focuses on the experiences and situations of students enrolled in school, primarily in undergraduate studies, followed by high school, and then all the other education levels, which tells us that scholars are trying to figure out what drove female students towards STEM fields or what is keeping female students away from STEM fields, and focus less on early education and conditions that create the ulterior gaps in student populations. Moreover, it is important that research also focuses on teachers, faculty, and professionals in STEM, to create a more comprehensive picture of the field.

RQ4: How do diversity and inclusion emerge in studies on girls and women in STEM? Importantly, intersectionality is a recurring lens across publications, through which scholars are trying to disentangle layers of vulnerability influencing individuals' educational and professional experiences in STEM; in terms of gender, very few publications account for a more inclusive perspective than the binary, female and male experience, but many studies acknowledge this as a limitation and argue solidly for more inclusive scholarship. From a geographical standpoint, however, most scholarship published focuses overwhelmingly on Western knowledge (*see Table 16*), as populations included in the research are mostly from the Americas and Europe. Studies covering any kind of minorities among these are not to be neglected. There are also several studies reflecting the experiences of other, marginalised populations.

RQ1: What is the current knowledge about girls and women in STEM education and professions? Based on the findings thoroughly discussed in the previous sections, we conclude by listing a series of barriers and opportunities for girls and/or women in STEM education and professions, discovered in the literature consulted as individual-, institutional-, and culture-level factors that need to be addressed. Both in the case of students, as well as teachers and professionals in the fields of STEM, *Table 15* highlights the interplay between individual, institutional, and cultural factors that shape the barriers and opportunities they face, across roles and stages in their education and careers. The list of factors identified is not exhaustive, but rather an overview of the most prevalent aspects revealed in the literature.

Table 18. Summary of benefits and opportunities for girls and/or women in STEM education and professions, informed by literature featured in Web of Science, SCOPUS, and Google Scholar

Levels and experiences	*Barriers*	*Opportunities*
Individual	**Self-perception and confidence:** As girls grow older, their awareness of gender stereotypes	**Exposure to role models:** Role models, particularly female and

	increases, often leading to a decline in self-belief regarding their STEM capabilities. This self-doubt can deter them from pursuing STEM careers. For example, in middle and high school, girls tend to have lower self-belief in their abilities in maths and science compared to boys, which influences their career aspirations. Furthermore, female students in undergraduate programs often struggle with low confidence in their STEM abilities, even when they perform well academically, which may lead to anxiety and underperformance in certain subjects. **Stereotype endorsement:** The internalisation of gender stereotypes, such as the belief that men are better at technology and women excel in caregiving, can negatively impact girls' interest in STEM. These stereotypes can also lead to girls perceiving STEM as incompatible with their identities, particularly as they progress through their education. **Performance anxiety:** Test anxiety and stereotype threat are significant barriers for girls in STEM. For instance, mindfulness meditation has been found to help reduce test anxiety among girls, thereby increasing their self-esteem and potentially improving their STEM performance. **Work-family conflict and burnout:** Women in STEM often prioritise family and community activities more than men, which can lead to increased work-family conflict and burnout, particularly exacerbated by the pandemic. Burnout and the lack of alternative career paths can push women to leave STEM or develop resentment toward their career choices.	minority women in STEM, play a crucial role in maintaining girls' interest in STEM fields. For example, exposure to women role models who communicate a growth mindset about their abilities in science has a motivational effect on girls, particularly girls of colour. **Self-regulation and social behaviours:** Early exposure to STEM education, particularly through computer science and extracurricular activities, can foster self-regulation, social behaviour, and a positive self-concept about science among girls, setting a foundation for continued interest in STEM. **Motivations and role models:** Women are more influenced by external motivations, such as status and prestige, when pursuing STEM careers, possibly reflecting previous experiences of stigmatisation. For Gen Z women, exposure to role models and stereotype-free environments significantly impact their career decisions.
Institutional	**Gender bias and stereotypes in educational settings:** Teachers and faculty members may unconsciously devalue girls' performance in STEM subjects, offering them less feedback and support compared to boys. This bias can discourage girls from pursuing STEM careers and contribute to lower self-efficacy. **Lack of female faculty and mentorship:** The scarcity of female professors and mentors in STEM fields can negatively affect female students' engagement and sense of belonging in these areas. Female students often find themselves in environments where their capabilities are questioned, leading to an investment gap from faculty members that hinders their academic and career progress. **STEM curriculum design:** Traditional STEM curricula often do not appeal to girls as much as boys. For example, girls may be less engaged in formal STEM classes but show greater interest in interdisciplinary approaches or real-world applications of STEM knowledge.	**Single-gender learning environments:** Programs and learning environments focused specifically on girls, particularly those led by women of colour, can enhance STEM engagement by fostering a sense of belonging and confidence. These settings provide the social bonds and identity affirmation necessary for girls, especially those from minoritized backgrounds, to thrive in STEM. **Mentorship and networking:** Participation in mentoring programs and diverse mentor networks significantly enhances girls' and women's sense of belonging and self-efficacy in STEM. These networks provide the social capital and support needed to

	Work environment and organisational policies: Women in STEM jobs face obstacles such as traditional cultural models, inflexible work arrangements, and a lack of gender-sensitive organisational policies. These factors contribute to a less supportive work environment and hinder career progression. Discrimination related to family attributes, such as marriage and parenthood, accumulates over time, further disadvantageing women in their careers.	foster long-term engagement and success in scientific careers. **Diversity and inclusion initiatives:** Integrating diversity, equity, and inclusion features into STEM courses and providing counter-stereotypical role models can help reduce stereotypes and increase self-identification with STEM careers among girls and women.
Cultural	**Stereotypes and gender norms:** Cultural stereotypes that associate STEM fields with masculinity and caregiving with femininity can discourage girls from pursuing STEM careers. These stereotypes are often reinforced by family expectations and societal norms, which can lead girls to undervalue their STEM abilities and steer them towards more traditionally feminine careers. **Intersectional challenges:** Women from minority ethnic backgrounds or with queer identities face additional barriers in STEM due to compounded discrimination and social identity threats. These challenges can create precarious educational and career pathways for underrepresented women in STEM fields. **Representation and stereotypes in the media:** Female scientists are underrepresented in news media and are often portrayed with increased stereotypes, particularly in hard sciences. However, social media platforms like TikTok offer a space for female scholars to present themselves and share their experiences authentically. **Perceptions of gender roles and equality:** Many teachers acknowledge the insufficient number of women in STEM and advocate for promoting female role models and addressing traditional gender roles through campaigns aimed at changing mindsets. Also, gender bias among pre-university teachers is often rooted in societal norms, leading to the underestimation of female students' abilities and lower expectations for their success in STEM.	**Cultural counterspaces:** Creating educational and professional spaces that affirm the identities of minoritized girls and women is essential for fostering STEM engagement. These counterspaces allow women to leverage their unique perspectives and experiences, thereby enhancing their sense of belonging and competence in STEM. **Sociopolitical agency in education:** Programs that integrate learning opportunities to foster sociopolitical agency can empower minoritized girls and women in STEM. By developing their perceived ability to influence their educational and career conditions, these programs can promote sustained engagement and success in STEM fields.

To conclude, addressing these barriers and leveraging these opportunities is crucial for consolidating the STEM pipeline for women by increasing their participation and success. To achieve this, there is no one-size-fits-all approach, but rather a sustained effort to identify and alleviate those individual, institutional, and cultural aspects that hold girls and women back from attaining their STEM potential.

Table 19. Distribution of research included in the systematic literature review, based on geographical coverage of populations studied

Geographical coverage of research[11]				
The Americas	*Europe*	*Asia*	*Africa*	*Oceania*
North America Andrews et al., 2021; Arada et al., 2023; August et al., 2016; Bailey et al., 2020; Bailey et al., 2023; Balasubramanian et al., 2023; Ballen et al., 2023; Barthelemy et al., 2015; Benavides et al., 2023; Birney & McNamara, 2023; Bliss et al., 2023; Bloodhart et al., 2020; Broder et al., 2023; Buenestado-Fernández et al., 2023; Burt et al., 2023; Callejas et al., 2023; Casey et al., 2023; Charlesworth & Banaji, 2019; Chen et al., 2023; Cisneros et al., 2023; Compeau, 2023; Copur-Gencturk et al., 2023; Corrigan et al., 2023; Costello et al., 2023; Cyr et al., 2023; Dabney & Tai, 2014; Davis & Wilson-Kennedy, 2023; Dasgupta et al., 2015; Dennehy & Dasgupta, 2017; Dou & Cian, 2021; Drew & Wilson-Kennedy, 2023; Du et al., 2023; Durán & Bustamante,	Achtzehn et al., 2023; Adžić et al., 2023; Aleksić & Dionysios, 2023; Andersen, 2023; Anghelache & Boștenaru-Dan, 2023; Archer et al., 2017; Ayuso et al., 2021; Bachmann & Hertweck, 2023; Bahr & Zinn, 2023; Botella et al., 2019; Bourabain & Verhaeghe, 2023; Boyle et al., 2023; Breda et al., 2023; Buelvas-Baldiris et al., 2023; Cekić-Jovanović & Gajić, 2023; Ćeriman et al., 2023; Chmura-Rutkowska & Kozłowska, 2023; Contini et al., 2017; Cotner et al., 2020; Cukrowska-Torze	Agarwal et al., 2023; Almukhambetova et al., 2023; Amirtham & Kumar, 2023; Arpaci et al., 2023; Balta et al., 2023; Bharadwaj et al., 2023; Bhore & Tapas, 2023; Budgea et al., 2023; Caspi et al., 2023; Chan, 2022; Hu & Stahl, 2023; Kijima et al., 2021; Lee, 2023; Mujtaba et al., 2023; Qadhi et al., 2023; Sellami et al., 2023; Sung et al., 2023; Wang et al., 2023; Wang, 2023; Wen et al., 2023; Wu &	Babalola et al., 2023; Beaudry et al., 2023; Clifford & Zaman, 2016; Dökme et al., 2022; Hailu et al., 2023; Mkhize, 2023; Park & Lee, 2014; Pilotti, 2021; Quarshie et al., 2023; Sikhosana et al., 2023.	Ananthram et al., 2023; Edwards et al., 2023; Fox-Turnbull et al., 2023; Hardtke et al., 2023; Kirk et al., 2023; McMaster et al., 2023; Ross et al., 2023; Shahin et al., 2021.

[11] Cross-country comparisons *across* continents (Chiang et al., 2023; Chinunga et al., 2023; Kaplan-Sayı et al., 2023; Lee & Riach, 2023; Midgley et al., 2023; Rodríguez-Abitia et al., 2023; Zhao et al., 2023) or cross-national studies with multiple countries that are not listed in the articles (Borgonovi et al., 2023; Dilli & Westerhuis, 2018; García-Holgado et al., 2019; Goldman & Penner, 2016; Hinsley et al., 2017; Mann & DiPrete, 2016; Mann et al., 2015; Stella, 2020; Stoet & Geary, 2018; Tselegkaridis & Sapounidis, 2022; Uunk, 2023; Vázquez-Alonso & Manassero-Mas, 2015; Verdugo-Castro et al., 2022; Wan et al., 2023) are not included in the table.

2023; Edwards & King, 2023; Ellis et al., 2016; Fisher et al., 2019; Folberg et al., 2023; Freedman et al., 2023; Garcia et al., 2023; Gazley et al., 2014; Gladstone et al., 2023; Glass et al., 2023; Gottfried et al., 2023; Grunwald & Daroub, 2023; Hernandez et al., 2023; Hernández Herrera & Hernández Herrera, 2023; Handley et al., 2015; Hewes et al., 2023; Hill et al., 2014; Hughes, 2018; Jantz et al., 2023; Jaumot-Pascual et al., 2023; King et al., 2023; Kugler et al., 2021; Kumar et al., 2023; Lara et al., 2023; Lawson et al., 2023; Legewie & DiPrete, 2014a, 2014b; Lemieux, 2023; Lewis et al., 2017; Lubinski et al., 2023; Luthi & Kosloski, 2023; Malespina & Singh, 2023; Madkins & Morton, 2021; Main et al., 2020; Maloy et al., 2022; Mansfield et al., 2014; Marshman et al., 2018; Master et al., 2017; McGee et al., 2023; McLean et al., 2023; Miller & Wai, 2015; Miller et al., 2023; Milton et al., 2023; Morton, 2021; Moss-Racusin et al., 2016; Mulvey et al., 2022; Mulvey et al., 2023; Myint & Robnett, 2023; Narh & Buzzelli, 2023; Nichols et al., 2022; Nissen & Shemwell, 2016; Nissen et al., 2021; Nix et al., 2015; Ong et al., 2018;	wska, 2023; Cutrupi et al., 2023; Dašić et al., 2023; De las Cuevas et al., 2022; De Wit et al., 2023; Delaney & Devereux, 2019; Devedzic et al., 2023; Duraku et al., 2023; Dutz et al., 2023; Eizmendi-Iraola & Peña-Fernández, 2023; Endendijk, 2023; Ertl et al., 2017; Fernandez et al., 2023; Gašić et al., 2023; Galano et al., 2023; Granato, 2023; Gkiolnta et al., 2023; Guichot-Reina & De la Torre-Sierra, 2023; Gulczyński, 2023; Henry et al., 2023; Horvat et al., 2023; Idrizi et al., 2023; Ilić & Novaković, 2023; Ivković Hodžić et al., 2023; Johnson et al., 2023; Kang, 2023; Knapińska, 2023; Kramarenko, 2023; Kryvonos, 2023; Kwiek & Roszka, 2022; Lalić-Vučetić & Mirkov, 2023;	Cai, 2023; Yoel & Dori, 2023; Zhan et al., 2023.		

Ortiz-Martínez et al., 2023; Osuna & Ruiz, 2023; Palid et al., 2023; Perez-Felkner et al., 2014; Pierre & Coleman-King, 2023; Potvin et al., 2023; Puccia et al., 2021; Riegle-Crumb & Moore, 2014; Samaniego et al., 2023; Sassler & Meyerhofer, 2023; Sax et al., 2016; Sengupta-Irving & Vossoughi, 2019; Seron et al., 2018; Seyranian et al., 2018; Sharma, 2023; Smith et al., 2015; Speer, 2023; Starr et al., 2023; Steele & Challis, 2023; Stevens et al., 2023; Stoop et al., 2023; Su & Rounds, 2015; Sunasee, 2023; Thippana et al., 2020; Tofel-Grehl, 2023; Toven-Lindsey et al., 2015; Trott & Weinberg, 2020; Wao et al., 2023; Wieselmann et al., 2020; Wu et al., 2023; Zheng & Weeden, 2023. **Central America** Breen et al., 2023; Mejía et al., 2023. **South America** Gallego & Casadiego, 2023; Kemechian et al., 2023; Kowalski et al., 2023; Medeiros et al., 2023; Radovic et al., 2023; Reznik et al., 2023; Sevilla et al., 2023; Vergara, 2023; Villa et al., 2023; Yepes Zuluaga & Granada, 2023.	Lazarević-Moravčević et al., 2023; Lazić et al., 2023; Leavy eet al., 2023; Lendák-Kabók, 2023; López-Iñesta et al., 2020; Makarova et al., 2016, 2019; Martínez et al., 2023; Martínez-Cantos, 2023; Martyniuk et al., 2023; Merayo & Ayuso, 2023; Milanovic et al., 2023; Mouton et al., 2023; Nagy et al., 2023; Ognjenović, 2023; Paksi & Tardos, 2023; Pata et al., 2023; Perišić & Miljković, 2023; Piekarski, 2023; Reggiani et al., 2023; Reisel & Seehus, 2023; Rodríguez-Baiget et al., 2023; Rogoza, 2023; Romero-Rodríguez et al., 2023; Ruiz-Bartolomé & Greca, 2023; Salehjee & Watts, 2023; Salnyk et al., 2023; Sánchez-Jiménez et al., 2023; Sarabi & Smith, 2023;			

	Schwinghammer et al., 2023; Dolores Serrano et al., 2023; María-Antonia Serrano et al., 2023; Siani & Harris, 2023; Sharlamamov et al., 2023; Sharova et al., 2023; Sheppard et al., 2023; Soto-Solier et al., 2023; Stanek & Palankiewicz-Mitrut, 2023; Stoeger et al., 2023; Stošić & Marinković, 2023; Sultan et al., 2023; Šuvaković et al., 2023; Tandzegolskienė-Bielaglovė et al., 2023; Tarrés-Puertas et al., 2023; Tellhed et al., 2017; Tellhed et al., 2023; Todorović et al., 2023; Tomás et al., 2023; Tran et al., 2014; Travers et al., 2023; Tretiak, 2023; Uebler et al., 2023; Van Wassenaer et al., 2023; Velasquez et al., 2023; Verdugo-Castro et al., 2023; Vooren et al., 2022; Vossen et			

	al., 2023; Vulović et al., 2023; Wong & Copsey-Blake, 2023; Zlatkovski et al., 2023.			

V. Research result on the obstacles girls and young women experience in STEM tertiary education

This chapter presents the most important results of our qualitative inquiry which targeted young female students who at the time of the data collection were pursuing their studies at one of the STEAM fields or have recently opted out from one of these. In total our partnership conducted 97 semi-structured interviews with women across Europe. Although the interviews which lasted on average 45-90 minutes covered a very wide range of issues, in the following we focus on the central topics of our project as a whole, aiming to uncover and understand those aspects of women's experience that on the one hand might be relevant in determining their (lack of) likelihood to pursue or continue STEAM studies and on the other which might serve as points of intervention for our or upcoming projects. This is why as the title of this Research Report suggests, we will first concentrate on exploring students' motivations to choose a more or less "male-dominated" field of study, searching to understand not only the decision making process, but the role of certain key actors in girls' study options. This will be followed by the description and analysis of the difficulties and opportunities identified by these young women.

1. Female students' motivations

It often happens, especially with members of a minority social group or with people who challenge certain age-old social norms and practices who thus, is often is compelled to reflect on their own decisions and (marginal or non-normative status within the larger community) that the motives which they claim and are aware of as determining them to make a choice does not necessarily correspond with how what really motivated them. By this we don't suggest anybody would be lying. On the contrary, when they are being asked about "the reason" or "the motivation" people tend to comply with social expectations which they perceive as relevant for their case and to answer with pre-constructed panels which they are convinced matches with their situation. However, individual trajectories might not be easily grasped with one or two schematic words, and in order to uncover the mix of factors and motivations, instead of asking young women why they chose a certain speciality at the university (which very probably they have already been asked several times) and thus, also very possibly they have an answer prepared for, we started all interviews with the same opening question: *"Please tell me the story of your journey/trajectory to this field of study"*. This type of question which involves no influence

on the researcher's part invites the interviewee to construct their own narrative including all those relevant topics and approaches that indeed shaped their decisions.
In the following we will describe all those typical and recurring themes and motives that emerged from these "opening narratives", as well as those that were given as answers for more straightforward questions regarding motivations (these were often formulated as clarifying or complementary questions in case when the interviewee failed to touch upon it by herself).

According to the empirical material which we collected, motivations that have come up either directly or indirectly may be grouped into 5 categories. Women were driven by (1) their skills and preferences, (2) by the social reputation of the field and its promising career options, (3) by their internal wish to feel useful for society, (4) by external factors or necessity and lastly, (5) by the encouragement of certain key actors of their lives, typically teachers and parents. Methodologically, it is important to note that this typology does not group interviewees, but motives, and that these motives are ideal types in the Weberian sense of the term which in real life open come up in mixed forms, that is, one person displays a blend of motivations, each playing a different role. We shall have a closer look at each of them in the following pages.

Preferences, skills

Although of course our quantitative data do not allow us to statistically generalise the occurrence of certain characteristics, we can safely assume that personal preference and the ease with which one can acquire a certain science has been decisive for the decision to pursue it on a higher level.

> "In fact, I became interested in physics in elementary school, even before it was introduced in the curriculum. I was really excited because I've been more of a science & tech girl since I was a kid. So, maths, which I loved in elementary school." (SI6)

Many times this more or less early discovery of the affinity or enjoyment of a subject in childhood was followed by the decision to join the group which prepares for and attends student competitions. Being considered an outstanding student and being part of the school's "elite" team could both lead to the strengthening of young girls' self-appreciation and their desire to aim for excellence and on the other hand to feel as too much of a pressure to prioritise one subject over all the others. However, in the cases that we encountered this experience did not discourage these girls from pursuing STEAM-studies

altogether, but it made for example one of them turn to a more “lighter version” of the STEAM-careers, teaching mathematics in schools.

The most common words and phrases used to describe their preference were: interest, passion, attraction to technical activities, “sheer love” for these subjects, and the characteristics they associated with the science they chose and the reason for which they felt they liked it were creativity, problem solving, and its compatibility with their personality. One of our interviewees recalled her “stubbornness” which was necessary for her not to give up on her dream to study physics: although physics training wasn’t particularly good in her school, she was very motivated, participated in competitions where she was in fact very successful, winning several prizes. Later, after finishing high school she was admitted to a physics BA program to the UK which unfortunately she couldn’t afford, that’s why she pursued her studies in Bulgaria. Nevertheless, after graduating she still managed to pursue her PhD studies in England which she found extremely useful. We may say it was rather rare for interviewees to bring the male-dominated nature of STEAM-fields into discussion, without any prompting, this is why we may underline the one single exception when a woman mentioned not giving any thought to the fact that she would have been the only girl in her class.

Within this set of preference-related motivations we may find those cases when our interviewees tried to find a compromise between their attraction to a “male” field, but not being compelled to face the burden of working in a male dominated profession: as an attempt to balance these two objectives, they sought a less male dominated subfield, such as teaching (e.g. mathematics or physics) or management within the larger fields of engineering, information technology or architecture.

The social reputation and promising career possibilities associated with STEAM fields

Gender based occupational segregation in the labour market means that women and men tend to specialise in different fields, however in most cases the relation between them is not horizontal, but rather vertical or hierarchical. This means that on the structural or aggregate level we find more or less significant differences between the social recognition or prestige of the occupations and fields of activity considered “feminine” or “masculine”, and as a rule, those regarded as more compatible with men’s character are more higher ranked. The hierarchy of prestige is reflected by the wage differentials between these gendered occupations or sectors. Not unexpectedly, our interviewees recalled being familiar with the social meanings and reputation of the STEAM fields and also having been

informed when making study decisions. Many of them underlined the importance of the promising career perspective, the wide variety of employment, the high salaries or the more secure forms of employment that these sectors have to offer. For instance, one of the women we talked to described with details how she simultaneously enjoyed social sciences and computer science, but eventually chose the latter as it offered long term and well paid employment and the much wished for predictability of the future. As she puts it, she has been having an ambivalent relationship with mathematics starting with high school. Although she was performing well in this subject, she recalls "falling in love" with social sciences during high school years when she says she encountered the type of explanations sociology can provide for facts and phenomena that preoccupy us in our daily lives. This is why she enrols in both sociology and mathematics and computer science, but decides to only pursue the first. Nevertheless, during her BA studies in sociology she does not entirely give up on mathematics, carries with her a mathematics book at all times and when she fails to enrol again to mathematics, decides to burn all her books and notebooks related to mathematics. After graduation she makes several attempts to find employment that would be connected to sociology, but after repeated failures, considers that she should be more pragmatic and choose a discipline that would grant her a more secure livelihood instead of holding onto social science which in spite of the enthusiasm failed her several times to make labour market integration possible for her. The following quotations describe her enduring dilemma and oscillation between what she felt her "real calling" and the profession that would provide her with a predictable future:

> "*What was your experience in the sociological BA and MA programs?*
>
> I enjoyed it, I really loved it. But in the meantime I kept crying and I was also mourning maths and computer science.
>
> *Was there a point when you made up your mind definitively?*
>
> Yes, when I was offered a possibility to pursue doctoral studies in Amsterdam. By that time, I had started my Computer science studies, I was in the second year. That was the moment when I really sat down to make up my mind. I still couldn't say I was especially into computer science and that I would have been able to work as a coder, that's why I tried to come up with something that would have allowed me to combine sociology with mathematics. Nevertheless, in the end I didn't go to Amsterdam, but decided to focus on Computer science. (...) At this department students are presented with various internship and employment possibilities from the onset, that is certainly a major difference between social science and mathematics or computer science. I must say I was very disappointed that as much as I loved it, sociology wasn't something you make a living from. This is why when I finally decided to enrol for my second BA, I was determined to make a more pragmatic choice and instead of studying something out of love, I opted for computer science besides mathematics." (RO10)

Usefulness, social worth

The third type of motivation is a much more altruistic one which puts a higher price on how through certain occupations and fields of activity one can have a positive impact on society. Very often in the social discourse technology is seen as the main driver of improvement in society, although many also warn about the possible threats that an uncontrolled technology may pose.

> "Well, I wanted to study something where I felt I could be useful, and I thought that if I could be useful in the future, it would be a good choice." (HU2)

External factors, necessity

In addition to the factors enumerated above we identified a cluster of very different motivations which have mainly one characteristic in common, that they all have shaped girls' decision from "the outside". Recent events either at the societal or on the individual level may stir up people's interest towards technology or natural sciences. For one interviewee the choice for a STEAM field was just the second best option, as studying at the Faculty of Letters, her first preference, would have been much expensive. Another interviewee decided to take a gap year after finishing high school in which year she got involved in her parents' agricultural business which eventually led her to enrol to the agricultural engineering specialty at the university.

Support and encouragement from "significant others"

Besides personal interest and preferences the role of family members and that of teachers has been very often underlined. Their impact was manifold. Parents, both mothers and fathers were remembered as the ones who recommended their children to join an after class course organised in school that offers extra mathematical training. Beyond that, parents' role in supporting and encouraging their daughters is very diverse: emotional support and their reassurance that they believed and trusted their children's talent and capacity for hard work, these were all remembered, appreciated and ultimately considered crucial for strengthening their determination.

> "Another influence was probably the one that came from my father, who guided me in this direction. He didn't push me to study this field, and it wasn't explicitly stated that I should pursue it, but he was always a great help during my university years. Even though he didn't study this subject at a university level, the knowledge and

> practical experience he gained in vocational school were very helpful to me, especially at the beginning of my university studies." (HU2)
>
> "I believe they were proud and happy about my choice. My father, in particular, seemed proud and supportive. I always felt supported by my parents, which was very reassuring for me. I never had any problems with getting their support and help in pursuing this career path." (HU2)

Parents' feeling of pride was especially motivating for girls who were just about to step into a world which is not equally open for women as it is for men. The importance of finding support in the immediate environment is best exemplified by the second quote below which belongs to a young woman who has fought with the more or less welcoming attitudes of her colleagues, and from which she felt somehow protected by the supportive attitude of her mother:

> "I consulted primarily with my mother when deciding which university to apply to. She has always been my biggest supporter and encouraged me to pursue my passions. Without her guidance, I might not have achieved as much academically. My decision to study at Reykjavík University was influenced by my interest in management engineering and the quality of the program offered there. My mother's profession as a teacher and beautician is not directly related to STEM, but her emphasis on the importance of education played a crucial role in my decision." (IS1)
>
> "Despite the fact that somewhere in the professional environment I may not be perceived in a positive way, my mother will always confirm that, Nastya, you earned it all yourself, you were able to do it all yourself, I see how you do all this." (UA3)

Teachers' roles cannot be overstated in directing talented children's attention towards science and eventually turning them into accessible and favourite disciplines.

> "I can give many more examples here. I would divide them into several categories - there are people who gave me a good example to follow. There were people who gave me the knowledge they had to develop my potential and meeting people who gave me a chance to develop my idea." (BG1)
>
> "Our class teacher was also our maths teacher, and I really respected and liked him a lot. So, when it came time to choose an elective, I chose maths, even though I didn't initially believe I would take the advanced maths exam." (HU2)
>
> "And back then, we put a lot of emphasis on English, but despite that, I was also drawn to chemistry. It was a very good subject for me and I was also very impressed by the teacher. She always taught the lesson with a smile and with a lot of enthusiasm and she always helped people and even if someone was not interested in that subject, she always considered her classmates and that's a very good impression she made on me and I always felt like her smiling, and I liked chemistry since then, and I decided to go down that path , and I found already after the

> matriculation exams, I found the university - Chemical Technological University in Sofia, and there was such a specialty chemical engineering, with French, some of the subjects were in French, the others in Bulgarian." (BG2)

> "Yes, my physics and chemistry teacher, who taught both subjects, gave me a lot of encouragement. He often told me that I had the potential to achieve great things in my studies, regardless of the path I chose. I think this gave me confidence and motivated me to aim high academically." (IS1)

Teachers not only make it attractive or boost children's interest towards studying STEAM subjects, but also give them hope, feed-back, attention and encourage them to aspire for more. This kind of impact may be reached in several ways: through involving them into the team which prepares for and participates at student competitions, through guiding them in their choice for university or specialisations, or through attention, advice and moral support. Many of our interviewees were especially thankful for those teachers who had behaved almost like parents, providing comfort, guidance, understanding or who had been feeling responsible for their students. Those teachers who managed to act equally gently and demandingly, who put effort into teaching talented children extra hours and who had believed in their students were especially appreciated. This kind of support and special attention is particularly cherished by those girls who were mainly surrounded by boys in the competition team.

> "In high school, definitely my physics teacher, who really motivated me to do physics and helped me a lot, and again, because I was one of the few girls in that physics club, she was really big on me and my participation." (BG5)

The support received from the family can take different forms, for example older siblings, especially sisters with experience from those programs can make favourable recommendations for that particular specialty. The role of parents, either as professionals of those particular fields, or as people who never succeeded in pursuing tertiary studies, advice that comes from a more experienced grown-up who has gathered sufficient experience with the labour market.

2. Difficulties encountered by female students

Questions regarding difficulties encountered both before and throughout their studies in the STEAM field were formulated directly in the interviews, but this topic was also addressed "unprompted" by interviewees while talking about different aspects of their lives and studies. In this subchapter we have worked with both types of qualitative data and grouped the difficulties that were described into six groups.

The “culture” and the burden of being the Other

Just as generally in social discourses the main roots of women’s underrepresentation in STEAM domains, such as that of all of their difficulties lie in our shared “culture” which is often regarded - at least from the perspective of gender roles - as conservative and traditionalist. Culture is the set of norms, values and expectations that each individual is expected to internalise in order to be able to live and get by in a society, or else, they risk facing sanctions of varying severity. In the perception of society in general and our interviewees’, too, people’s ideas about what constitutes a “feminine” or “masculine” profession and how women (don’t) fit into the expected (ideal) characteristics of scientists are the main obstacles that prevent women to enrolling in higher numbers to such university programs.

> “There is still this conception that coding and working in computer science is a very male thing. I think if you google “coder” or “IT-expert” you will most probably get pictures of boys sitting in rather dark rooms with closed blinds, wearing sleazy Star Wars T-shirts and working in front of the computer. I think this must have an impact. (...) If you are raised in such a cultural climate, it will make it more difficult for you to find a job in a very male occupation. This is one reason.” (RO10)

According to this interpretation this is not the result of anyone’s overt discrimination, it’s “the culture” that as a force “draws people back”.

> *“Do you think it would be easier if you were a man?*
> I suppose in many situations it would have been easier for me. I remember this statement from my high school years from a female teacher, "So what if men get in with a lower GPA, they'll be better doctors than you." I feel like their scores may not be as good on paper, but they automatically have more credibility to them and women are seen as people who constantly have to prove themselves. And that's why maybe women ourselves are always in competition, whereas for example with men there's not this feeling that they have to prove themselves to each other and you always know that they're going to have fulfilment and be chosen, whereas a lot of female friendships and including at university are dying because of this competition.” (BG5)

Culture is thought to damage women’s credibility and reliability: society often questions their capabilities, skills and “dexterity”, based on popular stereotypes such as girls’ weaker talent in technical subjects or in mathematics or their lack of confidence, but also informed by seemingly positive stereotypes like the one that recognizes girls’ determination and diligence as a means to compensate for their lack of or lesser “innate” talent. In most interviews young women shared with us the strategies they have adopted to tackle overt

and subtle forms of social pressure or expectation. These are of course rather varied, but probably the two most common strategies are the attempt to dismiss and not taking into consideration such aspects of our culture, whereas the other one focuses on identifying a smaller or larger support group which can protect girls and young women aspiring for a STEAM career from harmful influence. Such support groups may be formed by parents or other members of the family, teachers, classmates or friends studying at different specialities.

However, as members of the same culture, we identified data in the interviews which suggest that young women themselves have subtly internalised several of society's ideas of what it means to be a researcher or a scientist, especially in a STEAM field, what the basic tenets are of this social role. Not only the "social world", but also women aspiring to pursue a career in a STEAM domain have difficulties imagining themselves as a "real STEAM expert or scientist". This is mainly reflected in their very typical attitude to question themselves, to reflect on their "Otherness" in the world of STEAM students. Even without being asked directly, women interviewees seem to have been extremely concerned with their own characteristics, knowledge and skills. They were often wondering about whether they really fit into those particular STEAM programs that they enrolled in. This sense of "(in)adequacy" was a common topic of many of the interviews we conducted. Among the recurring motives we identified: virtues and defects, lack of inadequate background, the fitness of their personality for the STEAM programs. Often this materialised in unsolicited comparisons with "the boys", the "other students, classmates coming from better high schools", "kids with experience in competitions". Even if these comparisons did not result in a poorer evaluation of themselves, the Otherness, the need to constantly scrutinise themselves was rather widespread. Many of the narratives we encountered were built on the underlying assumption that their presence needs constant legitimation and confirmation, even to themselves. This is why many women were ready and determined to improve themselves, to join self-development training, sometimes on the grounds of acts of self-blaming and feeling of guilt. For example, the following interviewee asks herself what kind of traits of character she is missing that would help her find a good supervisor, and she replies by wishing she was more assertive and insolent:

> "Because it has happened to me that I have to behave much more confidently than a woman should behave, much more cruelly, I have to be more aggressive and even in some cases insolent. By no means in the negative sense of the word though, and it has more or less depressed me and made it difficult for me, because I am a girl after all and I carry my feminine nature." (BG3)

Thus, while we might have doubts as to the efficiency of the strategy which would require young women to simply "disregard" culture, not just because the entire process of socialisation is built upon the unquestioned assumption that people would want to obey social and cultural expectations, it seems that almost none of our interviewees feels it unbalanced to fight individually against a social or cultural force. However, this is further aggravated by the fact that women themselves are members of the society, and as such they carry and embody culture which makes it even more difficult for them to distance themselves from its burdensome expectations.

The attitudes of "significant others"

People from the closer or larger environment of young people might have different statuses and may be more or less closely connected to them, but they still have an important influence on how they will regard themselves and what aspirations they will follow. In sociology those actors who play a significant role in people's lives by shaping their wishes and actions, and who contribute to their sense-making practices, are called "significant others". Beyond their emotional role they also transmit cultural values and expectations, and also the meanings of what a "feminine" and "masculine" occupation is, and what is "adequate" or not for a girl to study.

> "I never felt any kind of doubt from my family, however there was this teacher who helped me prepare for university, who had also known my family for a long time, he attended my parents' wedding, saw me grow up and so on, and he said he would have rather expected my brother to build a career in Computer science, and not me, as a girl. Despite the fact that he was there for me and with me all along, he was aware that I was performing well in mathematics. But to actually get a job in Computer science, that was unexpected for him. My former teachers wished I had returned to the school, they invited me several times, but I didn't want to become a teacher. But yes, this was the only time I had experienced an overt discriminatory attitude, when I was let know that Computer science was more adequate for my brother who had never in his life liked Mathematics." (RO10)

> "Oh, I had felt something similar from my cousin, who is also a boy and works in the same field. I would have loved to chat with him about our common profession, what is it like, maybe to share with him my experience, to describe the firm, the tasks I am given. Both as a relative and a colleague, it would be nice to just talk to him, but he doesn't really... Whenever I approach him and try to start a discussion, he wouldn't let me, he tends to downplay my work, he keeps interrupting me and so on. So if I start to think about it, there are such moments when I'm not taken very seriously." (RO10)

Many of our interviewees have seen several of the questions as opportunities to reflect on the challenges encountered in their social relationships. Messages of doubt

or of being questioned have been conveyed by members of the family, friends, teacher or university classmates. All of these may contribute to the gradual isolation of girls in the class, to self-doubt or even drop-out from the university programme. In our empirical data we were especially likely to identify such “unwelcoming” or problematic attitudes from classmates or very often, from university teachers. These types of experience were decisive in girls’ lack of feeling of belonging to their study group or larger domain. One of our interviewees shared with us her negative experience regarding some comments she received from some of her boys classmates after receiving a prize at a contest. These comments suggested that the prize just reflected evaluators’ compliance with the gender quota expectations, that is they only awarded her because there was a need for a woman winner, too.

In another instance another interviewee’s experiences reflect the ways in which colleagues’ stereotypical and exclusionary practices intersect with traditionalist social expectations that inform their views of work-life balance. During a research internship, her colleagues, upon finding out about her engagement, gradually isolated her, questioning the commitment of a soon-to-be-married woman who was expected to prioritise childbirth and family duties over research.

> “Yes, exactly in those 6 months that I was at the BAS, exactly in September 2021, I got engaged, and for me personally, it didn't bother me. It's because the person I'm with has supported me in what I'm doing, but the people around me perceived it in a very different way, and anyway the professors are older and when they found out that I already have a ring and they expected me to go into maternity leave and then expect a baby, they expected me to be out of work and generally a lot of the people there had just written me off anyway.” (BG2)

Discrimination

Although similar studies are usually less likely to find respondents who have experienced discrimination, our qualitative study was able to explore some typical situations when girls as students faced unpleasant differentiation simply based on their gender. Although the term “discrimination” was only rarely - if ever - used in the interviews, we have collected such accounts in which as students or early career researchers women felt they received differential and negative treatment.

> “Yes, it became positive towards the end. The beginning... I'm not saying it was negative, but it was very challenging. There was some discrimination, of course, but people try not to take that personally. You have to find those classes, those subjects

> where you don't feel it, and then I think it's a positive thing. It's tough, but good." (HU2)

> "For example, 2 boys asked over a group if anyone knew how to do the assignment for Database theory. I said yes, what do you need to know? They said oh we will just ask Tumi (a boy). Tumi, my friend, answered them: ask Svana, she taught me how to do it. It's good when your boys back you up." (IS2)

> "Yes, there were cases, not personally for me, but some said that female students received easier questions. Some girls themselves said this, and as a result, they were given harder questions to prove themselves. I don't recall any exceptional treatment or favouritism towards me personally." (HU2)

Typically, these discriminatory attitudes and practices are rooted in gender stereotypes, however they often inherently aim to marginalise women and weaken their opportunities to compete for the scarce resources that are available for students, graduates or researchers, whether that's well-paid jobs or research funding.

> *"What was it like being a female student in mechanical engineering?*
>
> It varied. Some people paid special attention to us, while others didn't like it at all. The best experience was with those who treated us the same as the male students. It's not good when they are too lenient, but it's also not good when they are against you." (HU2)

Isolation in male-dominated groups

One of the most often mentioned difficulties is related to girls' or young women's attempt to integrate into competition teams, university classes or research groups that are dominated by men. One of our interviewees described the very gradual and rather slow process that was necessary for her to go through in order to become accepted by her fellow schoolmates with whom she participated at contests. At the beginning lack of acceptance was expressed through not providing her any kind of support, not really answering her questions, however, after she had demonstrated her abilities, she became the single girl of a team made up of four pupils and was soon fully accepted.

In groups where girls were a small minority they often encountered difficulties of communication with the boys, as the following quote suggests:

> "Like, from the very beginning it was difficult for me, because there were no people with whom I could have communicated, then I was thrown from one to another." (UA3)

However, according to a different interviewee these problems do not really disappear even at a later stage of women's career. The following interviewee has started her BSc studies in

Computer Science as a second degree, but this time she decided to take up part-time work while pursuing her studies. She describes her workplace experience in the following quote:

> "At our regular team meetings I am the only girl.
>
> *And what is it like?*
>
> I've come to get used to it that they don't refer to me as 'she', I'm a 'he' just like the rest of the team.
>
> *Are they joking or making a mistake?*
>
> It must be a mistake, but it's strange that they keep making this mistake over and over. It seems as if I was becoming a boy myself in this Boys' Club." (RO10)

Balancing work and family commitments

The difficulties of balancing paid and unpaid work for women working in STEAM domains is a general concern for most young women whom we have interviewed, whether they have actual experience with it or not. The social representation of "masculine" occupations is based on the expectation of a committed, hardworking employee or entrepreneur who is not being hindered by any personal duties when complying with the neoliberal norm of long hours work culture.

One of the reasons why young women anticipate they would be encountering challenges is the pace with which technology advances or at least it is seen to advance. Women's roles are often being perceived as "incompatible" with the logic of dedicated engineering or that of other STEAM expert whose career is not being "paused" by childbirth or childcare:

> "I consider that for a woman it is somewhat more difficult to get employment in the IT field in the long run, especially if she doesn't choose a teaching career, because technology is changing very rapidly. If the gap in your career lasts for half a year or one year, it's rather difficult to catch up. So we have this aspect that needs to be taken into consideration. But on the other hand there are things that you can learn so that you manage even after a break, so it shouldn't jeopardise your career. However, these concerns might be a reason behind women's drop-out: starting a family may determine a woman to leave this field." (RO10)

The inability to live up to the requirements of a demanding profession creates anxiety even before career really starts, resulting in young women trying to make concessions either in their paid or unpaid work, but inevitably struggling with a sense of inadequacy or guilt.

> “Honestly, I have this concern that I just started this profession, now I’m really in the middle of it. I should be able to develop, we have career management at the firm, I have my goals set and the milestones that I should reach by certain points in time. But I keep thinking how starting a family will interfere with all these objectives. For instance, I wouldn’t even want to take up a very long maternity leave, a half year maximum. Two years is not an option for me, unless something comes up which would make me change my mind. But I’ve studied and worked so hard for this career that I wouldn’t want to waste all this effort: if I fall out, it'll be extremely difficult to come back.” (RO10)

> “But so, summarising, I see myself with this vision for the future: starting to work in an office to gain some professional experience, and then from there, as a developer, working on... well, it's really bad, but many times, the thought crosses my mind that I'll have a husband who'll provide, who'll earn well, and then I don't have to worry about needing to work if I decide to have a child. I'm not saying that's very bad, but these are things I think are strange. It's just bad to think about that. I can't imagine fully focusing on architecture and supporting a family, and it's a bit unimaginable, so I don't see it. But then again, it could just be that I haven't seen enough future perspectives. For example, as I mentioned with the current instructor, Melinda, she managed it here. So, it's a viable path. And I'd be happy if I could really work in my field as an architect, but with a healthy balance. So, I wouldn't want my work to be at the expense of my family or my children in any way. Or I don't like to do irresponsible things like this. But at the same time, I definitely want to start a family or I've always been in my mind, either way, I always want this in my mind that I definitely want to be a mom.” (HU1)

Balancing work and family (or motherhood, more precisely) is not just a matter of improved time management, but many times a motive for discrimination or marginalisation. For this, children do not even have to be born, women’s age or marital status is a sufficient basis for being exposed to the questioning of their motivations or commitment.

> “Yes , exactly in those 6 months that I was at the BAS , exactly in September 2021, I got engaged, and for me personally, it didn't bother me. It's because the person I'm with has supported me in what I'm doing, but the people around me perceived it in a very different way, and anyway the professors are older and when they found out that I already have a ring and they expected me to go into maternity leave and they expect a baby, they expect me to be out of work and generally a lot of the people there had just written me off anyway.” (BG2)

> “The professors are older and when they found out that I already have a ring and they expected me to go into maternity leave and they expect a baby, they expect me to be out of work and generally a lot of the people there had just written me off anyway. (...) By the attitude. In general they started questioning me when they found out that we live together and I already have a ring and they expected me to no longer put my work first and since I often happened to stay after work there and even though I was 4 hours it happened to me very often, I even had to stay for more than 8 hours, and now that you are engaged and being a more serious

person, you cannot afford that.
And yes, from my point of view, what they already imagined, what they expected was that I would just defend my thesis, take my diploma and leave like other people do. And the fact that I was engaged, they already expected me not to be seriously involved in science, but take maternity leave and not to be involved at all." (BG2)

Lack of supportive work relations and lack of proper embeddedness

Throughout the interviews work relations and the importance of a friendly and inclusive workplace climate has been repeatedly emphasised, thus we may consider it one of the most crucial factors that shape women's experience in STEAM studies. Studying, working or being in a welcoming, supportive, not extremely competitive environment with meaningful social relations can result in a powerful feeling of belonging which has been several times called for, either for something that our interviewees missed or a connection which they were grateful for. The feeling of belonging may stem for a variety of social ties in their professional or social lives: a teacher, preferably a woman, just as in the quote below, good and friendly classmates, among whom girls or women are more likely to generate a more inclusive climate. Irrespective of their gender support and non-competitive behaviour is very often underlined as a decisive factor which can contribute to the feeling of belonging.

"But, for example, it was a very unfamiliar feeling, and it was such a new and really good feeling that now, almost until now, there hasn't been a female instructor with whom I could have the same experience... or, well, I love our instructors very much, but now there is a woman. And suddenly I realised that there's a lot of extra in this, not just because I'm not... because I don't really look up to them as much as men, or because they're honest people for me and they're inspiring and they motivate me a lot, and it feels really good, but because it's a bit... there's no thought in me that I could be this. Because, simply, I feel that they are different people, or in a different position, so their existence. And this is really bad, or I don't like this feeling, I don't like the idea that I could be, or that it's the first, or that I don't have this thought in me, that I could be, this and now it was a completely new thing. Really, when I recognized that there was this female instructor and that a very cool woman had achieved a lot of things, and it was a really good feeling that there was an extra in it, that she was also a mother, and that's when this thought came to me, "aha, maybe I could be that too someday," and it was such an important thing. I realised that. (...) And also, as a girl at university and in training, well, obviously there is this negative thing that now at university I am... and I don't feel... I don't feel that I am being distinguished among my fellow students at all. However, it's really bad to think that, well, in the profession, women are terribly underrepresented, and actually, the proportion of female graduates was around 70-80% last year, and yet we hardly see female names in the profession. So I don't really know where women are going or where they are disappearing to, and that's worrying, or I don't really think about it that much. And when I think about the future, well, actually, I don't know what to imagine, because I'm still battling with various sides or I actually don't know what I want, because I also want a family.

> However, this architectural lifestyle isn't always so family-friendly. So this is generally a question mark, and I prefer to let it go and say, "okay, okay, I'm just here now, somehow it will work out." (HU1)

Just as the young woman in the interview highlighted, we often don't know "where women are going, where they are disappearing to". Based on the semi-structured interviews we carried out we identified the most significant factors that prevent girls from embarking on a STEAM career in the first place, but also which hinders their integration and ultimately, may also drive them away from their path. Among these the most relevant are those that are embedded in the traditional cultural norms which associate technical, mathematical and scientific interests and skills only with masculinity, but equally detrimental for women's success in STEAM domains are the lack of a supportive environment and also the incompatibility of women's social and familial roles with the norm of committed STEAM worker.

3. Opportunities identified by female students

Although both the questions included in the interview guide, and the interviewees' own narratives were very much centred around problems and difficulties encountered, young women also made reference to all those aspects which they considered as opportunities or positive aspects of the training programs they attended. We have grouped all these into three categories which will be described below.

Feeling of support and of belonging

As a friendly and inclusive class or environment, capable of accommodating women students and their social roles, but at the same time not guided by stereotypes, is highly valued by female students. Thus, when such relations, smaller study communities or research groups exist, they see them as an important resource which can significantly improve their motivations, attitudes and performance. Although it is not necessarily women whose presence is being appreciated, an all-male group will more probably remain more distant or provide a less welcoming climate.

Nevertheless, the most important source of support is the family, especially in the early years, in highschool or even before that, when the first choice for a STEAM subject needs to be made. For example, we have encountered a case in which the members of the family encouraged the girl to pursue education in mathematics and computer science, however there were voices which expressed surprise or astonishment when learning that eventually

she will be working as a coder: “I would have expected your brother to work as a coder, and not you”, commented a close family friend who had also tutored our interviewee in mathematics, so he must have been aware of her abilities.
In other cases the showing up of a woman teacher after being taught by only male professors creates the feeling of enthusiasm in our interviewee:

> “In the first year, when we had our first design courses, there was one, she was also a woman, but she was younger. She was a supervisor named ..., and she was such a strong personality. I felt like she opened up new perspectives for me, talking about design methodologies that were new to me. I felt like I already had this attitude in me but it wasn't articulated, and it felt good...” (HU1)

> “So, I think this whole thing enters into the conversation, and I think it's also very important, and now I've talked a lot with ..., who is now my instructor, and I really noticed when she entered into my educational life, I noticed how much I missed this feeling, that I could think that I could be this person finally, who I not only look up to, and not just, yes, look up to her, and not just idealise her, but she turns over in my mind, that maybe I could be like her someday. This was a very, very important thing, and it would be so great if somehow I could feel this more often.” (HU1)

Having a woman teacher as a mentor also works as a role model and an assurance that there are effective strategies to tackle the burden of work-life balance.

Young women exposed to less pressure

A rather unexpected source which seems to provide a feeling of less pressure and maybe even more freedom for some of our interviewees is embedded in exactly those gender stereotypes which make it more difficult for women to pursue a career in science.

> *“If you were a boy, by the way, would everything have turned out differently professionally, personally?*

> Of course. Of course, well, first of all, I think, both in a positive and a negative direction. Because in the negative, I think that I would worry more about how to provide for myself financially. That is, even I can see on the example of my brother how much boys try to be financially independent at a younger age. And I think that would add even more stress to me. And I would try more to find some kind of professional income, accordingly, less time for studying.” (UA3)

According to our interviewee the same stereotypes and gendered expectations that limit women’s access to the STEAM fields have a more positive impact, at least in their

interpretation, by relieving women under the stress to subordinate their career choice to the norm of financial sustainability. It is a rather widespread strategy for women who study in a STEAM field to specialise in a less male dominated direction or subfield which on the one hand provides more sense of familiarity, on the other, however, it tends to be less financially rewarding (e.g. teaching STEAM disciplines in schools).

“Time works in our favour”

Lastly, not exactly an opportunity which may improve women’s career options in the present, but still, often mentioned as a general description of the wider context which confers women the sense of belonging or legitimacy: the idea that gradually the world of STEAM is becoming more and more inclusive from a gender perspective.

> “Interestingly, unlike many engineering fields, here we have quite a few girls. But I think the fact that women might not see many female role models in the profession should not deter anyone. I truly believe that this trend will change in the future, and women will come more into the forefront, or at least the underrepresentation will decrease. There are initiatives in this regard, for example, I once participated in something related to this, but that's not answering your question. So, the advice would be... Well, I don't know, never think for a moment that just because you're a girl, you can't take part in technical studies like ours, because I don't think gender has anything to do with it at all. For example, I have many girlfriends at university, and in the first five of our engineering and structural subjects, I think four are girls. So, it's not just that there are more of us girls at university, but we're really smart and great, and I've never faced any of those old ones.” (ES4)

The belief that women’s underrepresentation is gradually improving and that gender equality is a “historical necessity” that will materialise in the near future has multiple impacts on the way they relate to their own minority status. On the one hand, this vision exempts decision makers from actively getting involved into the improvement of women’s access to STEAM. On the other, by encouraging their fellow women classmates to “disregard” social gendered expectations and stereotypes, makes only them responsible for their own (lack of) success, that is they individualise a social problem that is basically social and structural. However, the thought that women’s equal representation should be the norm and will *soon* become the “normal” definitely improves women’s feeling of belonging.

VI. Gendering STEM Education: Institutional awareness on gender-based obstacles and their role in providing support to Women

1. Relevance of Increasing Women's Participation in STEM

Gender imbalances in STEM fields are widely addressed at various levels within the European Union. In recent years, there has been a notable increase in women's representation in STEM, observed in two significant ways: more women are enrolling in STEM university programs, and, although gradually, their proportion is increasing in traditionally male-dominated STEM fields. In our research, we aimed to understand how these changes — which have significant societal and economic implications — are perceived and addressed by representatives from Higher Education Institutions (HEIs) and secondary education. We specifically asked for their perspectives on "the relevance of increasing the number of women in STEM fields at the university level." In simpler terms, we sought to explore their views on the perceived importance of increasing women's participation in STEM education. Exploring their perspectives on these changes in women's representation in STEM is essential for understanding the policies they follow and the strategies or programs they implement at their institutions.

The responses highlight a range of perspectives on the necessity and implications of increasing the number of women in STEM fields, we can however also conclude that there was a strong tendency to recognize the relevance of increasing the number of women in STEM fields mainly with a connection to the importance of gender diversity, which in these causes appears as an explanatory factor to argue for the interest for increasing the number of women in the STEM education. At the same time, it appeared that the responses reflect a variety of perspectives that extend beyond a simple "yes" or "no" to whether it is relevant to increase the number of women in STEM fields. If we were to view their answers on a scale from "very relevant" to "not relevant," most responses would cover various points along this spectrum, rather than offering a clear "yes" or "no."

The following attitudes, perspectives were identified regarding how relevant the interviewees considered the question of whether to increase the number of women in STEM education.

SOCIETAL AND ECONOMIC IMPACT

While most participants acknowledged the relevance of increasing women's representation in STEM, only a minority explicitly emphasised its economic and societal benefits. Some respondents (interestingly, mainly from Bulgaria), highlighted that increasing the number of

STEM students in general is important due to the increasing demands coming from the economy (BG2), "the rapid development of technology (BG4) and innovation (BG8). The need for the diverse perspective in innovation is also highlighted and introduced as a prerequisite to foster innovation.

> "I think that the number of people engaged in STEM and those being educated in STEM profiles and specialties should increase because everything that the economy expects in the future is related to STEM skills and knowledge. For me, it absolutely does not matter whether the student I am working with is a boy or a girl. The only thing I expect is a responsible and professional attitude towards the work. I assume that this is what everyone in companies expects as well." (BG2)

> "Increasing the number of women in STEM is definitely essential for diversity, for innovation in relevant fields, also for our development as a society, for our progress as a nation. Because women have a different perspective, for example, on testing a product or in creating a product, when it is created by women or by men for men, the product has different functionalities. When women are also involved in the creation of a product, it becomes applicable regardless of gender differences. Increasing the number of women in STEM will definitely contribute to creating more innovative societies." (BG 8)

> "Increasing the number of women in STEAM education is highly relevant. Not only promoting gender equality but at the same time bringing diverse perspectives to these fields, which can drive innovation." (MKD 3)

In some cases, the increase of women in STEAM is linked to broader societal development and justice, emphasising the macro-level relevance of gender equality. This perspective underscores that gender equality is not only important for individuals but also essential for advancing society as a whole. For instance:

> "I think it is of great importance. First of all, it is a matter of, to put it simply, social justice, i.e. that these are also professions that are better paid, with better prospects. So I think that here, as much as possible, the increase in the number of women simply has an impact and has a meaning for their professional prospects." (PL 1)

GENDER REPRESENTATION IN NOT AN URGENT NEED

Some respondents explained that in fields where women are already well-represented, such as biology, mathematics (teacher training mainly), and chemistry, there is no need to increase women's participation. See, for instance:

> "Well, yes, it is increasing in some fields, but basically the fields linked to biology, all fields of medicine and so on have more women enrolled than men, that is real, but there are other fields where the numbers are still pitiful, as in the case of computer science, which is the other extreme, where there are practically no women enrolled." (ES 6)

It was not only suggested in the responses that the proportion of women is already high enough in some areas and therefore no further interventions are needed, but also that this

is not a gender issue, even though it is preferable to teach a gender mixed group, as the following quote shows:

> "From the point of view of managing the class, it is easier to manage the class either male or female. It is easier. The problems that a given sex creates do not come up. However, when it comes to relationships, the mixed class is definitely better. This is a more social feature. And when it comes to professional subjects, it doesn't matter to me. It would be more important to prepare the students for a specific profession." PL6

The two quotes above indicate that women university students in STEM fields are not a homogeneous group (as there are fields they are under or over represented). Furthermore, another perspective emerges that suggests that there is no need to focus on increasing the number of women in STEM education to avoid a disproportionately high female representation, indicating that the focus should not be solely on increasing the number of women but rather on achieving gender balance, as the following interviewee expresses:

> "And I think that the measures that have been taken in recent years have had their effect, as well as the changing conditions and the rapid development of technology. I don't think that any special measures are necessary for (Name) University to take in this direction. The plan is clear enough, it is producing results, and I do not think that the very large increase in the percentage of women studying STEM subjects is a positive thing either. There needs to be a balance between the two genders here. I think teams that are mixed, that are male and female, work best, so the creativity is much higher and the results are much better." (BG4)

GENDER EQUALITY AS A MATTER OF INDIVIDUAL CHOICE AND INTEREST

Some respondents (SI1, ES6, ES4, ES3, LT3, IS2, IS3, SRB 1) argued that increasing the number of women in STEM education is a relevant issue, but it should ultimately be a personal choice for women rather than a result of obligatory policies or quotas. Intention of studying in STEM fields should be based on individual will and desire. These respondents typically emphasised the importance of providing equal opportunities for all students while respecting individual career choices. This perspective also includes a rejection of measures like gender quotas, which were seen as potentially a danger of positive discrimination.

> "I think it is more important for everyone to choose what they really like. I think that, thank God, in recent years, the barriers of these studies are for boys, and these studies are for girls, have been breaking down. So, given that I feel that young people are no longer differentiating between them, I feel that they should really opt for the studies they want. " (ES4)

> "So, I think we have to increase the number of women to make these careers a little more plural, but we should not take it as an obligation, they should not be there out of obligation,

they should be there out of devotion, that is, because they want to and because they are capable and they know that they can choose these disciplines perfectly well." (ES3)

"Now young people study whatever they like to study. The distinction between male and female professions is ending." (LT3)

"I think it's very relevant that all education paths are open to everybody. And that you have, I mean the individuals, the girls that started a couple of years ago, they started it because of an interest or something that called them and they were maybe like the one girl with a lot of males because society has generalise the trade or this aspect of it as a male orientated field. " (IS2)

"I don't consider the lack of women as a problem but I would encourage girls to choose any path that will give them a chance to maximise their skills and chances of a well paid job." (IS3)"It is necessary to empower women by organising various educational activities and creating an environment where they can obtain all the information related to STEM and participate in STEM. There are different opinions because some women, due to entrenched stereotypical beliefs, do not want to participate in STEM and find it very difficult to accept the concept of lifelong learning." (SRB 1)

BENEFITS OF DIVERSITY

For many respondents, gender equality itself was not the primary justification for claiming that increasing women's representation in STEM education. They rather argued for the relevance of the increased participation of women in STEM due to the unique perspectives they bring. This viewpoint often emphasised the benefits of diverse teams in solving complex problems, particularly in fields such as engineering and technology. While responses highlighted diversity's positive impact, they often framed gender differences in essentialist terms.

"Not only for reasons of social justice and that we have to be there, but also because all the results, all the evidence shows that when we have greater diversity in any area, be it gender, ethnic or racial, the results in terms of economic benefits and innovation are better." (ES6)

"So I do think it is important that girls are represented in this area because they have a different perspective on things. Because they see things differently..." (ES7)

"It's crucial that diverse actors including women and underrepresented groups take part in ensuring this more inclusive and just transition (green and digital transitions). So there are definitely plenty of opportunities for girls and young women in STEM fields." (SK1)

"Attracting more female talents is of course relevant, as it brings more to the diversity not only within students' body, but moreover for the STEAM profession. As more female students mean at the end more female researchers, teaching staff and more women in the STEM industry." (MKD1)

> “Increasing the number of women in STEAM education is highly relevant as it addresses the significant problem of gender disparity, leading to a lack of diverse perspectives and innovation in these fields. ... Compared to other leading universities worldwide, our institution shares the consensus on the importance of gender diversity, although the extent of initiatives may vary across different institutions.” MKD2

> “I think it is good that there are more women in STEAM fields. I don't think the aim should be to have more women than men, certainly not, it's not like we're trying to take over the world here or anything, far from it. I think women bring a little bit of, I won't say it in a completely grammatically correct way, thinking from a different angle, they have different experiences from their own life as a woman, and that can really be useful in STEAM disciplines. Because as equal as we are, sometimes that thinking is slightly different between men and women.” (LT3)

> “However, we also know that, of course, you all know that diversity in work has a positive impact on team results. Not only, of course, gender diversity, but I think that solving these most complicated social problems must be done with the participation of various groups. And here women cannot be underrepresented, because we also see what it ends up with.” (PL1)

> “Increasing the number of women in STEM is definitely essential for diversity, for innovation in relevant fields, also for our development as a society, for our progress as a nation. Because women have a different perspective, for example, on testing a product or in creating a product, when it is created by women or by men for men, the product has different functionalities.” (BG8)

Arguing in the favour of diversity often appeared in connection of emphasising the differences between women and men. See, for example, the typical example below, an where an interviewee explains why it is beneficial to have equal representation of men and women in a particular STEM field - as an illustration of how referencing diversity reinforces the differences between men and women and the stereotype that men and women are complementary to each other:

> “I sincerely believe that for reasons of equality, of equity, it is necessary to have more or less the same number of women as men in careers, but because it also facilitates a different way of thinking, in other words, the way of processing information, from my perspective, which may be wrong, is different. For example, let's take the case of computer science. A boy usually makes or programmes are usually programmed very quickly, girls take much longer, but usually have fewer errors in that programming, so the combination of both, the speed to give an answer and control, are the two elements necessary to be able to work, I think they are visions that in the end are different, not so much perhaps because there is something genetic, which I have no idea, There is a type of training that, at the end of the day, from a very early age, means that women tend to make fewer mistakes, or tend to review things a lot in order to make fewer mistakes, and take into account more variables, perhaps than those taken into account by a more masculine mind, more accustomed to taking the plunge or being daring without studying the consequences. So, I think that the balance between the two is

> interesting to be able to understand the problems and to be able to find solutions to the problems." (ES6)

Another typical example is that the emphasis on diversity as an argument for increasing the number of women in HE is closely linked to positive sexism. From this perspective, relevance is not recognized in terms of improving women's equal status per se, but rather in terms of the positive impact of women's perceived feminine qualities (from an essentialist viewpoint) on the masculine environment, as this interviewee explains it in a simplified way:

> "It is much better for me to have a 50-50 situation in the classroom than to have only men exclusively. I had one girl in mechatronics, there were 8 boys and 1 girl and she studies mechatronics, robotics. And she has the main say. Yes, they do something blah blah blah this and that, two of them are protesting or something, but she practically has the main say. Coincidentally, she's the most beautiful and I mean she's quite beautiful, she's handsome and then the guys all get in line and it's unbelievable. And they were functioning well. And she wasn't exactly the best in class. No, the boys were much better, but she was absolutely in control of the whole situation and was like, negotiating with me when the exam will be, when this will be, if I can delay practice assignments a little and so on." (CR 2).

WOMEN'S REPRESENTATION IN LEADERSHIP

Some of the respondents reflected on the 'relevance' question by associating women's representation in STEM education with the need for gender diversity in leadership roles:

> "And then, how are we doing? Well, we are in fair shape and we need to continue to make progress because there are areas where we have more women, but we still have a very big problem when it comes to women participating, especially in important decisions, in leadership positions, and this makes it even more complicated for the situation to change. It is not that by putting a woman as director of a company, the whole company changes drastically and has a gender perspective, but it is true that if there are no women, it is very difficult for the situation to change."

> "Empowering women to teach STEM is important, not least because women make up the vast majority of teachers, and if STEM education is to be implemented effectively, women need to be the leaders." (IS 1)

EARLY ENGAGEMENT OF GIRLS IN STEM EDUCATION

A recurring theme was the importance of fostering STEM interest at an early age, rather than focusing solely on interventions at the university level. Some interviews clearly argued that the societal stereotypes about gender roles in STEM should be challenged by primary education. Next to the role of primary education, parental attitudes were highlighted as being crucial in shaping girls' orientation towards STEM fields.

One of the strongest findings of this research, which also emerged from the discussion of other interview questions, was that it is too late to attract girls to STEM fields at the HE level. This was a clear and a strong view that orienting girls towards STEM fields should start in primary education. While the functioning of gender stereotypes in society was closely linked to the context of parents, the importance of the need for societal intervention to overcome stereotypes related to girls' position in STEM education was also articulated.

> “So this is always kind of cultivated: a girl needs to be a mother one day, she needs to be someone who will run the house. And girls are never given a hammer in their hands, for example, a screwdriver or something, so I think that we should work on the promotion of STEM from an early age and say that all jobs are equal.” (CR1)

> “But in order to change education we again have a problem: education where and when? Because it is true that the impact that children receive from a very young age persists in the existence of biases and stereotypes.” (ES 5)

> “Still quite relevant, especially to increase awareness of parents of STEM pathways.” (IS 2)

> “I guess that aspect of empowerment has not been studied properly and addressed in the education itself. It is somehow left to the NGO sector to deal with it on a more ad-hoc basis. It should be the faculties together with IT companies HR departments thinking how to address these aspects at young age of the students (in secondary level).” (MKD1)

> “The problem is not with the children that they don't want an education. The problem is that the parents do not let go. And in the dialogue with the parents, they said, well, why are you enrolling here? This is a man's profession. Let's go, let's choose something else” (UA1)

> “Equality is about giving equal options and equal chances. So, in fact, this work on increasing the presence of women or on increasing the interest in STEAM as such, not only among women, but also on disenchanting these areas, that it is not some kind of magic, this work should start much earlier. It is not a stage of graduating from high school and choosing a degree. It is simply a stage from the beginning of education. When a viewer observes preschools, they [children] all do the same things. The boys lead the strollers and the girls build the sledge. There are always female teachers in preschools. It is very rare to find a man there. Children are surrounded by women non-stop. At home, the mother is there more often. In preschool, there are more women. In primary school, there are also more women. In general, there are more female teachers than male teachers. It is already known. So I say that it should be like that from the very beginning. But there is a moment when the thought comes that I will not wear pink, because it is for girls, that I cannot play with a car, because it is for boys. This moment comes. It probably comes from different things. I think that this is what it is about, to show that both the boy can lead the cart, the girl can play with a car and that there is nothing wrong with it, that it is not a threat. It probably comes from

preschool, to show that you, whether you are a boy or a girl, can do almost everything, because it is almost important. You cannot have everything. " (PL 7)

"There is a prejudice that women in STEM education have less knowledge than men. This problem should be addressed in the future by increasing the number of women in STEM education." (SRB 2)

"In my opinion it is important to ensure that, in short, girls, because there are also some prejudices, in the sense that probably the fact that boys choose applied sciences more than girls derives a bit from the fact that in the past it was like that and therefore there are prejudices. So, according to you, yes, we must commit ourselves, we must commit ourselves in this sense, we must ensure that women first of all have the same opportunities. And then we must also eliminate some stereotypes according to which there would be professions more suitable for men than for women." (IT2)

"Yes, the answer is yes. This need may exist. In my opinion it is not the most important thing, I repeat. I'll give you an example. In mathematics, in the mathematics major, for example, there are many more girls than boys. .... Why? Because many girls who do mathematics go on to be teachers, which unfortunately, even at middle and high school level, is seen as a job that is not well paid, and is more relegated to women due to sexism. that exists in this country. So, many girls go to do mathematics and then become teachers. What's the problem? Is this bad? No, nothing is bad, anything is fine, but the fact is society wants to solve the jobs problem with equal opportunity in mid-senior level jobs in this country. Because if that is resolved, then a boy or a girl can choose based on their own inclinations and not based on what society proposes. I don't know if this is clear. So yes, it is important to have, if we want, more physics, more engineers, more mathematics". (IT4)

2. Analysis and Summary of Obstacles Girls and Young Women Face in STEM Education

This subchapter presents the findings from our interviews with key stakeholders — teachers, educational representatives, and institutional leaders — on their perspective and understanding of the challenges and obstacles the girls and young women studying in secondary and tertiary STEM education. Our objective was to understand the perspectives of those at the front lines of education regarding the obstacles that young women face as they navigate their educational journeys in these fields. In particular we were interested in the institutional awareness of gender-based obstacles, as well as the institutional understanding of the broader societal and environmental factors that contribute to these barriers.

During the interviews, we asked respondents to identify the specific challenges, difficulties that girls encounter at the secondary school level and those that arise as they transition into tertiary education in STEM fields. We then continued to explore with the respondents what are the challenges, difficulties women face during their higher education.

Despite the very diverse backgrounds and positions of the interviewees, as well as their varied and diverse views on the situation of girls/young women in STEM education, some general observations can be made about how they perceive the difficulties the girls/young women face in participating in STEM education. It is worth mentioning that we met **interviewees from all countries who could not identify and list any barriers or difficulties that girls specifically face in STEM education**. Some did not have a greater insight into this problem, so they simply did not know what to think when we asked them about barriers, and there were others who specifically argued that there are no barriers, progress has been made, gender equality has been achieved, as there are many areas within STEM disciplines where gender balanced are achieved. See, for instance, as these interviewees categorically state, barriers no longer exist:

> "I truly believe that there is no obstacle today. If someone thinks that this type of study is more for one gender than the other, I think it's a bit of a wrong mentality, a bit old, because I see that the opportunities are the same for everyone." (ES4)

> "I can probably only speak from the perspective of the university where I study, work and teach. It's really our lecturers don't judge students by gender, the reporting system is the same for everybody, and a lot of the subjects follow the UDL guidelines, which is universal design for learning/teaching, so students can choose the format of the reporting a little bit, let's call it that, the material is available to everybody in the same way, so it's really not a barrier whether you're a guy or a girl, it really is an equal opportunity for everyone. At least I haven't really encountered any problems. And with my colleagues, lecturers, as far as the students are concerned, none of them has ever made a distinction that because it's a guy it's this, because it's a girl it's that. No, we always talk about students in general or about somebody individually, but I never feel that kind of gender distinction." (LT3)

> "When I started programming and studying computer science, it was more of a male-dominated field and somehow women were not as well accepted, but later, especially in recent years, I think that programming and everything related to software engineering and the application of STEM technologies have definitely achieved gender equality, and women are accepted as full-fledged, serious, and sometimes even competitive partners in collaboration with men. ... I definitely don't think that there are still such stereotypes in higher education in Bulgaria or at least not something I encounter daily. There is absolutely complete equality between the girls and boys who are our students. Just as girls can engage and develop in the field of technology, so do boys develop in areas that until recently were considered purely feminine." (BG1)

> "I see no particular obstacles for girls to enter secondary or tertiary education. Usually girls have better grades than boys, they also tend to participate in more competitions, so they have a better starting position (more scores and thus might have better ranking)." MKD1

> "To be honest, there used to be stereotypes, but now I see absolutely no stereotypes, and girls don't have any. Well, that is, neither in the girls nor in their environment. That is, it is not surprising that a girl will study science, and it is not surprising that she will understand technology..... Specifically, at our lyceum, there are absolutely no obstacles for girls to develop in STEAM fields." (UA6)

We also encountered an attitude that could not step outside its own personal experience and draw a conclusion for society that there are no serious barriers for women in STEM education and careers. See for example the arguments of a Slovenian and a Croatian interviewee:

> "I went to a natural science faculty. But it didn't turn out to be for me. There were indeed more men than women, but I didn't perceive that..... that they would treat you in any other way. Not at all. Seriously. Even by professors. I don't know, or maybe it's somehow different now, with these movements that are now.... Maybe something surfaced....I believe injustices are happening. But in our country, there is not so much of it. And I also think about the girls..... Given that they also like being educated, if we look at foreign language courses and other courses, there are more women than men taking courses. Women can, with their desire or diligence, achieve great things. But it's likely that those female scientists who are real scientists will be able to tell more on how many obstacles they encountered to get to the top. It seems to me that even in the newspapers nowadays, there are a lot of women in the natural sciences who give interviews and present their views. The more you travel the world, you see that Slovenian society is not a bad society." (SI1)

> "Apparently I would say no. I mean, from my point of view, when I started my studies here, I never noticed any gender differences. I don't think so. Maybe a teacher who maybe... But I don't know, I haven't noticed any big differences." (CR1)

In addition to the complete denial of obstacles, a more nuanced attitude appeared, which was not a complete denial of obstacles and difficulties, but a projection of them into the past. Several interviewees emphasised that the situation of girls and women in general was seen as better than what the interviewee had experienced as a young person. There was clearly a positive shift reported in terms of girls/women no longer having to overcome so many obstacles and difficulties in participating in university education. It was therefore stressed that the situation of girls in STEM education is moving in a positive direction, although there is still room for improvement. See, for example, how these interviewees argue that it is now easier for girls and women who want to succeed in STEM fields:

> "Previously, it was expected from girls to finish some more feminine, 'easier' faculty, start a family, take care of the family and so on. We are still a very family oriented society, but the role of women is changing, and we are becoming more practical when it comes to organising private and professional life. There are more services available for supporting women and men, so it is easier to balance. So things are definitely changing for the better. I am not saying there are no more stereotypes, no, there are in some cases, but I would not say that they are related to STEM, but in general, for example, if some family or community tends to think that girls should not study or work, that means in general, not only in STEAM. Thankfully, we have less and less examples of this." (MKD1)

> "So, in my opinion there are no difficulties, let's say, once they start the scientific high school there are no difficulties of any kind, in the sense that being girls does not hinder them in any way. And theoretically it is the same at university. In my opinion then the obstacles perhaps arise afterwards, in the working world, in the working world. ... I do not think that girls at university have more difficulties than boys. Today they have the

> same opportunities, the same possibilities. Some difficulties perhaps arise then subsequently." (IT2)
>
> "There is complete equality regarding the roles and positions of women and men in the educational institutions where I have worked." (SRB1)

Another version of the view that the focus should not be solely on the barriers experienced by girls shows that the problem is rather that there are too few young people interested in STEM subjects in general:

> "Also, we are trying to figure out why students in general are moving more away from maths and science and just STEM subjects. ...
>
> (Interviewer: But I think that's just human nature.)
>
> Yes. But we need to motivate more students to go through or take more STEM subjects. And in my opinion, we need to address this equally to boys and girls. Ten years ago, I would have told you we need to do this more towards the girls. It's pretty much equal in Iceland, if not... Like I said, the girls may have surpassed the boys by now. In general. In my surroundings, the girls are doing better." (IS1)

It was also a typical and well-defined attitude that, although women and girls face and overcome barriers in STEM education, these barriers are not related to the higher education institutional system or actors. We can identify three factors that interviewees pointed out:

1) We encountered a number of statements (in addition to the quotes presented below, from both Hungarian and Romanian interviewees) that sought to highlight **the significant role that parents, though not alone, play in whether girls are oriented towards STEM disciplines:**

> "Yes, I think that the biggest obstacles we have are at the social level, that is, what we are told at home, what we are told at school, and what we are told by those around us, by the people around us. So, the scientific level and the cultural level, the level of scientific culture that we have at home is very important. So if we are told at home, no, the programming is for boys, for example, the films we watch, the news we watch, we are only seeing men in these disciplines, it is already limiting you." (ES3)
>
> "I don't see any obstacles in our [architectural] field - the desire, the stubbornness, the work is the most important. Parents, maybe the older generation, have prejudices, but nowadays young people don't react much and go wherever they want to [study]. Maybe it's more when they are having families, maybe then the children follow in their parents' footsteps." LT3
>
> "Somehow parents themselves still impose on them [stereotypes], you know, when it's a girl - to go to a language school, when it's a boy to go to a specialised high school, it's still in the family..." (BG3)
>
> "And the problem is with them, the parents... The problem is not with the children, that they don't want an education. The problem is that the parents do not let go. And in the

> dialogue with the parents, they said, well, why are you enrolling here? This is a man's profession. Let's go, let's choose something else." (UA1)
>
> "The parents are probably still a bit... I didn't experience this because I grew up in a family of all women with strong personalities. For me, my mother told me to study chemical engineering because there were also scholarships available. I didn't force my daughter to study classical high school, but she liked mathematics, although she might have been a bit jealous because I loved it. I told her, if you don't like maths, go for classical or scientific high school. I didn't give her a choice. However, I think not all parents are like this because some think that classical high school is more suitable for a woman who wants to become a teacher. My father also told me that teaching was easier for a woman than working in the industry because you have more free time for the family and raising children. I didn't choose teaching for this reason, but this advice did influence my decision. If he had strongly opposed my choice to become an engineer, I might have reconsidered." (IT3)

2) Except the interviewees from Island (although they also admitted that subtable biases still impact girls's choices on STEM careers), **cultural and social expectations in society were mentioned often as a strong factor in discouraging girls from studying STEM fields.** Accordingly, it was pointed out that girls often face stereotypes and beliefs that STEM fields are more suited to boys (e.g., certain STEM fields require skills traditionally associated with masculinity, physically demanding or incompatible with family life), and in connection with it some interviewees mentioned that girls internalise stereotypes about their abilities (e.g., not good in maths), the right place where they should belong, which at the end determine their choice of studies in HEIs. Interestingly, the influence of media on a girl's career aspiration was mentioned only twice by an interviewee from Ukraine and Spain (see interview extract in attachment).

3) According to the interviewees, **the obstacles and difficulties were typically encountered by women before or after their university studies** - whether they were young researchers or young professionals. **Before university education, barriers were usually related to the stereotypical thinking and beliefs in education** (e.g., teachers who think stereotypically, societal beliefs about gender roles, teachers not supporting intentionally girls), but also arguments were shared that technical education in primary schools are inadequate, the early education do not introduce STEM subject in an adequate way (e.g, the number of STEM subjects are low), rural areas lack resources for a comprehensive STEM education, as well as teachers lack a sufficient science background which can affect the quality of STEM education in primary education, and which can limit girls' opportunities (see interview extract in attachment).

4) **Barriers encountered after university are typically linked to difficulties in the timing of having children, inadequate workplace conditions and discriminatory attitudes towards**

women. Professional women are often perceived by employers as less reliable or capable, especially if they have family responsibilities (see interview extract in attachment).

5) Only one example emerged, given by one of the Bulgarian interviewees, which suggests that barriers should also be examined in the context of **intersectional factors:**

> "In the school where I continue to work, there are a lot of pupils of Roma origin and this is true for all schools in Bulgaria where pupils from this community are taught. In the case of girls from this community, it is the norm that they do not go on to higher education; it is not accepted that they continue to study beyond the age of 18-19. They are expected to marry and start families. There are many examples, and I have many examples of girls who went on to study computer science at Plovdiv University, graduated successfully from that university. However, the problem came when they decided to enter the labour market. Employers still have a lot of prejudice against graduates from this community, even more so if they are women." (BG4)

In parallel to the emphasis that the source of difficulties derives outside the institution, hardly any interviewees mentioned **the role of higher education institutions in sustaining the difficulties experienced by young women**. Only 4 interviewees referred to problems faced by girls in connection to the institutional level.

One interviewee simply admits that the same problems exist and have the same origins in universities as in secondary schools:

> "I would say that obstacles related to secondary or tertiary education are more or less the same, and these challenges are rooted in cultural, educational, and institutional barriers. When we talk about cultural and societal norms, the main problem is the persistent gender stereotypes. Traditional gender roles and societal expectations often discourage girls from pursuing STEM fields, which are perceived as male-dominated." (MKD4)

In this interview extract, we can read that institutional support is far from adequate when it comes to exploring and treating discrepancies through formal measures:

> "And maybe not, maybe the environment is hostile, maybe not. I usually bring up this thing from socialism, this TTT thing, that it was tolerated, supported, banned (in Hungarian 'tűrt, támogatott, tiltott'), that there was a period when I was put on such a ban list, because I had a conflict with a man. And he tried to quasi, I don't know, push me out of my career, or push me out of the institute, but now I feel that he put up with it like that. So I'm not banned, but I don't feel supported." (HU11)

The following interviewee also questions the real intention and motivation of the institution to effectively promote diversity:

> "Sometimes also the motivation itself, it's missing and what I see and what I see also at our university is that there is a lack of diversity within the company, so within the university. And it's not the topic which would be considered so seriously." (SK1)

In this longer quote, we can see another aspect of the non. adequate institutional intention

towards supporting women. The interviewees elaborates on why the principle of meritocracy, despite being a strong determinant of institutional attitudes towards the performance of women and men, is a factor in inadequate institutional attitudes towards supporting women:

> "I think that maybe it is a bit like today in the academic environment, which is generally considered to be open, there is simply a shame to voice some opinions, so it seems to me that such people who simply say no, because women are not suitable for it, there are fewer and fewer such people. However, the question remains what these universities or institutions do to actually act on behalf of women. Because you can say, of course, that yes, they support this idea but it seems to me that the problem in the academic environment is this discourse and the conviction that only skills are really important here. And this conviction that we have to think not about women and men, but only about looking for the best people, is very strong. And this is also an obstacle that does not allow us to notice certain systemic obstacles, but only focus on what these women want and encourage them and convince them that they are just as capable. And this is probably not the case, because many studies also show that although for men the atmosphere of science or work is not so important, for women it is very important.....I think that [what is needed] is changes in institutions that go from fixing women, that is, from encouraging them and saying that even if they are not so great, they are still suitable, to showing them that it's just nice to study with us and creating such nice conditions." (PL1)

There were several interviewees who did not talk about the difficulties in a comprehensive way, as if they had a broader perspective, but spoke about the difficulties they had experienced personally, based on their own stories. Similarly, there were those, based on their own experiences, who argued that there is no discrimination towards girls in STEM education. These insights from the interviewees only highlight the fact that some of them did not have a comprehensive overview of the subject. Some of the barriers are difficult to perceive (only one interviewee reflected on the difficulty to notice the obstacles and barriers, ES8) for a number of reasons, from being invisible through well-embedded social and normalised stereotypes, to the fact that the interviewee may have experienced fewer difficulties in her STEM career due to her privileged position.

Additionally, we seek to identify the difficulties that can be linked to the institutions of STEM education, the institutional processes, their actors and the educational processes. We have therefore not included in the analysis barriers that are referred to as past barriers or barriers outside the institutional context (see e.g. biassed gender roles perpetuated by parents)

The data collected is not suitable for comparing countries in terms of what barriers were identified by interviewees. All we can say is that interviewees in Lithuania and Iceland were the ones who typically argue that barriers are not gender-related barriers, or that if there are barriers for girls/women in STEM education, they are not necessarily gender-related barriers, but rather due to the quality of education or the unpreparedness of teachers. The

following quote from Iceland, which shows a typical attitude, shows for example that if discrimination does occur, it is certainly not at the institutional level and not gender-related:

> "I think that there's probably a professor somewhere that believes himself to be full of equality speech but still singles out the female and makes this feeling of I shouldn't be here. But I would, from the general conversation and what I've experienced and through people that I know, I would say that conversation is very old in Iceland in general. I would not single out that an individual just is a negative individual by nature, but I would be surprised if I would hear that there's a whole division in the university that does this or talks like this. I would be very surprised." (IS2)

Overall, our analysis can therefore show what difficulties the representatives of the institutions are aware of, what difficulties they perceive, and what they consider important to mention. Therefore, our aim is not to present a complete picture of the difficulties girls/young women face in STEM education, but rather to show what are the insights the representatives of the institutions have insight on the difficulties, what they notice, what they take into account or even acknowledge as a difficulty.

In the following, we therefore present the obstacles and difficulties that the interviewees perceive as relevant for the present time. The difficulties are categorised according to the institutional level to which they are related. The quotes illustrating the identified categories of the challenges and obstacles are to be found in the Annexes.

Table 20. Obstacles and difficulties related to primary and secondary education

Stereotypical beliefs and expectation on performance, subject choice, career choice / Primary and Secondary education	
Girls need to try harder / girls are undervalued	HU10, ES8, SRB2, MKD2, UA4
Stereotypical beliefs on what subject are for girls and boys	HU7, BG5, IT4, SRB1
Stereotypical beliefs on what profession are for girls and boys/stereotypical environment	ES5,6,7, BG7,8 PL1,7
Secondary School Teacher's stereotypical thinking on girls' different/less capability and interest in STEM subjects	SI1, ES6, IS4, BG4, MKD3,4, UA3,4
Stereotypes/social and cultural factors mentioned in general which determine girls' opportunities	BG8 MKD3,4, UA4, IT1,2,3, PL1,2
Challenges related to the secondary education in general (quality of education)	
Lack of sufficient/quality education (STEM-related education)	SK1, BG4, PL7
Lack of information on STEM professions	SK1

Lack of role models for girls	SK1, IS4,5 MKD3,4 PL1, PL7
Lack of extracurricular education	BG4
Lack of support from teachers	BG8, MKD3,4
Lack of financial resources	BG8 MKD4, UA7, IT1

Table 21. Obstacles and difficulties related to higher education

Work-life balances and maternity / Early Career Researchers & Young professionals	
In general, difficulties of balancing work and life/children	HU6,10, RO2, SI3, MKD4
Becoming a mother / the timing of becoming a mother	HU3,5,6,10, CR2 RO3, RO2LIC, ES8, BG8
Dropping out of academic career after having children	HU13, HU11, IT4, PL3,6,7
Maternity leave is not accounted in applications, research evaluation	HU6,11, SI2
Lower capacity to perform academic job during and after maternity leave	HU11
Balancing work and life / more burden on women in child care	HU11, HU10, ES6, IT1, PI2
Career slow done due to family responsibilities	HU7, HU11, RO5, BG4, UA4,5, IT2
Persisting (positive)sexism, gender bias, stereotypes against women in academia (sexual harassment cases)	
Underestimating women students' technical abilities or knowledge	HU12, 13, LT3, PL1, SRB2
Sexual harassment	HU11, RO5, PL1
Sexis comments/jokes	HU1, RO2, PL3
Different treatment	HU1, ES6, PL5
Using rhetoric devaluing girls/women researchers	LT3, PI1
Sense of belonging	
Law self confidence	HU12, RO3 MKD3,4, UA5, PL1

Loneliness/lack of peer support	HU12, BG8, MKD2,3, PL1
Gaining visibility as a researcher, taken less 'seriously'	HU11, SK1, Pl1
Gaining visibility only as a good administrator, manager	HU11, PL7
Being a quota women	HU3
Participating less in networking activity	RO1
Being in a token position/being the only girl in class	ES7, IS2

Table 22. Obstacles and difficulties related to career/career advancement/employment

Difficulties in relation to career/career advancement and employment	
Lower salary	HU7, HU11
Less support in research (assistance)	HU11
Citation bias	HU11
Labour market expectations (biassed)	HU6, LT3, UA4, IT2
Expectation of having a family	ES6, BG2,3 UA4, IT1
Insulting/harassing environment forcing women to give up/hold career	ES8
Negative consequences of part time work	SK1
Unstable labour market - no secure positions	PL1

The above presented categories revealed numerous challenges and difficulties that young girls and women face during their STEM education starting from early education though HE till the advanced research positions and professional career. The obstacles - identified from the interviews - are shaped by cultural and structural factors (we were less concentrating on individual issues, as we were not asking the young girls/women). Based on the identified challenges and difficulties, the following conclusion are drawn, which can serve as an input for creating recommendation on how to better support girls and young women for achieving their goals in STEM education:

1) **Lack of institutional support**. It turned out that a higher presence of role models, a supportive network, mentorship system, better trained teachers would better help girls/women to envision themselves in STEM careers and counteract the obstacles

they face while studying in HEIs or transitioning into the workforce. Interviewees telling about discriminatory instances also revealed that reporting mechanisms are often inadequate or inequality addressed on the institutional level. (For instance, a case was found when the university overlooked a teacher's problematic toxic behaviour because he brought significant funding to the faculty.). The lack of adequate child care facilities in workplaces or educational institutions also shows the inadequate institutional support can deter women from pursuing demanding careers in STEM.

2) **(Unconscious) gender biases reinforced by teachers** in primary and secondary education strongly influences girls' choices and opportunities in STEM education and careers, it can lead to discouraging girls from considering STEM careers.
3) **Family in connection to societal pressures and expectations, plays a significant role** in influencing young girls's aspirations towards a STEM career. Based on stereotypical expectations from family members, girls are often oriented towards traditionally feminine fields, such as language studies or humanities.
4) It was found that **sexist and discriminatory attitudes still exist towards women** studying in STEM HE coming both from peers and academic staff. The scale of gender-based discrimination can be wide, it can range from sexist remarks, subtle forms of exclusion to harassment. Some examples were mentioned about teachers (often emphasised that they belong to older generations) treating male and female students differently, saying sexist jokes or devaluating the ability of women (perceiving them as less capable for certain STEM roles and professions), and in this way creating an unwelcoming and discouraging environment for female students. Subtle forms of discrimination were mentioned, such as young women researchers being given less important, less desirable projects and roles in research activities.
5) **Work-life balance and family responsibilities, particularly when it comes to maternity leave and child-rearing is still a major challenge for women.** Although we could identify many good examples and supportive attitudes, the lack of flexible work arrangements or insufficient institutional support still force women to slow down their career or drop out from STEM careers. It was revealed that women with a STEM degree still experience difficulties in hiring processes due to the expectations of having a family or simply just being a childbearing age (e.g., receiving questions about marital status and family plans). Several examples also showed that although institutional support existed, women (young professionals and researchers) encountered difficulties with re-entry into the workforce and

research career. Academia is especially understood as a field which requires continuous commitment from researchers, therefore having a family can seriously hinder career advancement.

6) **Even within STEM, there are perceived gender-appropriate disciplines and career choices within STEM fields, which are determined by expectation on women's societal roles.** Some professions within the STEM fields are seen more as feminine (more appropriate for women as they are often seen as primary caregivers), more compatible with child bearing, channelling women towards certain STEM fields (e.g. being a maths teacher due to its compatibility with family responsibilities), and contributing to women internalising beliefs about what is acceptable or achievable for them.
7) The **peer pressure** is already strong in primary-secondary education: girls less likely voice their thoughts, show their knowledge, take leadership roles or rather take management roles in group settings. At the same time, girls' performances were acknowledged by teachers (it was consistently expressed that girls perform better academically in general), and were pointed out that girls/ young women have to work constantly on overperforming boys/men or proving themselves constantly to dispel doubts about their abilities.
8) The **inadequate 'sense of belonging'** causes difficulties for girls and women in STEM education and can appear in various forms, each contributing to the girls/young women internalising the belief of being less competent, the feeling of having less confidence, especially in male-dominated classes, laboratories.
9) **Financial constraints in pursuing a STEM career**, for instance paying tuition fees, was hardly mentioned (only by interviewees from Bulgaria, Ukraine and Italy) as a factor causing difficulties for women to continue studying STEM subjects in HE.

3. Institutional Support for Girls and Young Women in STE(A)M education

This subchapter addresses the following research question: ***What are the strategies and efforts employed by educational institutions to overcome gender-based barriers and support young women in STEAM (Science, Technology, Engineering, Arts, and Mathematics)?*** With this research question we had the intention to explore the institutional intentions, strategies, tools, and initiatives aimed at improving gender equality and inclusivity in STEAM education.

3.1 Institutional attitude and approach on supporting women

Each interviewee was asked the following question: ***What do you think, how should young girls (young researchers) be encouraged to develop an interest in STEM fields? Should there be dedicated support for girls in this regard at all? In secondary education?*** *In tertiary education?* Based on the interviewees' responses, different institutional attitudes can be identified regarding how female university students and young researchers should or could be supported in their STEM studies. The interviewees mostly discussed support for girls entering university, spoke less about students at the BA and MA levels, and focused more on women in their Early Career Research (ECR) stage.

Institutional attitudes toward the level of support appear to be closely linked to how the disadvantages and difficulties faced by women are perceived—whether they are seen as systemic and reinforced by the institution or as obstacles connected to social stereotypes (maintained by teachers and/or parents) or challenges specific to secondary education. In sum, the **obstacles young girls and women face during their STEM education were often perceived by the interviewees as occurring outside the walls of the university.**

As mentioned in the previous chapter, we found few attitudes linking (better, more effective) support for girls and young women in STEM education to any form of institutional change or intention. **Only four interviewees expressed explicitly this perspective**, as highlighted below:

> "This conviction that we have to think not about women and men, but only about looking for the best people, is very strong. And this is also an obstacle that does not allow us to notice certain systemic obstacles, but only focus on what these women want and encourage them and convince them that they are just as capable. And this is probably not the case, because many studies also show that although for men the atmosphere of science or work is not so important, for women it is very important. ... So if these girls in computer studies will even hear certain opinions in the corridors, such a stereotypical male work environment - it can discourage them very quickly. And it seems to me that we should now move to this stage to change universities and workplaces in such a direction of friendship, not so much for women, but in general to notice some diversity." (PL1)

> "So, I think it is important to change that idea because in fact the data we have, for example, is that girls are already more attracted to everything that has to do with invention, 90% of girls are attracted to what it means to invent and do new things compared to 80% of boys, in other words, there is a big difference in favour of girls, the problem is that they encounter a series of other barriers throughout their lives that make them think that science and above all technology is not for them. So, what we have to change is the image we give and the structure we have of not thinking about women. Of course, in the end it's a bit of a catch-22, because if there are no women in ICT areas, when we develop technology we don't think about women, and when we do

> think about it, it's a pink technology that doesn't take into account the real needs of girls, young women and women." (ES5)
>
> "(researcher: Should there be encouragement and targeted policies or support to engage girls in STEAM?) I don't have a straightforward answer, but I see that there are many programs that do this because it is clear that reducing inequalities in the number of girls participating in these fields, if it is a focus of educational policy or at the national level, means that consideration must be given to the time and human resources that need to be allocated, including financial resources, to provide activities that encourage development in this direction." (BG7)
>
> "When we talk about who are the key players, I would say all of us, but primarily the education system, the family and the community. Indeed, the educational system needs to work on addressing all aforementioned institutional challenges by gender mainstreaming its policies and actions, and introducing dedicated support programmes. No doubt, the role of educational institutions is pivotal. But also engaging parents and communities in supporting girls' interest in STEAM is very important as it can provide a nurturing environment for their educational pursuits. Highlighting success stories and achievements of women in STEAM within the community can reinforce positive attitudes towards these fields." (MKD4)

These interviewees clearly indicated that, for an effective support system, both structural and societal level changes are essential. One interviewee (PL1) emphasised that gender-specific barriers must be recognized to understand the unique challenges faced by women and noted that women may be more affected by an unsupportive, stereotypically male-dominated atmosphere. The interviewee from Spain (ES5) raised an interesting point—which is aligning overall with our research findings—about the counterproductive effects of the "pink technology" approach, which may not reflect women's real needs or effectively counter the discouraging stereotypes and barriers that limit women's opportunities as much as intended. Another interviewee (BG7) suggested that reducing gender inequality is not solely an educational objective but also requires national-level commitment, proposing that long-term support programs could provide a more robust pathway for girls in STEM fields. Similarly, the fourth interviewee (MKD4)highlighted the need for gender mainstreaming in education policies, targeted support, and community engagement. Together, these viewpoints suggest a **need for a holistic support system: 1) structural reform in educational and university environments, 2) systematic effort to challenge cultural stereotypes, and 3) the active involvement of various stakeholders to create a supportive ecosystem for girls interested in STEM.**

This view, expressed above, which focuses on structural or cultural changes at the institutional level (e.g., improving the working environment, implementing affirmative

policies), was not as commonly held. Instead, **the majority of interviewees suggested that a support mechanism should be maintained on individual level and focus on:**

1) **increasing girls' self-confidence**, empowering them to engage in STEM education with greater motivation and skill development,
2) **and training secondary school teachers** to break down harmful stereotypes and adopt STEM-specific methodologies and approaches.

This individual-focused approach to support is further substantiated by findings indicating that interviewees frequently identified **three key actors having a prominent role in guiding, supporting girls toward STEM fields: (1) parents, (2) secondary school teachers, and (3) role models.** Although a few interviewees acknowledged the state's role in funding support systems, they generally provided limited detail on its specific responsibilities. This emphasis on individual actors is exemplified in the following interviewee's quote, where, despite a reference to the state's role, the focus remains on the impact of role models.

> "It's a difficult question, because it is not a simple question. Here, parents, teachers, the environment, the state, if we are looking at such a large scale, everyone has a role or a place to support, they can support, they can promote the increase in the stem area, the increase in the proportion of women, everyone at their own small level, as they can support girls, but it is very important to have positive examples. Because if girls hear about it or read about it or reports or research, that's all fine, but if they don't meet flesh and blood women researchers that they can actually talk to and believe or ask about difficulties, it's much harder." (HU3)

3.2 The lack and the informality of the top-level institutional support

Some interviewees' responses also suggest that the active role of universities in supporting girls is not reflected at senior management level, or that if it is not reflected at senior management level, it limits the effectiveness of the support. For example, one interviewee, who is the dean of a private university, explains that he, as dean, does not need to provide more than a certain level of support:

> "Now, I'm also noticing in students, of course, that good female students and good male students are completely equivalent and it's a pleasure to work with them. But to organise something like that.... Of course, I, as dean, clearly, support all of these efforts. But, of course, I leave the initiative - to women. I support, but of course I'm not leading, I'd say, I don't think that might even be a dean's job. The dean simply supports all of this and gives them every opportunity to realise their wishes. If they apply for projects, if they organise groups, whatever, in any way." (SI2)

Notably, examples from Hungarian interviewees reveal a lack of commitment at the senior leadership level within universities to provide systematic, long-term support for girls in

STEM fields or Early Career Research (ECR) positions to overcome structural disadvantages. While we did observe some positive attitudes among top-level management, in the Hungarian context, support programs for girls appear largely reliant on the voluntary efforts of women (teachers, researchers, research group leaders, and university students). For instance, young female researchers arranged childcare independently with only one-time grant support from senior management (HU5), and an advocacy organisation for young researchers has undertaken a grassroots initiative to assess the challenges faced by young mothers in research (HU11). Similarly, recruitment programs for secondary school students often depend on the voluntary efforts of female university students, as illustrated in the following quotes:

> "For example, one of our university's specialties is the (name of the summer camp) which is a distinctive feature of our institution. The (name of the summer camp) has a dedicated team of enthusiastic volunteers. Some of these volunteers came together to organise the International Women's Day event. A small portion of the funding for this event came from grant money.Similarly, camps and preparatory programs are organised by volunteers, who seek support through various means.
>
> (Interviewer: Who are the volunteers?)
>
> Primarily, the volunteers are university faculty members. We also try to involve students, but it is challenging. Recently, our university has developed a methodology to reward university students' volunteer work with credit points, as stipulated by the higher education law. This allows students to earn a certain number of credit points for their volunteer work, within a specified limit. There is an administrative framework in place for this, but it is often difficult to engage students consistently. They are very enthusiastic initially, but as the semester progresses and their academic workload increases, they tend to drop out.It is noticeable that female students are significantly overrepresented among volunteers compared to their numbers. This trend is also evident in programs that focus on high school students and promotion activities, where women volunteers are again overrepresented relative to their numbers.Interestingly, in these volunteer activities, female faculty members are also significantly overrepresented. Generally, in low-paid, demanding roles, women faculty members are disproportionately represented, which is also the case in volunteer work." (HU1)
>
> "Our current management has already bridged these problems, one is that in the beginning I was always talking about it, and we organised programs, and now it is also Girls' Day, it is a traditional event, and there is no question, when I tell the Director General that I get permission to organise my own, as a researcher, within my institute, to organise my research center within my institute and to apply for funding and everything else that does not arise from the 'No'." (HU3)

The following quote, also from a previously mentioned Hungarian interviewee, illustrates that addressing challenges faced by female university students often occurs through informal channels, highlighting a lack of formalised solutions at the institutional level:

> “(Interviewer: When such an issue arises, with whom can you discuss it?)I generally do not communicate these matters further. For instance, if female students come to me with complaints or if I read about such issues in anonymous faculty-student surveys, and the names of the faculty involved are mentioned, these remain anecdotal experiences. They are not investigated or substantiated. Consequently, I do not take specific actions regarding these individual cases but rather keep these experiences to myself. I focus on advocating for broader systemic changes to address these issues in general.My approach involves collaborating with other empathetic colleagues who serve as informal support systems and can help shape the overall climate. For instance, in our female mentoring programs, having more women as volunteers allows us to address these experiences collectively. We can discuss and address these issues as a shared experience, which helps in raising awareness and pushing for improvements without needing to explain repeatedly that problematic behaviours still exist among some faculty members.This collective approach naturally directs attention towards addressing and improving these issues. By fostering a supportive network and focusing on systemic changes, we can more effectively drive progress in this area.”(HU1)

We also identified instances that demonstrate the lack of structural changes at the institutional level in providing support for girls and women. Specifically, support for women's access to leadership positions is often offered without formal changes to existing mechanisms and processes: See the following quote:

> “From my perspective, the committee operates in a somewhat adversarial environment, where the current chairperson diplomatically works from behind the scenes to achieve change gradually. A direct, confrontational approach might not be effective in such a context. For instance, the chairperson was the head of the (research Institute)’s Nominating Committee for officer elections last year, and she lobbied for the inclusion of female candidates in leadership positions, such as deputy chairs. However, this lobbying was conducted carefully and diplomatically, ensuring that there were female candidates without overtly influencing the voting process. ... However, I notice some resistance, especially among my generation of aspiring "great doctors" who aim to become academicians. These individuals often view the committee’s efforts as a threat because they operate in a male-dominated system. The introduction of measures to promote women, like having additional places for female candidates, is perceived as unfair competition by some male researchers who feel they might be at a disadvantage.Despite these individual resistances, there is no systemic opposition to the committee’s work. It’s more about individual perceptions and the inherent biases within the academic community.” (HU11)

The previous quote already indicates that the implementation of affirmative policies faces considerable resistance. The following quote, also from a Hungarian interviewee, further illustrates that substantial changes in institutional attitudes—cultural change—would be necessary if a university were to adopt quotas as a strategy to increase the number of women in leadership positions:

> “But we had to start somehow, and I said I was against quotas because it is really humiliating that they take you on because of that, but you also have to understand that

> if they don't do that, then we will never get the opportunity, or very few of these ladies will get the opportunity. So I think it is a positive move forward in the long term, and after a while we will not have to deal with it, but we had to start somehow. How come these parameters are still in force, that the proportion of women and the proportion of young researchers are taken into account in the proposals, whether they are for internal proposals or for proposals in the academy. Well, this is also very important, to train the next generation, regardless of whether they are male or female, but that all these things are tied to quotas." (HU3)

The following quote is also an example for showing how young women researchers support one another through informal channels, suggesting that 'sisterhood' has a greater role than institutional incentives and tools in supporting young women researchers in their career:

> "Female academics also coordinate among themselves to ensure that they nominate potential female candidates for various positions. However, this approach is more about quietly ensuring representation rather than engaging in open confrontation. The committee's activities, such as organising sessions and lectures, generally go unnoticed or unchallenged, though participation and visibility remain limited." (HU11)

The quotes presented above are derived from one Slovak interviewee and primarily from Hungarian interviewees, which is a limitation given that we collected data from 14 European countries. However, these responses suggest two key insights, which can be informative as an illustrative example to countries too: 1) the role of senior management within institutions is not particularly strong and formally institualised in supporting girls and young women in STEM education and research, and 2) it would be valuable to explore in greater depth the implications of senior management commitment and active engagement in fostering support for girls and young women in STEM education within higher education institutions. This exploration could show how such involvement might enhance the effectiveness of programs designed to support female students and ECRs in these fields.

3.3 Perspectives on supporting girls' interest and motivation in STEM education, with a focus on entering tertiary education

Based on the interviewees' responses, the following groups were established to reflect **varying attitudes regarding how, and if, girls should be supported in developing an interest in STEM fields.**

1) Gender-Neutral Perspectives on Support in STEM

In this group are a very few responses from **interviewees who did not differentiate between girls and boys in their answers.** Consequently, no specific insights were provided regarding dedicated support for girls in STEM education or the role of institutions

in this regard (e.g., UA6, HU8, HU12). These interviewees did not express that they are against supporting girls, and their answers also show that they mostly have opinions and ideas on how to support students in STEM university education, but their responses did not indicate any intentional focus on gender; they rather viewed students in general without distinguishing gender-specific needs.

Quotes illustrating the perspectives of this group can be found in Annex 2.

2) Advocates for Gender-Neutral Support in STEM

The second group comprises **responses from interviewees who believe that there is no need for special support for girls in STEM.** They explicitly opposed the dedicated support for girls studying in STEM. They contend that all students, regardless of gender, should receive equal support in their STEM studies, and that dedicated support is unnecessary for university access. It is not hard to explain that their view might be based on gender blindness. Within this group, two main viewpoints on gender-neutral support emerged:

2.1 Equal opportunity to all

Some interviewees argued that support should be provided equally to all students, through individualised attention, scholarships, or opportunities, based on principles of fairness and without considering gender as a criterion. These respondents explicitly expressed gender neutrality as the foundation of their view, and within this framework they emphasised the importance of providing encouragement and resources that are available to all students, regardless of gender, to help them succeed academically and personally. In line with this view, the respondents did not elaborate or mention at all the specific challenges the girls might face white entering into or while studying in STEM fields. Additionally, several quotes indicate a belief that girls/women in STEM do not require unique support to succeed and that they perform equally well as their male counterparts when provided with the same resources and opportunities. The overall recommendation that these interviewees offered is to not set specific targets for female participation in STEM in the name of equality but at the same time they also stress that a supportive environment is necessary to all girls and boys to develop their strengths and interests.

2.2 Concern over Positive Discrimination

A notable subgroup of interviewees (11) expressed opposition about dedicated support for girls, indicating that such measures could create a disadvantage and unfair situation for boys as it would be positive discrimination. For instance, interviewees expressed that dedicated support based on gender might unfairly exclude boys or lead to a feeling of

inequality among students. Therefore these respondents argued that only that approach is acceptable which does not disproportionately favour one gender but rather supports all students equally, which is seen as fair and effective.

Some interviewees went further and argued that dedicated support is not preferred by girls themselves as it would create negative feelings for them and having the feeling that they were accepted for a scholarship for instance due to gender-based support rather than merit, or or that girls do not require such support, as they perform equally well in STEM subjects without additional intervention. In summary, these responses interestingly (falsely) emphasise that equal opportunity should not be based on gender-specific interventions. See the illustrating quotes in Annex 2.

3) **Addressing the broader issue of the declining number of students and workforce in STEM fields / A gender-neutral approach to student support**

The responses in this group reflect a broader systemic challenge in STEM education and employment, centred around the insufficient supply of students and skilled professionals in STEM fields rather than a specific focus on gender-based support. In this group, interviewees argued that the question of whether dedicated support should exist for girls in STEM is less relevant compared to the broader issue of declining student enrollments in STEM fields overall. They highlighted that the root problem lies in the low numbers of students pursuing university education and subsequently entering the STEM workforce, a trend that affects both genders. The quotes presented in the Annex 2 illustrates that the focus for the universities is on attracting students of any gender due to declining enrollments. Gender-specific support is minimal or secondary to the priority of simply filling seats in specialised programs.

In this context, the focus on orienting and supporting girls in STEM education is connected to the general shortage of university applicants and the subsequent employee deficit in the labour market. However, this argument extends to boys as well, given the parallel need for qualified male candidates in STEM disciplines. Therefore, the interviewees suggested that support should be available to all motivated students, irrespective of gender, to address the overall enrollment and workforce decline and therefore high necessity in STEM. The overarching viewpoint in this group reframes the issue: the challenge is not solely the underrepresentation of women but the overall insufficient number of students entering STEM education. See the illustrating quotes in Annex 2.

4) **Advocacy for targeted support to increase female participation in STEM education and research**

A substantial portion of interviewees emphasised the necessity of targeted support to increase the representation of girls in STEM education and support them in overcoming barriers as emerging researchers. While many interviewees simply recognized the need for such support, an analysis of their responses reveals distinct proposals and justifications for this focus. These recommendations and perspectives can be grouped into several thematic areas, with the first two themes receiving the most comments/responses, underscoring their perceived importance.

Examples for simply acknowledging the need for a dedicated support for girls:

> "I think it's always good if there is dedicated support for the girls in this field in this area. Yeah. It's good if we can do something, especially for the girls, that's definitely true." (SK2)

> "I believe that female students should be attracted to engineering majors and that their aspirations should be supported." (UA3)

4.1 The importance of early education in orienting young girls towards STEM education

Several interviewees consistently indicated (see the collected quotes in Annex 2) that **the timing of support is crucial for encouraging the participation of women in STEM. Many of them argued that intervention should start well before university, preferably in primary education or even earlier.** This early focus on support is viewed as essential because by the time students reach secondary school or university education, societal and gender stereotypes about STEM fields have often taken root, shaping career aspirations in ways that may discourage girls from pursuing STEM careers, or certain male-ceneterd fields within STEM.

Many interviewees expressed that primary or even education in kindergarten is the ideal time to foster interest in STEM. They argue that foundational skills and confidence and interest can be established in young ages. This timing is also seen as crucial for challenging gender stereotypes. There was a consensus expressed by these interviewee experts that intervention in secondary schools may be too late to create equal access to STEM education, effectively engage girls in STEM education and counteract gender stereotypes.

In addition to widespread agreement on the need for early STEM education, interviewees also provided insights on the specific focus areas such support should address. A

frequently mentioned priority was the introduction of hands-on, playful learning experiences in early education to foster a natural interest in science for children of both genders. Additionally, exposing young girls to female role models in STEM was highlighted as an especially effective strategy for encouraging their engagement in STEM subjects. As students transition to secondary education, interviewees emphasised the increasing importance of a supportive environment, including mentorship, workshops, and STEM-focused clubs dedicated specifically to girls, as key interventions for sustaining interest and providing guidance in STEM pathways.

4.2 The critical role of teacher support and school culture

The influence of teachers was a predominant theme when speaking of supporting girls in STEM education. Many interviewees noted that teachers play a crucial role in fostering motivation, self-confidence, and a sense of capability in STEM subjects among female students. The interviewees clearly suggested that teachers's attitude and encouragement significantly impact female students' choices for tertiary STEM education.

Following this concept that the teachers have a prominent role in motivating and encouraging girls in STEM education, **the teachers appeared as a change agents in the school environment**. Therefore there was also an emphasis on equipping teachers (teacher training) with the skills to treat students equally, regardless of gender, so they will be able to recognise gender bias and stereotypes they might apply in teaching, to avoid gender-specific differentiation in classroom activities. As one of the interviewees highlighted, teachers must put extra effort to ensure that both boys and girls feel equally encouraged and capable in pursuing a STEM career and in line with it many interviewees expressed the strong need for the professional development and awareness among educators about gender issues in STEM. Clearly, the interviewees argued that there is a recognition that while efforts are being made to improve STEM opportunities, significant gaps remain, particularly in the training of educators who often lack the resources or knowledge to effectively support female students.

Additionally, next to the role of teachers, **the importance of a positive school culture** (they were talking about mainly secondary schools) was also underscored as a vital factor in shaping students' and hence girls' aspirations. Many interviewees suggest that a supportive culture, policies and practices that promote gender equity, is essential for fostering an inclusive atmosphere in learning.

The interviewees recognized that societal pressures, norms, gender based stereotypes influence young girls' aspirations in STEM, and it was clearly connected then with the emphasis on the need for teachers training. The parents were also mentioned a lot as agents often deter girls from pursuing STEM fields. **In our understanding this is a positive finding: many of the interviewees underscored the critical role of teachers and parents in encouraging girls to pursue STEM careers. Interestingly, however, while they reflected on the need for encouraging girls at the secondary school level, they did not discuss their experiences at the university level, although the majority of the interviewees represented HEIs.** Instead, they universally acknowledged that the gender dynamics regarding admissions—specifically, the number of girls and boys admitted—were largely determined prior to university entry. This insight suggests that it is perhaps not surprising that **universities are increasingly implementing programs aimed at supporting girls in secondary education, recognizing that early interventions are essential for fostering greater gender equity in STEM fields.** See the illustrating quotes in Annex 2.

4.3 Emphasising (gender) differences in arguing for dedicated support to girls in STEM education

The perceived differences between girls and boys are frequently mentioned as justifications for dedicated support initiatives. A recurring theme was the (perceived) difference between girls' and boys' learning styles, interests, and social behaviours

These differences of girls are often framed in comparison to a "norm" based on boys' abilities and knowledge, but they are not portrayed negatively. Some interviewees even referenced societal expectations of gender roles to underscore the need for such support, reinforcing the idea of inherent differences between male and female students. This additional support, according to respondents, is essential particularly beneficial to girls because skills commonly attributed to girls, such as creativity and strong organisational abilities, may be more effectively cultivated when dedicated support is in place.

Furthermore, by fostering girls' potential, these efforts are seen as enhancing diversity and the associated benefits it brings to STEM fields. Interviewees frequently emphasised that the complementary strengths, competencies of girls and boys contribute positively to the learning environment. For example, girls were noted for their strong organisational skills and ability to work well in teams, which contrasts with boys' preferences for competition and hands-on activities.

However, these observations also reveal an underlying complexity: while advocating for special, dedicated support for girls aiming to foster gender equality in STEM. For example, emphasising girls' tendencies toward organisation and collaboration, or their hesitation in competitive environments, might inadvertently communicate these characteristics as inherently "female" traits. Similarly, when speaking about the young researchers, we identified underlying assumptions that women naturally expected to balance STEM careers with family roles, thus requiring additional support to manage these dual responsibilities. Although we admit that we were asking about women, still such perspectives suggest that societal expectations for women remain a significant barrier to gender equality in STEM. As a consequence, the argument for dedicated support based on the perceived gender difference might further reinforce traditional gender distinctions rather than bridging them, despite good intentions. See the illustrating quotes in Annex 2.

4.4. Building confidence through empowering girls

Boosting girls' confidence was a key reason mentioned by a significant number of interviewees in advocating for dedicated support for girls pursuing STEM education. For instance, it was noted that girls often exhibit lower confidence levels in developing technical skills, particularly when compared to their male peers. Such psychological barriers which often root in societal expectations of gender roles highlight the necessity of targeted support to foster personal development and confidence-building. Moreover, hands-on activities and participation in competitive events and experiential learning were mentioned that enable girls to succeed in STEM environments. See the illustrating quotes in Annex 2.

4.5 Methodological renewal: innovative and gender-sensitive methodologies for supporting girls in STEM education

We have collected many responses that underscore the need for innovative, gender-sensitive approaches to foster greater engagement among girls in STEM education. When asked how young girls can be encouraged to pursue STEM and whether targeted support should be available, participants highlighted the importance of well-designed, inclusive methodologies. The ‘adequate methodology' was understood as a tool to support and encourage girls in STEM studies through a supportive environment. **Interviewees widely recognized the need for institutional change in STEM education, noting the critical role teachers play in either challenging or reinforcing existing gender biases. However, many respondents rather focused on out-of-school programs as**

effective solutions for reducing challenges girls face especially in mixed-group classrooms.

Interviewees pointed to several existing, effective methodologies believed to support girls in building STEM-related skills and confidence. These include experiential learning, extracurricular programs, hands-on workshops, coding camps, competitions, and project-based learning approaches. The integration of creativity-driven, hands-on, and collaborative learning techniques also seemed essential. Moreover, a prominent recommendation was to revise primary and secondary education curricula to better reflect girls' interests and unique learning and problem-solving approaches. The integration of collaborative methods was viewed as particularly effective in establishing a supportive and inclusive learning environment. Creativity was emphasised as a key element, where combining it with technical skills is seen as particularly beneficial for girls.

Out-of-class programs were also highlighted as inclusive strategies that create a welcoming environment with less social pressure and fewer gender stereotypes often found in traditional classroom settings. Customising programs to align with girls' interests, such as through design-oriented or societal impact projects, was another prevalent recommendation.

Two approaches were particularly emphasised as effective in encouraging girls toward tertiary STEM education and careers: (1) the significant influence of **role models**, especially when coupled with mentorship opportunities, and (2) **Girls' Day** events. These initiatives were viewed as especially effective in demonstrating to girls that they are capable of succeeding in STEM careers.

Divergent perspectives emerged regarding the creation of girls-only groups or competitions. Some experts advocated for such spaces, arguing they offer a nurturing environment that allows girls to develop confidence and technical skills without the competitive pressures of competing with boys, where boys may be perceived as more advanced in areas like maths and science. These answers clearly indicated that separate spaces can initially be beneficial for girls. Others, however, cautioned against gender-exclusive activities, suggesting that they may not fully prepare girls for the diverse dynamics of the real world. Nevertheless, there was consensus on the importance of addressing girls' specific needs through well-designed curricula and supportive teaching practices, whether in mixed or girls-only group settings. See the illustrating quotes in Annex 2.

4 Recommendations collected from expert interviews

This subchapter provides an analysis of responses given to the questions exploring how young girls should be encouraged to develop an interest in STEM fields and what recommendations are offered on effective interventions for increasing girls' interest in STEM?

The expert interviews highlighted a **multi-faceted approach to encouraging girls' participation in STEM**. **Key strategies include early skill development, gender-sensitive teacher training, hands-on and creative learning methodologies, exposure to female role models, financial support, and dedicated programs for girls.** Equally important is the need to involve parents, teachers, and the community to create a supportive environment that fosters gender inclusivity in STEM. The identified collection of recommendations implicate that systematic, institutional-based efforts that include tailored interventions, inclusive policies, and practical learning opportunities are essential for building a more diverse and inclusive future in STEM education and careers. The recommendations identified from the expert interviews can be grouped into 7 distinct subgroups:

1. Skill Development

A key theme across interviews was the importance of developing specific skills that boost girls' confidence and interest in STEM fields. Problem-solving, research skills, and leadership were identified as critical areas for fostering a strong foundation in STEM for girls.

2. Need for teacher training

Another prevalent theme was the crucial role that teachers play in shaping girls' attitudes towards STEM. Many of the respondents strengthened that teachers often unknowingly reinforce gender stereotypes, which can deter girls from pursuing STEM careers.

3. Methodology: Creative and Hands-On Learning

A recurring suggestion across countries was the need for innovative and hands-on learning methodologies that make STEM subjects more accessible and enjoyable for girls. The interviewees also emphasised the importance of ensuring that programs and events aimed (not only) at girls are not only informative but also entertaining. This point was particularly stressed in relation to the education of younger age groups, with several respondents arguing that at this stage, it is sufficient to spark interest in STEM fields, and

learning theories and formulas can come at a later time. The integration of real-world applications into STEM curricula was another strategy highlighted for making the subjects more appealing to girls.

4. The significant role of Role Models

Interviewees stressed the significance of role models in motivating girls to pursue STEM careers, as they argued, the access to female STEM professionals helps girls envision themselves in these fields.

5. Financial Support

Financial barriers were noted as a significant factor in limiting girls' access to STEM education, especially for those from disadvantaged backgrounds. Offering free or subsidised programs could dramatically increase participation rates and provide critical 6. Dedicated Support for Girls in STEM

6. Gender-sensitive methodologies

There was consensus among many interviewees on the importance of providing dedicated support for girls at both secondary and tertiary educational levels. Some respondents, however, cautioned against isolating girls through girls-only programmes, recommending instead gender-sensitive approaches that integrate boys as allies. The idea behind this type of argument is that by offering both dedicated spaces and inclusive environments, girls are encouraged to thrive in STEM without feeling isolated from their peers.

7. Community and Parental Engagement - creating a supportive environment

Engaging communities and parents was identified as a powerful tool in sustaining girls' interest in STEM. Community programs and family involvement were seen as essential in breaking down societal barriers.

VII. Policy recommendations

Based on our research effort we formulate the following policy recommendations:

1) Integration of STEM education early in primary education to build the interest of both girls and boys towards STEM.
2) Redesigning curriculum in primary and secondary education with gender-sensitive methodologies and a focus on real-world problem application, experiential learning and themes resonating with girls' interests.
3) Providing Teachers Training for educators to recognize and challenge gender stereotypes, learn gender-sensitive teaching methodologies, inclusive curriculum development, and bias-free classroom practices (e.g. Implicit bias training). Facilitate networks that enable educators to share best practices and resources across regions, supporting gender-inclusive approaches in STEAM education.
4) Establish mentoring programmes and involve role models to connect young women in STEAM education with professionals.
5) Advocate for policies that promote equal access to resources, leadership opportunities, and a supportive learning environment for girls in STEM.
6) Institutions and employers should adopt policies that support work-life balance, such as parental leave and flexible schedules, making STEM careers more accessible for women with family responsibilities.
7) Provide scholarships specifically for female students pursuing STEM degrees, with a focus on girls from disadvantaged backgrounds.
8) Mentoring and networking opportunities for university students, to enhance their sense of belonging and self-efficacy in STEM education and professions;
9) For exposure to role models: a) in formal education settings: Gender mainstreaming in STEM textbooks across educational levels, to expose both girls and boys to diverse role models; b) in non-formal education settings: Fostering school collaborations with STEM organisations, science museums and institutes, for visits in which students get to interact with or shadow female role models.

ANNEX 1

Stereotypical beliefs and expectation on performance, subject choice, career choice / Primary and Secondary education	
Girls need to try harder / girls are undervalued	HU10, ES8, SRB2, MKD2, UA4
"So, back in my time, when I was a university student, which was ages ago, there was a female associate professor in one of the departments who specifically said, "Girls, you need to try harder, because for you..." And she emphasised that we need this support because of the environment. It surprised us at the time, and I don't even remember anything else, just this one... She taught biochemistry, and it felt strange because no one had told us this before, but she put it this way. Later on, I realised... as a university student, you don't think about it because you're writing a thesis, and the boy sitting next to you might want to cheat you, so you don't feel this boy-girl difference, and it surprised me that this teacher pointed it out. Then I realised she was right. Later, as a vice-dean, and now in the doctoral school, there are countless opportunities to have personal conversations with young people, and I also consciously try to offer support if someone doubts their ability to pursue a doctorate. I tell them they are capable of it. "HU10 "I provide a personal example that I always had to work much harder than men in the IT field to demonstrate and prove my expertise, both in STEM education and in the IT industry."SRB2 "I don't know if it's a question of them thinking that.... Well, they might not be good enough to study a certain career, because that's what they say."ES8 " For instance, while we see an increasing number of female students in informatics, they often face scepticism about their abilities from peers and sometimes even from family members."MKD2 "And, in fact, despite the fact that we have a larger number of girls, in my personal opinion, probably some, I cannot say that it is easier to study, but men have good success, perhaps due to the nature of some things, that women are more emotional, men have a more analytical mind, and chemistry requires such an analytical mind."UA4	
Stereotypical beliefs on what subject are for girls and boys	HU7, BG5, IT4, SRB1
"My son also went to physics school, where the boys were the majority. So I think somewhere here the girls are losing here. The belief that he can be good. We can be better at this, or we can be just as good at it. " HU7 "Nem tudom, nem érzékeltem sosem, hogy például küldjenek egy lányt mondjuk elektromérnöki szakra. Tehát, hogy ez úgy nem hallod gyakran. Tehát nagyon sokszor én tapasztaltam, amíg én ugye vegyészmérnökit végeztem, hogy azért megkaptam én is, hogy minek kellett a mérnökire menni, nem volt jó a sima kémia?"RO2LIC "There are societal stereotypes about education in the STEAM environment. Historically, girls have tended to choose humanities specialties and subjects, while boys have gravitated towards technical subjects. I believe that at this stage, this stereotype cannot be changed. The reason for this is the different ways boys and girls think." BG5 "Culturally, however, both mathematics and physics are always seen as something where it is more normal for boys to be good than girls. However, I have to tell the truth, with my students, in my experience, I have always had students who were good or poor or interested or disinterested for personal reasons....I didn't feel like there was a lot of cultural pressure for them not to study these subjects. As far as choosing university is concerned,	

yes, I believe that culturally the difficulty for girls in choosing an especially very technical subject, i.e. engineering, this stuff here, is now a little greater.... Yes, perhaps there is still a bit of a difference, but instead there are still paths that are culturally male, as I gave the example of information technology. Computer science is seen as a male subject. This is stupid, because until the 1960s, IT was something for women and that's it."IT4 "First and foremost, girls face stereotypes and prejudices that STEM is a male-dominated field."SRB1	
Stereotypical beliefs on what profession are for girls and boys/stereotypical environment	ES5,6,7, BG7,8 PL1,7
"Although it is changing, because there are more and more women, there are male-dominated careers. Let's take a case of civil engineering. Here it was the old civil engineering. It is a male-dominated career. So, the teaching profession is also dominated. So, there is an undervaluing of women."..."In other words, they have pursued STEM careers in very different fields and in different countries. However, the problems are the same. In medicine, girls are told which speciality they are going to follow. Specialities such as surgery are never recommended to them. For example, from the moment they start. In other words, they are going to dedicate themselves to activities or areas within medicine that are more compatible with a schedule, and they tell them a schedule that is familiar. I mean, what does that mean? Well, that they can't work in trauma, or emergency medicine, or surgery. Because they consider that it is incompatible with the role assigned to women, which is to be the mother of a family. So, from the very beginning, this leads you not to do it. And the same thing happens in engineering. That is to say, you are not capable of being on a construction site."ES6 "But apart from that, if we go to school and we find old visions of, no, the doctor has to be a man, the nurse has to be a woman, to give an example, which is one of the most common in the world of human care. Or, for example, teachers who do not encourage girls, and this can be seen at school, who do not encourage girls to develop these scientific-technological vocations."ES5 "We have looked at it many times and in the end it seems to us that it is a cultural problem, that's all. That is to say, when we ask the secondary schools to send us visits to the students to see if they like or dislike vocational training, they send us the boys directly. They tell us no, that they ask, so as they ask, the girls don't want to come, so why are they going to bring them?"ES7 "Or like some company asks me for a person to work and says, well, I offer them the names of some girl. They tell me, man, she has to get on a very big truck. Well, but it will have stairs like the others. I don't know, or she has to jump and the others have ladders, I don't know. She can get on the truck. But in people's heads it's, how are we going to get her on a truck to do a measurement. It wasn't a job either, I had to measure up. The fear of if she falls, and if that girl falls off the truck. It's not a worker like everyone else, no, it's a girl who falls off a lorry."ES7 "I don't know to what extent I can answer this question specifically because I don't think there are obstacles for girls to pursue STEAM in school. Regarding stereotypes and perceptions, they are only those that limit them within the school time, making them feel uncomfortable working in this field."BG7 "So, what happens is that when you have an environment that supports certain behaviours, it is naturally easier to orient yourself in a given direction. I think that for girls, there is a smaller environment. It is harder to find enough girls who share this interest, work in this field, and can collaborate in this direction. It's not impossible, just less common. Subsequently, the support they receive often includes hearing that certain professions are not for girls. "This isn't the field for you to develop in, it's better to study at a particular school," or "Study economics." Yes, I study economics. Or "Study languages, because	

that's more suitable for girls.""BG8 “That is a real problem regarding to education, but many families I must say in Croatia, let's say are old fashioned and it's not normal, let's say for a girl to be an engineer or to be electrician, or to be a tile placer, or to work in a factory with automation. It's more likely expected for them to be lawyers, doctors, or some sort of that field that's already established, let's say, a good gender equality.”CRO2 “I think it can already be related to school education. It's true that we don't deal with it in our studies, but it is known that it is already the earliest stage of education, even before high school [where obstacles appear], because even girls who participate in these various projects, e.g. with the Perspektywy Foundation, say that polytechnic [technical university], first of all, was not their first choice, e.g. IT, that they were wondering about different fields of study, they said at some point that maybe IT, but even at the beginning they themselves felt that they had some lack of knowledge or skills. And they themselves said that maybe it was because the boys started programming earlier, boys knew IT was for them, boys didn't even have such thoughts at all, whether they were suitable for it or not, because they knew they were suitable.”PL1 “I think these are such obstacles associated with the fact that someone will tell them that it is not for them. This is one thing. Generally, we [women] tend to meet other people's expectations, to behave according to these expectations. If someone who is important to me tells me that it is not for me, I really start to believe it. However, it is still based on authorities, although we are talking about the fact that these are important people. So these are social norms that we want to fulfil. If someone tells me that I am rude and keeps repeating to me how rude I am, how disobedient I am, how I don't listen to them, it results from the theory of labelling. This person starts to behave like an indecent child. Because everyone tells me that I am rude, so I will behave to meet these expectations. And this is how it drives. So here, both boys and girls receive such a message that humanistic subjects and humanistic profiles are for girls, and mathematical and physical profiles are for boys. This biology is somewhere in the middle.”PL7	
Secondary School Teacher's stereotypical thinking on girls’ different/less capability and interest in STEM subjects	SI1, ES6, IS4, BG4, MKD3,4, UA3,4
“I would like to emphasise this right from the start, that I am often upset when the organisers of the trip bring groups to us and they say, "yes, our population is more or less girls.... explain to us some such topics that are more for girls." I mean, I don't know. That bothers me. I believe that we are offering such topics that the presenter can make it interesting for everyone. Of course, it is also up to the teachers to motivate that group, to prepare them well before they come to visit us. That they even know what they're looking at. So yes, a lot of times we encounter some kind of suggested differentiation... that the boys are more interested in road vehicles, because this is our largest collection, and let's present to the girls something as a textile collection. To me .... that seems to be.. nonsense. We also always emphasise, when schools choose workshops, that these workshops are suitable for everyone, including vulnerable groups. Because we also have, for example, a weaving workshop that is related to the textile collection, and then they often say "let's have this workshop, because there are more girls in our class".SI1 “I think it's the social norms. Basically from classmates and teachers. In other words, if you managed to overcome the handicap of your family, who can tell you why you are going to study that? And you've got in, the problem is going to be your classmates or the teaching staff themselves.” ES6 “It's usually gender stereotypes that obviously play a role, but I don't think that they realised it that much.” SK1 “Of course, in STEM majors, the studying is much more systematic, much more time consuming, and that largely prevents female students from graduating successfully.”BG4 “In secondary school, they might encounter a lack of encouragement from teachers or	

peers who believe that STEM is more suitable for boys.”MKD3
“We also need to be honest about biases and expectations that some teachers might have, this is not so strange, especially if we take into account once again the traditional norms. Teachers may consciously or unconsciously hold biases that favour boys in STEM subjects, influencing their expectations and interactions with students. Thus, girls may receive less encouragement and support from educators to pursue STEM subjects. But not only in primary or secondary education, gender biases are present in higher education and employment as well. There are examples of women facing gender bias and discrimination, leading to fewer opportunities and career advancement.”MKD4
“It depends on the school, on the teachers, on the teachers. Likewise, these thoughts that females should study the humanities. Females take care of the family and do not need to study.”UA1
“. I faced that when I was studying at the university, and now, perhaps, there are such people among the teachers who are biassed towards female students. These are rare cases when it is believed that female students cannot be engineers.”UA3
“Here, probably, the general trend is that when teenagers who are deciding where to go to study hear the word "chemistry", the next thing that follows is that chemistry is difficult. For some reason, we have such a wrong association with the subject of chemistry, since when, apparently, that stereotype should be broken, starting from high school. And part of the girls, probably due to their natural, I don't want to say the weaker sex, but somewhere more susceptible to some such stereotypes, then, probably, partly scares them off.”UA4

Stereotypes/social and cultural factors mentioned in general	BG8 MKD3,4, UA4, IT1,2,3, PL1,2

“They're persistent, they're dedicated, they're disciplined, but it's still important to emphasise that the differences in success, the differences in interest in STEM sciences are not so much due to differences in the potential of individuals, but rather are due to the influence of different social factors, different cultural factors, different stereotypes that have been embedded in us as a nation going back in time and historically.BG8
“Girls face several obstacles when they are entering in tertiary education in STEM fields, which includes societal expectations and stereotypes.”MKD3
“Media and family expectations can also discourage girls from pursuing these fields.”MKD3
“I would say that obstacles related to secondary or tertiary education are more or less the same, and these challenges are rooted in cultural, educational, and institutional barriers. When we talk about cultural and societal norms, the main problem is the persistent gender stereotypes. Traditional gender roles and societal expectations often discourage girls from pursuing STEM fields, which are perceived as male-dominated.”MKD4
“Well, I guess that's society after all now. There is a lot going on, information is coming from society, and the female students probably see what is possible, they are looking for an easier way. Because there are a lot of bloggers who promote an easier way. It seems to them that blogging is enough to earn money. And build a career on this, and earn money that way. I think it's a bit of a misconception, but it has an effect on them, basically. A lot of advertising goes the same way, different ones that allow female students to draw false conclusions about what they can build their life career on. I think that has a big impact too.”UA3
“No, not objective, cultural, I think it's a little different now honestly, but for this reason you should ask this question more to those who deal with the university enrollment office, because they have the statistical data at hand from year to year. year, for years and years and years, so you can see how the trend changes.”IT1
“I always say this, in fact, since we have civic education hours that we must also do within the science curriculum, among the various topics I also address gender equality in science, among other things I also cite some examples, such as the famous one of Rosalind Franklin,

for example, who was discriminated against, who had a fundamental contribution to the discovery of DNA, but was discriminated against by Watson and Crick, and so on, many other examples could be made. So the situation, the perception that the situation is improving, but we are still far from actual parity and this applies more to applied sciences than to basic sciences."IT2
"So, I believe these stereotypes persist because we women are expected to take care of the family and the house. Even if we study STEM disciplines, we often end up in jobs that allow more free time, such as teaching. I'm not saying being a secretary, as that might not leave much free time, but less demanding jobs.IT3"
"So if these girls in computer studies will even hear certain opinions in the corridors, such a stereotypical male work environment - it can discourage them very quickly."PL1
"On the other hand, I can't say anything about some tiny centres [villages/small cities], where perhaps these stereotypes work more. If a little girl can already think that she is not suitable for mathematics, that she should rather do other things, this influences her choices from the beginning."PL2
"Because even in the media, although young people use these media differently now, there are not many messages that if there is an expert, it is the female expert. Of course, there are some ladies, but they are experts of education, they are from the health field, they often speak, but it will be e.g. a family doctor. When it comes to an expert on vaccinations or a surgeon, it will be a man."PL7

Challenges related to the secondary education (quality of education)	
Lack of sufficient/quality education (STEM-related education)	SK1, BG4, PL7

"So based on our research, it was obvious that it is either lack of technical confidence or lack of technical skills from the school because the level of informatics taught at schools really differs. Somewhere they learn programming. Somewhere during informatics they play with Excel and the internet. And that's not really encouraging that to apply for STEM."SK1
"For example, for secondary school, for the majors that are related to computer science, I can say that not studying computer science in secondary school at all as a compulsory subject is a problem. Informatics is studied only in profiled training and in vocational training in the profiles of software and hardware sciences, as well as in professions related to computer science. All other students completing their secondary education may never have encountered any form of programming."BG4
"When we talk about educational barriers, we need to acknowledge that not everywhere and not always we can provide access to quality education. In some regions of the country, girls have limited access to quality education, particularly in rural areas. And not many of them can afford to study in another region, despite their talents or aspirations. In some cases, schools may lack resources and facilities to provide comprehensive STEM education."MKD4
"A few years ago I was doing an analysis of school textbooks. It was in terms of disability, but it shows a review of how diversity is treated in textbooks. And sometimes it is basically checklists. Ticking off. Here we have on the front page a black person, Asian, a girl in a wheelchair and someone signed in Ukrainian. That we also have a Ukrainian. It's not so natural. And it ends on the front page, that everyone is different and everyone is equal. And then there are no more of them. It is ticked off. We have a topic of diversity. And it looks like that in many textbooks. And I think it also looks like that in the messages that children receive. That the father is doing a serious job and the mother is taking care of the house. We have it very much imprinted [in the heads]. For many years it was like that."PL7
"They probably do meet some obstacles. The first obstacle is probably that we don't

introduce it early enough, that if you want to be specific, something that needs a higher education on a certain level, an individual at an early age maybe doesn't know that they want to be there or the interest path takes them somewhere else. So the first obstacle might be that they graduated from the upper secondary school with a certain degree which, let's say engineering for example, doesn't say that it meets their criteria. So that they need to do an add-on like something in between the maths, extra, like maths or science knowledge that you didn't take in the path of the secondary school. So that would be the first obstacle." IS2	
Lack of information on STEM professions	SK1
", then it was a lack of information where they can study and what exactly they can study because they also had some biases about what work in ICT or STEM looks like. And after studying, they also had a lack of information about working in STEM, what it means, what roles can I have?" Sk1 "There are many specialties that are currently unknown to us as options for applying to universities and later for professional realisation."BG8	
Lack of role models for girls	SK1, IS4,5 MKD3,4 PL1, PL7
"And another obstacle they had was the lack of female role models in their environment that would encourage them to think about studies in STEM." SK1 "...fewer role models in rural areas."IS4 "lack of female role models in the field of STEM."IS5 " However, challenges remain, such as societal stereotypes and a lack of female role models in STEAM professions."MKD3 "Next, there are fewer female role models in STEM fields, I mean the visibility of successful women in STEM is limited, reducing the motivation for girls to aspire to similar careers."MKD4 "Well, the problem is also that there are not many women who teach in these fields of study, so the lack of these role models can also be significant."PL1 "So here, both boys and girls receive such a message that humanistic subjects and humanistic profiles are for girls, and mathematical and physical profiles are for boys. This biology is somewhere in the middle. So everyone is pushing it, because it is a beaten path, some norms, schemes, stereotypes. And if we don't have any counter-examples, such role models, that someone will come and say, look, I am a woman, and I just built a bridge, or designed a bridge, and look, I did it like this. If there is no such person, it seems to be a strong abstraction and just something impossible."PL7	
Lack of extracurricular education	BG4
"Also, graduating students in small towns also avoid these STEAM majors because during their studies they did not have access to enough extracurricular forms, to study in different schools, to participate in different interest clubs and competitions, as there are not enough facilities for this in small towns. Therefore, I think that girls graduating from secondary schools in such settlements logically prefer to continue their studies in some humanities or pedagogical profiles."BG4	
Lack of support from teachers	BG8, MKD3,4
"Girls may face regular obstacles in school by not getting enough support, not being guided by their teachers."BG8 "In secondary school, they might encounter a lack of encouragement from teachers or	

peers who believe that STEM is more suitable for boys. Additionally, the process of applying to tertiary institutions can be daunting without proper guidance and support."MKD3 "We also need to be honest about biases and expectations that some teachers might have, this is not so strange, especially if we take into account once again the traditional norms. Teachers may consciously or unconsciously hold biases that favour boys in STEM subjects, influencing their expectations and interactions with students. Thus, girls may receive less encouragement and support from educators to pursue STEM subjects. But not only in primary or secondary education, gender biases are present in higher education and employment as well. There are examples of women facing gender bias and discrimination, leading to fewer opportunities and career advancement."MKD4

Lack of financial resources	BG8 MKD4, UA7, IT1
"They may also have limited resources when preparing for university exams."BG8 "When we talk about educational barriers, we need to acknowledge that not everywhere and not always we can provide access to quality education. In some regions of the country, girls have limited access to quality education, particularly in rural areas. And not many of them can afford to study in another region, despite their talents or aspirations. In some cases, schools may lack resources and facilities to provide comprehensive STEM education. .... There are really many different obstacles. We've seen cases where economic constraints prevent girls from entering STEM programmes. Families with limited financial resources prioritise boys' education over girls', especially in higher-cost STEM programmes. These economic pressures can lead girls to choose fields perceived as more accessible and flexible rather than STEM careers. MKD4 "Perhaps the obstacle for current students is tuition fees. I think that's a barrier for many, right now, for our students. It is the tuition fee where they want to study, perhaps this fee is an obstacle for them. Because they choose, not everyone can go to public education, and not everyone can pay for this education. Because it is four years, and one must understand that not everyone can afford to pay for education for four years."UA7 " In my opinion, once again, apart from the socio-economic issues, which have increased with that poverty rate, let's face it, so many families don't feel like putting their children through university. The majority of my colleagues' children did their undergraduate studies in Palermo and their specialist studies outside, and it takes money to support a child to go to university outside, including high rent costs."IT1	

Work-life balances and maternity / Early Career Researchers & Young professionals	
In general, difficulties of balancing work and life/children	HU6,10, RO2, SI3, MKD4
"Secondly, whether it won't be too difficult for me as a young woman throughout my life if I go into such a field, how will I reconcile this with family life. Now, I... until one is a university student, I remember not dealing with this or at least not much. But after graduation, deciding on a field that allows reconciling private life and children with the profession requires encouragement. And somehow, I have the impression that I was relatively fortunate during my youth and when starting a family. There was quite a bit of support. Although, of course, there were comments like, "Oh, she wasn't here because she was on maternity leave," but now it's even a bit worse. Talking to young people, because it's no longer my problem, about school, dealing with homework at home. The problems presented by the family are bigger than before. ... So, a woman who is a beginner in a STEM field with a fresh degree	

and two kids at home, facing increasing difficulties with kindergarten and school, will think thrice about pursuing a career." ... "And this significantly affects every woman's life, now specifically those with STEM degrees. They might say, "Thanks, I don't want a promotion," despite having graduated from the Technical University, or a physics program, or any STEM field, they then try to meet all expectations. Since one area requires a lot of effort, or more than before, it takes a toll on the other area, especially for young people." HU10 "Not to mention the problem of balancing family and career that can be particularly challenging in demanding STEM fields. We have rather limited support system for working mothers in general, such as childcare facilities and flexible working arrangements, and this is particularly relevant not only for choosing working career, but also for women's progress in STEM careers."MKD4	
Becoming a mother / the timing of becoming a mother	HU 3, 5,6,10, CR2 RO3, RO2LIC, ES8, BG8
"At this point, the only factor that might play a role for a workplace leader when hiring for a position is whether or not the candidate might have children. This cannot be eliminated. It's an eternal part of the equation. However, based on their knowledge, an industrial leader won't have a heart attack if a woman... Even among my classmates, there were women in serious positions."..."The parameter of when they might have children remains, of course. I had a classmate whose wife was an architect, and they had three children. When an architectural engineering position was advertised, and they found out she had three kids, they said, unfortunately, they couldn't hire her. So, this bold classmate of mine went to an interview, learned all about his wife's professional achievements, and when asked what he had done, he explained this and that, in this field and that field, this was my work, that was my work. They said, "Great," but then he said, "I'm not the one coming, it's my wife," and they couldn't say no because of the three kids."HU10 "The other is that obviously for many women it is about starting a family. Family is a very pivotal point in their lives, in their careers. And obviously, in the case of showy stories in the lab, especially if it is related to, say, physiological biological research, where we often have to adapt to external things in, say, animal husbandry or laboratory experiment or crop production. So you can't say, oh saturday or oh Sunday or there's a holiday coming, but if it's something new, you have to go and do it. So biological research requires more flexibility and more leisure time sacrifice in this regard."HU6 "I think what we probably haven't talked about so much is how starting a family affects your career path? And I think this [...] we have it at the university. And that beyond that, let's say, one gets into a good research group in a good department, where the supportive atmosphere is very positive, so institutional guarantees are not so much."HU5 "I defended my PHD in (year) and started working as a young researcher in (Year), met my husband and started applying. I had so many references, so many publications or whatever that you can kick the ball around and I could, say, win a young researcher grant and I was at home with my first little boy when I did, because I was applying in between. What was going to happen when I wanted to come back, where I'm going to go and what I'm going to start from, and I won an (grant) and a (grant) because my parameters were really good, and there was a big situation where I either come back to work or I lose the grant, and I had my second child, I think, who was one and a half years old, and. ... I didn't know what else to do but put her in a private daycare. And it was a big trauma for me, it was a trauma for the child."HU3 "But it seems that for women it is more difficult to maintain than for men, that is, if they want to have children before the age of 35 there is no guarantee that in 10 years of hard work they will have a fairly stable job, with a fairly good work-life balance, so this might alienate some of the female students."RO3 "There comes a time when, if you are doing research, it's almost as if you have to choose between your family and your career, or if it is very difficult depending on your	

circumstances. But I think there comes a point when you are almost forced to choose, because of course, for example, if a woman decides to become a mother and you finish your degree, then maybe you can't dedicate yourself to research because research is very demanding and above all that, and then maybe if you have to go abroad and have a family, well, maybe....”ES8 “It is very common in a job interview for girls to be asked how old she is, if she has a boyfriend, if she has a husband and if she is planning a pregnancy. These job discouragements also hinder women's future fulfilment in STEAM professions.”BG8 “The main obstacle here, I think, is the biological obstacle which we already discussed earlier. That's when let's say, students want to start the family or something, basically you cannot study or do work when you're pregnant in a higher stage of pregnancy, and after birth there's also a period that women have to stay with the child in Croatia.”CR2 “It probably depends on the personality of the girls. First of all, girls, they can get married, it can be a hindrance for them in their further studies.”UA7	
Dropping out of academic career after having children	HU13, HU11, IT4, PL3,6,7
“I returned from maternity leave in 2016, and I saw that women tend to drop out when they have to choose between children, research, and their careers.” HU11 “I'm very happy about this and I wouldn't want anything else, but in the country where women and basically families are largely saddened by the fact that women give up their careers, unfortunately it's a terrible thing, but it's the way it is. Obviously I could do anything to change this, but this is how we work. Even giving opportunities, in Sicily this year the statistics say that 50% of women who have had a child have abandoned work.” IT4 “One of my doctoral students is going to defend her thesis now and I want to hire her and I have to announce a competition. And she asks me what will happen if she gets pregnant in the trial period which lasts one year. In my opinion, nothing should happen. She will just give birth to a child and she will come back when she wants to. But if it really happens like that, I am afraid that it can be different. She told me then that at her current job she knows that she might come back to work after pregnancy and she will have a job. On the other hand, she wants to go to work at Technical University even though the salary is less because she thinks it is a challenge and she does not want to sit in papers and she wants to be in contact with young people. This job attracts her but there are no guarantees that she can get pregnant in the trial period. So I cannot persuade her.”PL3 “The question is at what legal level it will be. You also need to think about things like parenthood. Because here we have a break in the case of these girls who decide to have children and if they decide then they will simply lose the continuity of work. For example, I try to exchange the programming equipment for computers, for programming for PCs every three years. If it changes for me, the question is does it change in the workplaces as well. And the technology goes forward so quickly. And if we have an annual maternity leave and then an annual pregnancy leave (some women do it during pregnancy because of health reasons). They can't be at work anymore, they have two years out of work, then the question is if they are able to come back.”PL6 “I think that it's a matter of biology. We often think that I will do a doctorate and then start a family. In my case, during my doctorate, I already had one child, then I defended my doctoral thesis being pregnant with the second one. And in fact, you fall out of this circulation a bit. Especially now, when these scientific publications are so important. And it's hard to catch up with it. And they often give up their further scientific career.“PL7 “So something else is probably important at some stage. It's my assumption that it's a matter of satisfaction from this work, the conditions of this work. Theoretically, this work at the Academy is so flexible. Because, of course, it is flexible in the sense that there are fixed hours of classes/lectures, for example, or some meetings. The rest can be done whenever you want. And this “whenever you want” is a bit complicated from the perspective of how to have a family. Because it's not “whenever you want” anymore. And not always the hours at	

the university are in line with the hours of opening of the facilities [children care]. So in my case, leaving the Academy was caused by that.”PL7	
Maternity leave is not accounted in applications, research evaluation	HU6,11, SI2
“Then, obviously, those who have children interrupt their studies. There, completing studies is always a question of how to help. There are those who do not finish, there are those who do not come back, or their return refuses precisely because this kind of commitment and sacrificing this kind of working time or free time with children is no longer possible. A big problem is when they come back after 1-2-3 years. If there are more children, then even later that there is a gap in their CV, so there are no publications, no conferences, no details, no performance, but in this case they always get the impression that there is equality, then from day 1 you will be subject to the same condition as anyone else, and this is difficult to handle. Then we see that on paper there are flexible forms of employment, but somehow this does not pass in education.”HU6 “We have certain rules, let's say the rules for titles appointments and advancements, specifically. We have these five-year periods, where you are, for example, an assistant professor. And then after 5 years you have to reapply either for the same title or for a higher title, depending on what your bibliography is. And here's one thing, that's in the system. If a woman goes on maternity leave for one year, then this period is extended by one year. Of course, we both understand that this is, in fact, just too little. Because.... Because one year, to have a child who is aged from zero to one year old.... It is very difficult to do anything. But at least there's something in the system that helps. But it's true, that probably it’s not enough... It doesn't help enough. At least there is something. Even in the case of doctoral work, for example. Those who work as a young researcher have 4 years to complete their PhD. And even in this case, it is extended for an additional year. Or more, if there were several children..... Yes.... Otherwise, of course.... Yes..... It's probably still not enough, in its own way. If you think about it.” SI2	
Lower capacity to perform academic job during and after maternity leave	HU11
“then we showed that they can write fewer articles under the GYES, this is clear and this needs to be explained.”....”, I'm not sure if I'm right, but I understand that the Czechs had 4 years of GYES, and we had three, and how could it be related to that, that it really is that many people drop out there, because after that, there is no support for the return, that this is my losing partner, so that those who still want to stay on the field, when they return, to become independent, to form an independent group, would need support at work, but there are none. You have to fight in the same way, with the same men. Good, now we have reached GYES, that GYES is counted, but this is approx. it's not even fairness, it's a maximum equality level, or I don't know if we'll bring women up a bit, but they won't be able to compete with men because, as we've shown, they publish fewer articles under the GYES, and therefore have a lower number of citations in the for women than for men, because the articles they did not write between the ages of 30 and 40, during the GYES, are not logically cited, while men who published continuously will have higher citations, and then this is a science metric , and everywhere else in competitions, it is a disadvantage for women, so it is more difficult for them to win tenders. “HU11	
Balancing work and life / more burden on women in child care	HU11, HU10, ES6, IT1, PI2
“So, if someone has all the housework and child-rearing there, it's only on them because they have such a spouse, it will be difficult for them to be successful there.” HU11	

“If you go to the emergency room, in the emergency room you see the mother with the children, it's difficult to see the father with the child. If you see the father, you see the father and the mother, but you don't see the father alone. That means that in the end it is still mostly the woman who is in charge. When there is an illness, or the same when you go to schools, few fathers go to the parents' meetings, they are basically mothers.”ES6 “There were important changes, for example, as a result of COVID and the type of jobs. It is true that in some cases, for example, we have found that, undoubtedly, as the ones who stayed at home for the most part, it is still the women who take care of them.”ES5 “Given how our society is structured, if a woman then decides to have a child, let's be clear, it's not the man who helps her, it's her who has to take care of the situation. It's a sad thing to say, but we really look at it as it is. So if in software development companies, I'll give an idiotic example, there was the possibility, as there is in some American software development companies, of having a nursery in the same company, women would have no reason not to do that job. That is, we are always there. If the main parental care is always assigned to the woman and women do not have any kind of support, when a developer sits at nine in front of the computer and gets up at eight in the evening or six in the evening from the computer, how can he manage a son? Except that in my opinion this isn't life, but that's another matter. For a woman who wants to have children and to whom every parental care task is delegated, it is clear that that type of work is no longer congenial. Then I don't know if there is some sort of preconception in companies against women developers or engineers. I can't tell you this.”IT1 “We talked about it and there is definitely one [obstacle] when it comes to the further doctorate career, i.e. obtaining further scientific degrees. Namely, at least here, in these strict sciences, and especially in physics, actually, if you want to continue your career, even after getting a doctorate, it is actually necessary to go abroad for a postdoc. Well, for two years, most often, you have to go. And this is where the stairs begin at this point, because if by that time, the woman has already managed to start a family, then it is very difficult for her to do something like that, right? Well, if she wants to leave for two years, and she has children, for example, she would have to leave, well, she does not want to leave children to go somewhere in Europe, so I usually imagine, probably a husband would not be willing either. Therefore, she would have to leave with children. Well, and with her husband. These are quite exceptional situations in which the husband resigns from what he does, if he works and decides to accompany his wife in such a stay, longer stay abroad as a companion.”PL2	
Career slow done due to family responsibilities	HU7, HU11, RO5, BG4, UA4,5, IT2
“Partly in the case of women with small children, when I was at GYES, my male colleagues were ahead of me, an elderly male colleague of mine already had a leading position, he took the... I don't know, docent position, of which there is not an unlimited number, let's say in a department. So I don't see if there is a bias in advance surprises, but it is certain that women are left behind and this is sure to cause frustration.” HU11 “Then another problem is that if your child is sick, who takes care of him, because who is left out of the work process of making decisions, where companies have to be held, where progress must be made, so if everything here also has 2 sides to the coin, because I look at it from the point of view of employees, then I should not be judged because I gave birth to a child or even more.” HU7 “I and (female name) could have produced more if we hadn't had to do everything. And I think all my other friends I know like that might have gotten their doctorates sooner, or whatever. So it's not like she is stuck, nobody's stuck, it's just that she might have been able to get a little bit more out of it if she didn't have three kids to look after, I only had one.”RO5 “Something that is a problem to a certain extent for women who want to start a family, raise	

and educate children, which requires a lot of time that they cannot take away from their family to develop their own careers. This slows down to some extent the development and career progression of women in these fields, and this prevents them from being competitive in the labour market in these fields."BG4 "Also in terms of academic advancement, single motherhood or double motherhood, maternity leaves, all these hinder the academic advancement of a woman scholar. And that is also why women are habilitated later on and reach higher academic positions."BG4 "Well, to say that everyone has the same access to knowledge. Here, probably, again, when this component is included, that even when studying in the first, second, senior years, very often in our country, first of all, girls get married and try to combine family and education. And, of course, the question arises that it is difficult to do it at the same time. Some decide to take an academic leave and do not always return with it."UA4 "Well, also for the female students, these female educators that we had this year, also for some of them there was a family factor, that they are expected to create their own family, children sooner, and then they will think about whether they should continue their education, master's, postgraduate, or further. That is, for girls we see, if for boys it is clear that there can also be a family, but at the same time the career does not slow down its pace, then for girls, in my opinion, one of the points that must be taken into account is the creation family, child care, and this can slow down their career a bit, or, for example, they can give up something at certain stages."UA5 "So it partly depends on discrimination, but also on the fact that women are limited also by being mothers, and there is not always attention for mothers in our country, in the sense that very often women find themselves almost at a crossroads between being mothers and continuing their careers."IT2 "And then, when we move on, we know that if they decide, for example, for a scientific career in this area, they encounter some natural obstacles, i.e. the stage of establishing a family and then it is also such a moment when they can fall back."PL1

Persisting (positive)sexism, gender bias, stereotypes against women in academia (sexual harassment cases)	
Underestimating women students' technical abilities or knowledge	HU12,13, LT3, PL1
"Now there was one, obviously this is a secret matter, but I had an ethics case where we convicted the colleague, he no longer works for us. He told the colleagues, the female students, that he had brought them a rivet, that the boys would draw, and that they should look at the rivet, because they must be girls and don't understand it." HU 13 "And the other thing is that there is still this perception that STEAM fields, the study of them, is difficult, that, say, social sciences, humanities are easier, but the exact sciences are harder."LT3 "This is a very delicate topic. I remember the campaign "Girls at the Polytechnics [technical university]" a few years ago, when the rector of the Technical University of Warsaw encouraged in an interview I read, he encouraged these girls to come to the STEAM fields of study [saying] that: it is not so difficult and they will manage so we encourage them, but we know that they are not so great, but it is not so difficult, they will manage..."PI1 "There is a prejudice that women in STEM education have less knowledge than men."SRB2 "We aim to combat the stereotype that this field is only for boys. In my view, this misconception partly stems from the belief that boys are better at computer games, which translates into the perception that they are also better at informatics." HU 12	

Sexual harassment	HU11, RO5, PL1
“So there are sexist comments, I don't know what it's called... sexual harassment, so that this kind of thing happens though... Or that such comments are also a value, or they could have hit the students because of it, or it was covert or not so much covered, but there is such a thing.” HU11 Sexual harassment by peer RO5 “It is interesting that they all did not say that... They usually said that they did not feel discriminated against. But after they told such a loose story about their entire careers, there were a lot of such situations in which they were discriminated against. Whether lower wages, or even cases of sexual harassment, or such neglect by colleagues, for example, that they were placed in the role of invisible assistants who help in something, but then their contribution is not noticed. It was really very visible. Because then they were no longer looked at as young women by the prism of sexuality and that they are not good enough, because that's what these women in techno-science may know. Only when they were already of a certain age, they got a professor, they were already looked at by the prism of this high title. ”PL1	
Sexis comments/jokes	HU1, RO2, PL3
“There is no problem with welcoming them warmly in most faculties. However, occasionally I receive feedback from female students indicating that some outdated attitudes still persist. For example, there have been reports of certain instructors behaving rudely towards female students simply because they are female. These reports have come from faculties such as Electrical Engineering and Mechanical Engineering. Nevertheless, such instances are becoming increasingly rare.”....Among the comments, we have encountered instances where female students reported inappropriate remarks or jokes directed at them due to their gender.” “For example, there was an incident a few years ago where a teacher, known for inappropriate behaviour, began touching a female student during a major exam. The situation only stopped when nearby male students intervened. Despite this incident, no formal action was taken, and it remained unresolved.There are also cases where a colleague makes inappropriate sexual remarks, albeit in a supposedly humorous manner, such as referring to a student's sexual habits or body parts.....Often, feedback from female students indicates that male colleagues may not recognize that their comments are humiliating rather than humorous. For instance, a brilliant female mechatronics student cried to me because a teacher made a derogatory comment about her blonde hair, suggesting she would receive easier tasks because of it. Despite the student's excellence and the lack of laughter from her peers, she found the remark demeaning, and rightfully so, even though the teacher may have intended it as a joke.”HU1 “It may. Unfortunately, among the lecturers, there are individuals who can't behave, who can speak in a provocative or impolite way, and this is definitely a bad sign. It doesn't just concern the older men, who see a female student and immediately smile and start talking nonsense, but it also concerns young people, young male lecturers, who sometimes make inappropriate jokes.”PL3	
Different treatment	HU1, ES6, PL5
“ It is also noted that some students have complained about differential treatment of female students during exams. However, these occurrences are rare and becoming increasingly infrequent. It seems that such attitudes are dying out. As a female instructor, I have	

observed that complaints about negative experiences after a tough exam are becoming rarer, and positive experiences are more common.”HU1 “But you see a group in engineering, there are two girls and two boys, the ones doing the experiments are the two boys, and the ones who are acting as secretaries... The secretaries are the girls.” ES6 “The physics’ teacher we had in high school was very good. He was a very good physicist and a good teacher. I still respect him. But he was a chauvinist. He thought that girls would not learn physics. Therefore, when we entered the classroom, there was never a good morning or just a good morning. Only good morning, gentlemen. We were ignored in such a passive way. Until my friend didn't get to the second stage of the physics’ competition. Until I didn't start [to take part] in these competitions. Then it suddenly turned out that you can say good morning to the girls.”PL5

Using rhetoric devaluing girls/women researchers	“LT3, PI1
“I think there is probably less discrimination. Well, perhaps some men - I suspect so, not necessarily so, but my hunch is that perhaps and the slightly older generations have that, which is something that you have to deal with in society in general - I am not a girl anymore, I am over 30 years old, I am about to finish my PhD, I am a married woman, well, as an adult, and I often hear the reference 'girl'. Well, it's a diminutive, like it is true as in I'm not a boy, but that's it. ...I know someone [a woman] who is also married, who has already defended her thesis, and she was addressed as 'girl' at a rather formal scientific event. Well, a sort of belittling, basically. Because I don't know how PhD students, or PhDs for that matter, would react if we addressed them as ‘boy’. It would probably be reacted to in some negative way. And 'girl' is kind of all right. “LT3 “However, after the girls come to the studies, it seems to me that the very fact that in some fields of study there are only a few of them in groups, in groups where there are many, many men, well, it can also act somehow discouragingly at the beginning. They [girls] also say all the time that they actually sometimes hear various allusions or unfavourable comments during classes. And this is probably also a problem all the time.” PL1	

Sense of belonging	
Law self confidence	HU12, RO3 MKD3,4, UA5, PI1
“We often see how many women feel uncertain when they start a career in informatics, sometimes feeling slower than their male peers or relating to the field differently.” Hu12 “it seems to me that there are young men who receive recognition more easily than women with the same training, of the same age who may just not assume to sell herself as full of self-confidence.”RO3 “In my experience I would say that the girls often struggle with confidence issues at the secondary school, partly due to societal norms that suggest STEM subjects are more suited for boys. Media and family expectations can also discourage girls from pursuing these fields. For example, girls might hesitate to participate in competitions or advanced classes due to fear or failure or judgement.”MKD3 “And there is a psychological moment on the top of all these, that I guess is once again result of the societal expectations – due to societal messages and lack of encouragement, girls sometimes have lower confidence in their abilities in STEM subjects, and fear of failure can be more pronounced among girls in STEM, affecting their performance and persistence.”MKD4	

"Also, lately I understand that for some reason in school, especially girls, there are extremely large gaps in mathematics, maybe it is related to COVID-19, maybe it is related to the war. Actually, with mathematics. We understand that STEAM is, one of the points of STEAM, and maybe the girls somewhere due to misunderstanding, due to the loss of some skills, knowledge, during those school years, they are afraid, hesitate and somewhere do not dare to connect somewhere, in fact, with hereby."UA5 "I think it can already be related to school education. It's true that we don't deal with it in our studies, but it is known that it is already the earliest stage of education, even before high school [where obstacles appear], because even girls who participate in these various projects, e.g. with the Perspektywy Foundation, say that polytechnic [technical university], first of all, was not their first choice, e.g. IT, that they were wondering about different fields of study, they said at some point that maybe IT, but even at the beginning they themselves felt that they had some lack of knowledge or skills. And they themselves said that maybe it was because the boys started programming earlier, boys knew IT was for them, boys didn't even have such thoughts at all, whether they were suitable for it or not, because they knew they were suitable."PL1	
Loneliness/lack of peer support	HU12, BG8, MKD2,3, PL1
"We ensure that female students are not alone but are in groups with other women. This is vital for their sense of belonging and confidence." "So, what happens is that when you have an environment that supports certain behaviours, it is naturally easier to orient yourself in a given direction. I think that for girls, there is a smaller environment. It is harder to find enough girls who share this interest, work in this field, and can collaborate in this direction. It's not impossible, just less common. So, what happens is that when you have an environment that supports certain behaviours, it is naturally easier to orient yourself in a given direction. I think that for girls, there is a smaller environment. It is harder to find enough girls who share this interest, work in this field, and can collaborate in this direction. It's not impossible, just less common." BG8 " In my personal opinion, I think girls have more obstacles if they want to have a STEM education in secondary school as from when I was in high school. I think the STEM programs in high schools were mainly male majorly, enrolled by male students, and it's a bit tricky for girls to enrol in such courses in such programs due to, you know. Am I going to be the only girl there."MKD2 "In our country the situation for girls and women studying in STEAM fields is gradually improving. More girls are showing interest in these subjects and enrolling in relevant courses/studies/universities. However, challenges remain, such as societal stereotypes and a lack of female role models in STEAM professions. For instance, while we see an increasing number of female students in informatics, they often face scepticism about their abilities from peers and sometimes even from family members."MKD3 ", it must also be said that there were a lot of such voices about this queen bee syndrome, that is, that women do not support themselves and that in this scientific environment those who achieved success thought that since they went through these difficult situations, everyone can go through it and indeed there were also such voices. So I think it's a very complex problem and of course it cannot be said that it is some fault of these women, because it is also known that when you work in such a masculinized environment, you also have such a need to adapt and it is probably easier sometimes even if something does not make you laugh, to laugh at it in order to be accepted."PL1	
Gaining visibility as a researcher Taken less 'seriously'	HU11, SK1, PI1

“So I don't know what it's called now... sorry, I'm not a gender expert, but how you can only sell your own research idea if you put it in the mouth of a man or your boss... it happened to me too, I told my boss a my research idea, isn't it good, no, it's not. And later on, he wrote an OTTKA on the topic in which I was involved, in the end he may not have won, but that is irrelevant now, he did the research and the articles, but the first reaction was this, so that the credits are not get it, and many of the respondents also wrote that such things happen. Well, this is bullying... and what I think is tragic about it, I'm sorry to put it so harshly, is that we don't even understand it, that we don't even notice it.” HU11 “...but this visibility, that they are not elected to committees, they are not asked to be editors, they are not asked to participate in panels, for presentations, and then this results in the overall result that they will not be so well-known, recognized and visible , and this is a problem.” HU11 “It is interesting that they all did not say that... They usually said that they did not feel discriminated against. But after they told such a loose story about their entire careers, there were a lot of such situations in which they were discriminated against. Whether lower wages, or even cases of sexual harassment, or such neglect by colleagues, for example, that they were placed in the role of invisible assistants who help in something, but then their contribution is not noticed. It was really very visible.”Pl1	
Gaining visibility only as a good administrator, manager	HU11, PL7
“... when my colleagues joke about me questioning my competences, they joke about it, and that this has the message that my, it takes away my self-confidence and gives me a bad reputation, because, because it's like this... they intend it as a joke, but that's why it is, so that it certainly exists at the level of the middle generation, it really exists that women are not visible, that they are not they get assignments, once the men don't think of them as being suitable for any position, just the sucking tasks with a lot of administration, or with loving sucking... So that's it. And then they beat me because you are so good at administration, or because it goes so well for you.” HU11 “So yes, I often observed something like that. I don't have data on it, but these are my observations, that women are given organisational tasks more often. Even in didactics. For example, they take on the positions of head of field of study, because they are well organised, because they take care of students, because it will be good, and so on. So they focus more on didactics, and men do science. So I also suspect that there is a gap in the achievements on the scientific path. Not in didactics, but in the scientific-research path.”PL7	
Being a quota women	HU3
“And for example, in the applications, it is within the European Union to move this percentage, they stipulate as an indicator that there must be a certain percentage of women in the applications, and when this rule started, it was unpleasant for us and it was unpleasant for our colleagues. For us, because if I was admitted as a woman, mostly my older colleagues, my male colleagues, were admitted to tick this indicator, and you don't need anything, you don't need anything, it doesn't need to be dealt with somehow, but there's your name, you put your name and you've got it. But not to take me into a competition so that I can tick the indicator, but so that I can really develop in my own professional life, and I can see that it took a good 5-6-7 years, 10 years, when these first criteria were introduced, that now they are not always so, I'm not saying that there are no exceptions but not based on the fact that a woman is taken into a competition to tick the indicator.”HU3	
Participating less in networking activity	RO1

“I had several projects in which I worked on this part, besides the school part itself, I also work with CISCO Networking Academy, we do networking and cybersecurity courses, in which fortunately we have both boys and girls, and that's a good thing that we see... Usually, girls don't come to the networking part, so to speak, it's a fear of networking. It's a man's world, and I think that's often a problem.”RO1	
Being in a token position/being the only girl in class	ES7, IS2
“ And some girls have also told me that seeing a girl alone in a classroom seems strange to them, like in the end they are very well received, that nobody eats them up, but that they feel very isolated and if they need to confide in someone or something, it's harder for them with the boys. Or because boys are less sensitive to their problems, or because boy-girl relationships are misunderstood, it's still very closed.”ES7 “Second obstacle would probably just be the personal one. If you feel like the whole, like if you are one girl with 20 guys, And if that's like a personal thing, because it takes a strong individual, doesn't matter if it's male or female to be the only gender with a group of other gender.”IS2	

Difficulties in relation to career/career advancement/employment	
Lower salary	HU7, HU11
“They (Men) have fewer second jobs, the part-time job does not support them, but almost supports the other men, since they are the breadwinners, which is again the traditional model, so that the woman stays there with a lower salary, we showed in the 2021 survey that significantly lower women's earnings, and this is clearly related to having children, so that women who have children have lower salaries.” HU11 “This is a very difficult situation in the labour market, because it often turns out that a woman earns less than a man in the same job.”HU7	
Less support in research (assistance)	HU11
“There were three laboratory assistants in our department, before there were four, and none of them helped me officially. So how is it that they are allocated... it used to be that they were allocated to people, somehow the group I worked in before was formed in such a way that we didn't have much help. But when I came back from GYES, and I indicated that it would be good for me and I should, it was smeared like that, and it is not relevant to me at the moment either. However, it would help a lot if there was a fixed person who is here, is present, when I'm at GYES, even if the child is sick, takes care of the lab or helps the students, so that would be very important, but there isn't . And now I'm thinking about whether I'm saying that I'm not saying it out of spite, but that I should hire him, because colleagues who had a part-time laboratory technician assigned to them are now retiring, and now that laboratory technician has not been reassigned, especially not me. But the way it is now, because I'm at work anyway, is that it depends on the boss, and I see that men, right, for science... and that's especially true for the STEM fields, I think it's cumulatively true, because right here the big groups need a lot of money and produce the knowledge and the articles and whatever, so that I concentrate the power in one hand. Because now, at our place, all of the three laboratory assistants work for the head of the department, who is a man, and I can't do much with that, or I only know how to indicate that I have a need for this. The question is what he will do about it.” HU11	

Citation bias	HU11
“there is no meaningful dialogue about these, I don't know if they feel threatened. So no one claims this, nor do I quote someone because she is a woman, but because women are not as visible, or they are not the reviewers, or they are not the editors, so there is a difference of a few percent here as well. And this is also a disadvantage, which, if it is only a small one, but if there are many such small disadvantages...” HU11	
Labour market expectations (biassed)	HU6, LT3, UA4, IT2
“By the way, I think that the labour market side has a very strong impact on students coming out of agricultural education, so perhaps there is a little more separation between the situation of women and female students within universities, and what it's like when they enter the labour market with a diploma in their hands, because I think that there it is much more decisive that in previous years a significant proportion of agricultural enterprises were run by men.”HU6 “Társadalmi szinten más okokat látok, ott azt látom például, hogy vannak percepciók a munkaadóknál, és ezek nem tudom mikor fognak megváltozni, hogy mennyire kemények, hogy ki mit tud ellátni. Tehát mondjuk az, amikor nálunk elnőiesedik egy STEM-szakma, vagy megjelenik mondjuk sok nő például akár a mérnöki szakokon. Kérdés, hogy mondjuk egy kisebb cégnél hogy fognak viszonyulni ahhoz, hogy mondjuk jön egy női vagy egy férfi versenyző egy posztra, és nem azt fogják-e mondani, holott már rég nem kell kilókat emelni, és már rég nem arról szól, hogy erőből csavarni valamit. Vajon nem fogják-e mégis ezt reminiszcens módon megtartani ezt a felfogást és preferálni a férfit?”RO2 “. The other thing is that in some companies, in some institutions, especially in STEAM fields, there is definitely a higher proportion of men in the staff, and then maybe not all women, girls, when they come to work, it is not so easy, because you have to not only prove that you are a good professional, but also prove that you are able to do the same job as them. There's a kind of a weighting, I think that can be a brake sometimes.LT3 “Well, to some extent we have already said, the software business, for example, is too engaging and requires continuous qualification and continuous self-education, which is difficult for women with families. In addition, we have also already said, employers prefer men because men are much more predictable, they can work in their free time and overtime, while for women it is much more difficult.”BG4 “Well, let's put it this way, if chemistry here is such a discipline that unites both science and technology, and all these letters in the acronym STEAM, if we are talking about chemistry specifically, then, apparently, there are nuances that we encounter, despite the fact that most of our students are girls. If we talk about demand and employment, and requests sometimes come to the faculty, where our students are already in need, as their future employees, are taken from junior courses, for part-time employment, then we often come across that in the job request they ask still a man, partially arguing this in our realities by the fact that such an employee, as in the female gender, for example, in chemical production, faces the problem that very often, if it is, for example, an enterprise, there is such a nuance that they work with large quantities of chemicals that arrive in bags must be moved somewhere. And, in fact, from such a banal point of view, a man is a more suitable candidate for them. These are the comments we hear from people. The second thing. Unfortunately, they don't really want to hire women for such a permanent job with young girls, let's say, after graduating from university. It is often argued that now you will graduate from university, we invest a year or two in your studies, and then we are faced with the fact that you go on maternity leave. Then you have small children who get sick, then you go on a second maternity leave. And, unfortunately, of course, it is not announced officially, but somewhere unofficially, that if there are two candidates equally, let's say, with a good quality of education, with the same diploma, with the same skills, knowledge, if we take a	

man and a woman, rather, this position will be for a man, if he does not refuse, and from the point of view that, actually, somewhere in these nuances he will avoid."UA4 "So, in my opinion there are no difficulties, let's say, once they start the scientific high school there are no difficulties of any kind, in the sense that being girls does not hinder them in any way. And theoretically it is the same at university. In my opinion then the obstacles perhaps arise afterwards, in the working world, in the working world. ... I do not think that girls at university have more difficulties than boys. Today they have the same opportunities, the same possibilities. Some difficulties perhaps arise then subsequently."IT2	
Expectation of having a family	ES6, BG2,3 UA4, IT1
Let's see, I think that... there are equal opportunities, at least up to a certain age. What is also true, and what I know, is that, for example, in construction companies, when a woman who is applying is already 26, 28 years old, they ask her if she is going to have a family or not. ES6 "In my opinion, the problem is not so much girls' education in STEM specialties at universities, but rather their transition to working directly in companies afterward. And this is not related to companies' unwillingness to hire girls, but perhaps more to the fact that many women wish to fulfil themselves both as wives and mothers. This significantly discourages companies from hiring young girls and women."BG2 "Like, for example, in a job interview between a man and a woman, when they are invited, questions are often added to the woman, and do you intend to have children, and how many children do you intend to have, and are your children often sick... that is, these are questions that reciprocate, firstly, that are not asked to men, but secondly show exactly this bias and this gender divide."BG3 " The second thing. Unfortunately, they don't really want to hire women for such a permanent job with young girls, let's say, after graduating from university. It is often argued that now you will graduate from university, we invest a year or two in your studies, and then we are faced with the fact that you go on maternity leave. Then you have small children who get sick, then you go on a second maternity leave. And, unfortunately, of course, it is not announced officially, but somewhere unofficially, that if there are two candidates equally, let's say, with a good quality of education, with the same diploma, with the same skills, knowledge, if we take a man and a woman, rather, this position will be for a man, if he does not refuse, and from the point of view that, actually, somewhere in these nuances he will avoid."UA4 "Given how our society is structured, if a woman then decides to have a child, let's be clear, it's not the man who helps her, it's her who has to take care of the situation. It's a sad thing to say, but we really look at it as it is. So if in software development companies, I'll give an idiotic example, there was the possibility, as there is in some American software development companies, of having a nursery in the same company, women would have no reason not to do that job. That is, we are always there. If the main parental care is always assigned to the woman and women do not have any kind of support, when a developer sits at nine in front of the computer and gets up at eight in the evening or six in the evening from the computer, how can he manage a son? Except that in my opinion this isn't life, but that's another matter. For a woman who wants to have children and to whom every parental care task is delegated, it is clear that that type of work is no longer congenial. Then I don't know if there is some sort of preconception in companies against women developers or engineers. I can't tell you this."IT1	
Insulting/harassing environment forcing women to give up/hold career	ES8

Well, the girl I told you about from Granada did have a very bad experience there, she did a postdoc in Portugal with a woman as her boss and she also had a very bad experience, because this woman, despite being a woman, was also quite sexist, which we don't seem to understand but there are cases and so in the end she left research and the other colleague was on the point of leaving and now she is back in her country and think she still doesn't have a permanent position but she is there with a university to see if they will hire her and so on because I think in her case it was just a few months, it wasn't as long as the other colleague who was with someone for 4 years but she went through it. I know that both of them had a very bad time and I know that there are people who have left research because of these cases because if you are with a person for 4 years who does you the best possible good and treats you badly even with insults or making you less because you are a woman then of course they make you leave, we could talk about this before nothing happens but yes, those two cases for me have been at the beginning when they told me it seemed unbelievable I can't believe that people like that still exist and above all the worst thing is that the rest of the department colleagues cover it up because they bring a lot of money to the university. ES8

Negative consequences of part time work	SK1
“Then something else which comes to my mind is linked to the family and children and taking care of children. So they would need perhaps some part -time contract, but on the other side there are limited career perspective for part -time employees.”SK1	
Unstable labour market - no secure positions	PL1
“It must also be said that in recent years it is known that science is no longer such a stable place of work where you can find a warm seat and survive. It is a very competitive environment. And there are also such studies that show that women leave because they do not find stability here. Because, I don't know, there is only employment from grant to grant and yet they need this stability. And contrary to appearances, very often this stability is in the private sector and not in science.”PL1	

Annex 2

Group 1: Gender-Neutral Perspectives on Support in STEM
“I know that we have several student organisations, a student government, a pro-union student organisation. And in fact, they have developed such an interesting system that I am simply amazed by my students, how eager they are to participate in conferences, write articles, and give STEAM presentations.”...”Our lyceum has a fund of graduates, and the fund of graduates takes care of those who take prize places at Olympiads, or at regional, or at All-Ukrainian, or scientific research works, that is, scientific works that children write, or participation in some other tournaments , mathematics, physics, biology and the like. And those that occupy the highest places, for example, the All-Ukrainian Olympics, then they receive more funds. Those who receive, those who won prizes at the regional Olympiads, have a little less money, and so on.” UA6 “...at the beginning of the tenth semester, to a reception that is specifically about students coming together with their parents, i.e. children and parents at the same time, and they visit the teacher of the student who teaches from the faculty he is thinking about wanting to

choose, and then this is specifically about the host To talk about what chances the child has on that fact, choose it according to the teacher's discretion, don't choose what that fact will be about, what it will prepare him for, that sort of thing, so there is help here for those who need it to get advice on this, so that it is not mandatory, but who wants it. There is also a career guidance programme, and now, I confess that I don't know the name of the organisation with whom the school has been cooperating in recent years, and that organisation organises it, this is such an outdoor programme, and then students go there." HU8

"We also had a series of lectures aimed at providing information and career orientation, we went to secondary schools for visits, where we promoted not only this robot competition and robot programming things, but also the trainings of the institution, specifically and emphatically for our technical trainings, because we are basically an economic education institution, but our institution has also had a technical leg since 2012." HU2

"And obviously, there could be more scholarship programs like this, which... the university can, but fundamentally, in my computer science department, there are many contacts with companies, and there are scholarships in the Neumann group too, so I think these could... and it's really a bit like advertising, going to work for them to finance their university studies. A good scholarship program would be good for this, where they can really... so they can support themselves, which can be a motivation. This is what I don't have so much influence on, but what I've listed, I think it's important..." HU12

Group 2: Advocates for Gender-Neutral Support in STEM

2.1 Equal opportunity to all

"We don't highlight the female students specifically; we pay attention to everyone equally. It's crucial to convey that women have the same opportunities as men. The goal is for every student to find their place here, and we support them with a multitude of programs to help them transition from high school to university. The aim of these programs is to create an environment where students can manage their newfound freedom productively and efficiently. ...In conclusion, we don't single out female students; instead, we encourage and support everyone equally. The goal is to ensure that all students, regardless of gender, find their place and thrive both academically and personally." HU12

"I think then the first thing they, as I would say, I would put it this way, is that we need a good education for boys and girls, so we need to change how we do the teaching process without thinking especially about girls or boys." SK HETFA 2

"I definitely agree that everyone, regardless of gender, needs encouragement, especially when they are in upper secondary and high school, when they need a gentle push or assistance, or guidance on where to go. Indeed, the STEM centres developed in recent years encourage not only girls but also more students to focus on STEM technologies." BG1

"I believe that all children, both boys and girls, should be equally supported and encouraged in their involvement in STEAM. Equality is important to me, and everyone should contribute to the collective idea with their strengths." BG5

"No, we don't make any difference. We are very student-centric. And, in fact, we give students from the first year the feeling that we, the teachers, are open to communication. And if men or women have problems, whether of a private nature, or related to some financial situation, or with security, they know that they can turn to the administration, to

their teachers.... We do not make any difference here whether it is a male student or a female student." UA4

"I think then the first thing they, as I would say, I would put it this way, is that we need a good education for boys and girls, so we need to change how we do the teaching process without thinking especially about girls or boys." SK2

"The trend is clearly increasing. I do not see a problem with attracting female students; in fact, their numbers in IT are growing steadily due to various initiatives. In civil engineering, the number of female students has become dominant, with around two-thirds of the students being female. It seems that the issue is not so much about not knowing if this field is suitable for them but rather about ensuring they are aware of the opportunities and support available." HU1

"Recently I read a very interesting thing about medicine. I don't know if you know, but until the 1970s in Poland it was so that women had to get more points to get into medicine. It was very interesting for me that already then there was a parity solution, so of course you could try to think about it. But today it is very difficult because there are no exams for studies, there are matriculation results and we also know from experience that these parity solutions have two ends and the environment is not positively focused on it. And girls do not want it. It will always be that they got it because they could get fewer points or something like that. So I don't think it's the best solution." PL1

"In my own school, girls don't need special support, they can stand on their own just like boys. We do not have any programme for this, because we do not consider it necessary." HU8

"Because it suggests a fundamental difference between sexes in the perception of these subjects, in skills in this field. I do not notice such a difference. So I cannot imagine that it would be possible to change something fundamentally, by increasing artificially the number of women. Because if we set an indicator which we want to reach, we will achieve it. I have no feeling that the very fact of increasing the number of women will have any noticeable effect on a given industry" PL3

"I think it's unfair to boys. To be honest, I don't know. Maybe it's just my opinion, but I don't think there's any difference. It's a natural difference. We are different and we won't be the same. I think accepting it is crucial. I always feel that such direction can have the opposite effect. For me, it's more about focusing on the youngest kids, preschoolers, classes there, but not aimed at girls, but at everyone, in every aspect. When we do classes with great physics' experiences, we do them for everyone, not only for boys. ... It's the same as having playing at home with the whole group, not only for girls, so that boys can take care of their kids in the future. Let's do everything that helps everyone who is interested, without discrimination." PL5

2.2 Concern over Positive Discrimination

"But then again, boys shouldn't be excluded either. Let them all have the opportunity to behave as equals. ... we would have to be very careful because there is a risk that others might feel a bit excluded and we don't want the opposite effect either. ... Maybe yes, but we would have to be very careful because there is a risk that others might feel a bit excluded and we don't want the opposite effect..." ES8

“On the one hand, yes, they do need extra help, but on the other hand, too much help would also be detrimental in the long run, so there probably needs to be a balance and overall I agree that it would be fairest to have equality in helping both girls and boys but also not to have such a not so positive effect as I think has been achieved with too much welfare help for Roma and somewhere it has had the opposite effect. So there has to be a balance in support. That is my opinion.”BG9

“Yes, in the sense that when we have open days, we encourage the girls, we take them by the arm, we show them under microscopes, we give them small experiences. But in reality we do it with everyone, male and female. I don't even like the idea that you have to do something more for girls, because it's as if you have to do something less for others. In my opinion you have to treat people like people. I don't like this stereotypical thing. You can be any gender, I don't care.” IT1

“I would treat them as underrepresented and disadvantaged, which means that there can be some kind of support which is not positive discrimination...” SK2

“The rector could mandate a review of how many students are participating in the Student Science Association (TDK) and how many of them are girls, and then try to mobilise the girls. But it's a challenging and sensitive task. You can't say, "Of course, because she's supported since she's a girl." There is no recipe for this because it's a delicate matter. If the teachers are open-minded, then sooner or later, the girls will follow” HU10

“Continuing from my response to your previous question, I believe that there is no need for special measures to encourage girls in STEAM, nor boys accordingly. In this field, gender equality is necessary, both professionally and between teachers and students during STEAM education because education and training are a two-way process of action, experience, emotion, and realisation, in which each person can be helped to discover their uniqueness. In this process, teachers can discover and unfold their own potential on one hand, and on the other hand, help students develop their personal qualities as the younger generation.”

“Specifically, STEM lessons provide opportunities for creativity, for creativity, for breaking stereotypes, and for putting each participant in the educational process in a non-standard situation. These moments are significant for each individual and are important for their development.” BG6

“This problem always appears, yes. These scholarships are just directly aimed at girls, while we withdrew from this very Open Day for girls only, because there were such voices that here boys would be excluded. There were such protests at other universities. At ours it was mild. We also quickly introduced just this system, that we do a joint Open Day, and there are simply some stands dedicated to girls, primarily an information stand, where girls can learn about these very scholarships or grants that are specifically provided for them.” PL2

“The institution intends to support STEM education for all students and encourages equal participation. Programs like Stem-Húsavík aim to promote STEM education, but there is no specific institutional strategy focused solely on increasing the participation of young girls and women in STEM.”... “There is no mentality here of if you get pregnant you will lose your job. There is a stable work market for families. The government has been trying to implement not restrictions but to force the men to take paternity leave as well in the sense that we have 12 months and you have certain months that you can divide between the parents but then you have certain months that you cannot divide between them, so this parent has to take it but there is a there is not a mentality of that you have to choose which. I

think it is also a positive aspect in that if you wish to go on a challenging work path, your personal choices won't, you don't have to choose between them. So I would say that we probably are quite high compared to others in Europe in the sense of, or maybe not compared, but we are quite high in the sense of if the male or the female gets the job. The last five years, companies have even been trying to think a lot about gender diversity. So being a female might actually be more positive. You are more likely to get the job because they are trying to [match the agenda]. The other day I had a conversation where somebody was saying that they even found that this was going too far now. That they're more looking at, like, are you a female instead of the credentials of the individuals. But because we're such a small society, it's..."IS2

"I don't know, and there are of course co-educated mixed people, but there are always those who are obviously more sensitive to this, let's say, what do I know, that they don't accept, let's say, their shape, and they don't want their colleagues to see it them that the university pays attention to having a date where only ladies can go. And this is also true for the female students, that it is separate, that they can go, so you have to pay attention to that. So that's why there are such program initiatives, maybe it can be called that. It's very general, the dean doesn't highlight that there should be programs in addition to this, because we talk about this with the ladies too, and to be honest, they also said that they don't need to be highlighted too much, because it might be counterproductive it will be if we are very concerned with the fact that they are ladies. In the same way, the fact that they are ladies and that they are ladies is a distinction, so that it is not good to fall through the cracks." HU13

"I still have a certain doubt whether such affirmative actions, such as positive discrimination directed to girls, is a good way, whether it does not cause them to have such an impostor syndrome, that I may not deserve to be here, because someone additionally supported me. It then comes to their minds that maybe I got into these studies, but is it because I am good or because I am a woman and they need women here? This is my doubt. As I say, the intention is very good and the effect we want to achieve is also indicated but if someone does not feel right there, even if he finishes these studies, she may go in a completely different direction in order to feel good about himself." PL7

Group 3: Addressing the broader issue of the declining number of students and workforce in STEM fields / A gender-neutral approach to student support

"But on the one hand, the fact that there is not enough manpower is also a critical point in Hungary, that there are not enough researchers or engineers, that women are taken more seriously, and if the previous generation or those who work with us prove that we really show why we are doing it, or that we can do it, and that we are not just taken as filler, when in the long term, I think it will take a good few more years, but that this will turn around, and they will not take a woman because they need the number." HU3

"Úgy gondolom, hogy Szlovákiában az egyetemek helyzete vagy az iskolaügy egészében eléggé sok sebből vérzik. Úgyhogy itt már a diákot csak arra ösztönözni, hogy valamicskét tanuljon már, az nehéz. Még azon belül, hogy megkülönböztetni, szerintem ez erőn felüli lenne, mert tényleg sajnos oda jutottunk, hogy az egyetemek versenyeznek azért, hogy a diákok hozzájuk jelentkezzenek." SK1

"Well, here in total from the dean's side such a proposal was made to join. It was one more way to promote ourselves, right? And to reach more students. In particular, to promote our offerings and, in particular, to provide information about these new majors/faculties of ours, which we thought would also be of interest to girls." PL2

"At my faculty, no. However, there have been general actions encouraging girls to study at polytechnics. However, I'm afraid that now it's a time when every faculty is happy that students have come to the faculty [have chosen certain faculty].There are no additional reasons to make them girls, but they just should be willing to study. At my faculty, although I have a female dean, there have never been such discussions or such problems. ... How to gain interest [how to reach them]? I would say that it's getting more and more difficult. I'll give you an example. Everyone is trying to have students in their specialties [fields of study]. In my department, for example, there are 8 specialties." PL3

"This is one thing, and the other thing is that we work together with secondary schools in this completely independent way in the field of career orientation in general, and every autumn we implement a so-called road show, when we tour the institutions here, and here, obviously, as I have already said, we always draw the attention of the girls. Originally, your question was what could motivate girls in general, and we used to say that job opportunities and prospects are important for girls as well as boys, but this is precisely the area where industrial parks in Tatabánya and the surrounding area are constantly bombarded. that we train more engineers, and that, as a result, whether you are a boy or a girl, the job prospects will be much quicker, more secure than in any other field, and the prospects of earning will be better. And obviously this can also be a motivation for girls, because women are still relatively rarer than male engineers, so they welcome female employees, so maybe this could be such a motivating factor." HU2

"I don't know if there are clear efforts in this direction, in our university I notice that the idea is to have students, as everywhere, it doesn't matter the gender, if they can get in and we can get funding it's ok, if not it's not, and there doesn't really exist, I mean I don't know if there is anything specific. Personal initiatives from some colleagues who see someone with potential, try to lift them up and involve them, but that's about it. Perhaps, likewise, colleagues of mine who have daughters see certain things at some point and try to take a small, individual measure or see certain students that are angry, depressed and somehow it is easy to empathise, but no, unfortunately there is nothing institutional." RO1

Group 4: Advocacy for targeted support to increase female participation in STEM education and research

4.1 The importance of early education in orienting young girls towards STEM education

"Do you think there should be some special programs, some support dedicated to girls by schools, by universities to go to these areas?A: They should. I think from high school, sooner I don't know if that's the case because I still don't think anyone knows what they want to do, but from high school there should be, so they can realise that they can do those things. From the side of the universities there is openness, again, as we have summer schools, there is no such thing... No one has a criterion to have many boys or girls, they try to reach a balanced number or as many as possible to be accepted, but I believe that something should come from pre-university. We have all kinds of exhibitions and events, but we don't have anything special for girls, that's right, apart from Women in IT I don't think there's anything else in town... But there should be, otherwise again, they leave with the same idea, that it's not a job for women, although I don't know if it's appropriate to say that anymore." RO1

“It's mostly high school, and I'm going to go there. We used to work with high school students, but over the years it's proven to be too late. It's primary school now, let's say in the upper grades the freshmen are still young, but it's worth it in kindergarten.” HU3

“There should be more support and encouragement for them to develop interest in the STEAM fields. But my opinion is that that should start at the earliest level.” MKD2

“To encourage girls to develop an interest in STEM fields, dedicated support is essential since primary education.” MKD3

“Yes, I don't think it would be wrong at all to give girls special encouragement as well. Because in general, through development, and we certainly have this since before..... women always.... Women are more likely to think they're not good enough for certain things. The boys can do something worse, but they won't have as much trouble with it. They will be less self-critical. But for women, certainly, yes, in different areas.” IS1

“What are the limitations that girls have in the institution of the Day of Girls and Women in Science, which is not just a day, but a whole week. The issue of showing women scientists, not just scientists but women scientists, all those elements of empowering girls to see that there are women scientists that they can look up to. I believe that these are actions that are partly aimed at university students, but above all they are aimed at children, at the younger generations, at children in primary and secondary school. And I think this is very important. I think that this type of action is much more important than what is done in the university. At the university it can be done, it can be monitored, it can be accompanied, but I think the fundamental problem is one: how many arrive?” ES6

“So these are the 2 points, because I believe that from kindergarten children to university students have the right to enjoy learning and how this can be achieved, but for this the physical environment must also suggest a pleasant environment.” HU4

“...where she goes to primary schools to do career guidance days, she and her husband are researchers and they work together, similar to me and my husband, and she says through her own experience you have to reach young people in primary school because secondary school is too late. They are still young and you can appeal to their interest at kindergarten, but if you are serious about it, you have to be serious about the upper primary school in the long term.” HU3

“So, I think we should give examples and start very early. Start in primary school because almost in secondary school they start to opt for easy and difficult maths and you already have a bias. Because once they take the easy maths, as they say, get them to do a part of engineering robotics and they won't be able to do it. So, that's it, start early.” ES8

“What I think is that a lot of attention is being focused on secondary education, in secondary education the stereotypes are already ultra-formed, and they are already inside the brains of girls and boys. So, in secondary education, for example, we see a lot of girls who go into biology, maybe chemistry, or something else, but they are very detached from all the engineering subjects, or for example, even from architecture, they are very detached. So, what I think is that we have to continue our efforts in secondary education, but we have to go to the root of the problem. So, when stereotypes are formed, and when girls and boys are more sponges, it is when they are younger, in primary education. So, I think we have to invest a little more effort in primary education, so that they don't arrive at secondary school with that perspective of, well, it seems that a girl wants to choose biology, perfect, that they see it as engineering, that they don't see it so well. So, I think we have to try to make a little

more effort in primary school, which is where all the stereotypes are formed, and where boys and girls start to talk to each other, and they start to give each other feedback, and they start to feed this idea that technology is not for girls." ES3

"In my opinion, the biggest problem in Iceland, in STEM subjects, isn't really the university or the secondary school. It's earlier on. Because I think the damage has been done." IS

"There should be more support and encouragement for them to develop interest in the STEAM fields. But my opinion is that that should start at the earliest level. Like given, I would say, primary school, kindergarten. They should have more courses. And this is not just for the girls, also for the boys but if they start from the very early age of 6, 7 years old when they're 1st grade in primary school that would mean a very promising start in the same career. I think currently, we don't have one in our country. We have some 10 courses that start usually around 4th, 5th grade. If I'm not wrong, I think it should be much earlier, much more focused. And yeah, definitely, the programs should emphasise that there is nothing bad for a girl to be in that area." MKD2

"To encourage girls to develop an interest in STEM fields, dedicated support is essential since primary education. There shall be more mentorship programs, scholarships and initiatives that expose girls to successful female role models in STEM. At secondary level, interventions such as workshops, STEM clubs and partnerships with Universities can be very effective." MKD3

"Because I think children around 8, 9, 10 years old are most accepted to being interested in things. And if some STEM subjects are not visible to them and they have good teaching and don't have teachers who can go into STEM subjects well and make it interesting. It may be a bit late doing that at the age of 15." IS1

"It needs to start early, in Kindergarten, early elementary education. ..." IS4

"There is a clear intention to increase STEM opportunities in primary and secondary schools. The introduction of STEM workshops aims to enhance teachers' ability to teach these subjects, thus indirectly supporting young girls and women in pursuing STEM education." IS3

"I think it should already start in primary education. I think when we come to secondary education it's already too late, because most girls are already going to high schools or to secondary education schools with a fixed idea of what they want to do. I think it's more important to start in primary school showing young girls. That's okay to be, let's say auto mechanic, to be an operator, to be a maintenance worker in the industry." CRO2

"No, it's nice to feel this dynamic. I don't like the idea that we have to help girls in high school. I like it when girls are helped when they are little, already at preschool age, because that is precisely where imprinting is, the thing I was talking to you about before. The majority of efforts should be made there, in avoiding gender stereotypes. ...I don't know if it's clear what I want to say. For me we need to start with a different way of teaching mathematics in primary schools because everything starts there, if there I start to get into the heads of children and especially girls, you are not made or are not made to do mathematics, maybe they say so from alone because they can't, because mathematics can be taught in many ways, in the traditional way, in the laboratory way, by playing and in many other ways." IT1

"The centre we work with in Barcelona has a programme with primary school girls. So, you have to start early. When the children are deciding what they like. And what do you do? You can go and give talks in secondary school because they listen to you, but in primary school

they don't have a head for it. So what they do is bring them to the centre. Then, they take them to the vocational training centre and for a few hours they teach them robotics or mechanics. Of course, it will be a very simple thing. It will be a very safe thing to do. But in the primary school they already know that they have the possibility of taking the girls to the VET centre for a week. And the girls are telling each other that they are actually playing, because in primary school, if they don't learn by playing, they are not motivated. And so they are programming a robot to play tic-tac-toe with them or to do things, but they are programming. So, if that motivation is awakened or it is seen as a normal thing, if the motivation does not have to be awakened. In other words, the same way you like to take care of the doll, the same way you like to programme the robotic arm to play with you. So, they are things, they are all parts of the same thing, aren't they?" ES7

"I think it's very important that science is given importance from an early age, and I think that this is the moment when both boys and girls, when at an early age....I mean, this is going to lead many of them to become, we are going to study careers of this type and this regardless of whether they are men or women, because it is going to be considered very much the same. So I think that the basis is very important. In other words, the basis of developing science from an early age is extremely important." ES8

4.2 The critical role of teacher support and school culture

"Actually, I feel that the best motivation for a child is if the teacher trusts her. The teacher makes her believe that she can do it. There are so many cases of students who simply give up on something because they think that they will not be able to do it. But if there is a teacher's motivation behind it, or a positive reinforcement that yes, but listen, you can do it. ... . In fact, I find that whether it's a boy or a girl, if you trust them enough... Of course, the child has to put herself there, but if you take small steps towards the goal, you're bound to get where you need to be at some point." RO LIC1

"I need to encourage my students in the same way, that they need to succeed in realising their potential and first understand what their strengths are." BG2

"If I was the principal of a school, I would definitely first train the trainers, so the teachers, and put in place a code of conduct that is strict in treating girls as equal, as this is really coming from many stories we heard from girls that some teachers really split the classes to boys and girls and let boys program and girls can play or go to internet and some microaggressions and inappropriate comments. This is something that a school should have in control, how the teachers treat students. ... So I would start with the same as a director of any other school, train the teachers with the same stories we hear also from the universities." SK2

"However, there is a weakness in that serious resources were directed towards creating purely technical STEM centres, but the teachers were not well prepared and trained on what and how to develop something in them, which is yet to be addressed. ... So, everyone needs mentoring, but it's also important that the mentors themselves are well-trained, and it doesn't matter how they encourage, whether boys or girls." BG1

"So unfortunately we don't have much, I still get information like this, I read another book, I look at what studies are published, we have IEEE, they have a special section of Women in IT and I read an article from time to time, to see what's new. But look, I'm not doing a lot of research, I'm noticing now, you know? That's why I say, reflecting on the questions in the interview, I realised that I should read these parts more, but we think we know them and we don't know them, it just seems to us, like on Facebook: we saw a news story and we think

we know it. I think that also because I have my daughter I started to see things a little differently, to see what I should expect for her, because otherwise maybe I wouldn't be as aware either, so the whole social environment, the entourage, we go to the right place."RO-UNI1

"Another actor that plays a big role along with the teachers is the school itself. And here I would like to underline a school culture that can be key to empower both female teachers and students in the sciences." SK1

"There is a clear intention to increase STEM opportunities in primary and secondary schools. The introduction of STEM workshops aims to enhance teachers' ability to teach these subjects, thus indirectly supporting young girls and women in pursuing STEM education. ... Strategies include professional development workshops for teachers to improve their STEM teaching capabilities, integrating STEM into the curriculum, and making programming a compulsory subject." IS3

"Even here we first started in high school, recruiting, it is not a nice word, but rather opportunities to show young girls, because it was the experience that already teachers or parents always said go to be a kindergarten teacher, or go to be a teacher, but not an engineer, or a metallurgist, or they were totally freaked out and needed a change of perspective, and so there were programs, and there still are, even teachers' days, where... The emphasis is on changing attitudes and understanding that if there are girls like that, don't discourage them, but rather try to encourage them. It's a very important activity because a lot of times parents or teachers or the environment that surrounds girls discourages them, even the few girls." HU3

"So yes, I think there will definitely be more and more girls in STEM in the future. And they should be encouraged, we as teachers are simply the first to come into contact with them and I say always give good examples from practice also to parents, especially because... Parents are always interested in what kind of job they will have, what my child will do, what the salary will be, whether she will be able to be a mother. These are some things of interest and I think that we should always answer these questions in a really targeted way. Or some kind of poster, advertisement, something, so always purposefully go to make the family, the parents, aware that these are really wonderful jobs where they can have successful careers, but also be mothers if they want to". CRO1

"The second actors are the teachers, and here I think the particularly female educators in STEAM play a role in shaping the attitudes and aspirations of their students. And it can be done again in several ways through expertise and leadership. There is also the possibility that the female teachers are becoming a kind of agents of change, breaking down stereotypes and fostering a welcoming environment for girls and for all the students, of course." SK1

"Naturally, it is important that the girls' motivation comes from their teachers, who would do well to take on more of a mentoring role and be able to provide a supportive environment so that girls' development in STEM can be possible and relaxed in a university environment." BG8

"I don't think that they feel that urge, generally, teachers, and it's very individual. And as you stated, it's not backed up by research, which is a shame. We cooperate very often with those active teachers who are exactly the opposite. I would say they are in a minority. They really go the extra mile to spend time with kids, generally, not just with girls, but they treat boys and girls equally, and they can spark the fire also in girls for STEM. So because of the way they teach and how equal they treat students. But yes, I've also noticed reactions like,

what should we do? They're not interested. And the truth is they really are not sometimes. They are not because they maybe haven't experienced what it is, what it could be if they were interested. So it is the teacher's task to spark the interest, to spark the passion, to show the possibilities. But if they're not shown, how can girls be interested in something they don't know exists or is for them. So it's like a circle sometimes. Some teachers already know that and break the biases. But when I prepared for this interview and read the questions, there was also some kind of a question starting with a sentence that we see many, many more girls applying to STEM, and we don't. (break) So we don't see such progress in the past 20 years. Actually, as you probably know, in 1989, until that time we were a socialist republic. And during socialism, we had more girls than women in STEM than we have now. So we can't say we see a huge improvement in the area here." SK2

"Well, if I go all the way back to, say, little children, this is how we raise girls, how do we raise boys? And that's okay, if you made a mistake, well, no problem, let's say this to the boy and say that there is no problem, the circumstances were like that. You're good. That's okay and go ahead and we'll encourage her while things are a little different for the girls and comfort her that she wasn't skilled enough. So it's not the circumstances that are like that, but that the circumstances tell my students that they are careful when they praise me, evaluate me, or don't praise me, how I like this, so if as an educator I could give one piece of advice to my peers, it is that they shouldn't necessarily discriminate when we have achieved such a failure. How was that now? We should pay close attention to this. Basically, if there is a failure, we should look at both sides. So what depended on us or on us and what depended on the environment? And it would help children realistically, because if we keep reassuring girls that it's okay, you weren't enough, you weren't enough, you weren't smart enough, you weren't smart enough, then after a while they will believe it." HU7

"If we want to encourage more girls to take up STEM studies at tertiary level, we need to first improve the educational environment, starting from the teachers. Teachers' attitudes and biases can significantly influence students' perceptions of their abilities in STEAM subjects. Girls benefit from encouragement and positive reinforcement in these areas." MKD4

"And we have lecturers trained on how not to support any gender biases. And that works. And that works. And I think it's really good also for boys to see girls that are good in tech because it also breaks their biases. And for the competitions, I have the same opinion that it's fine to have the mixed competition, but maybe focus the competition should be broad enough so that the girls can also bring their ideas that are creative enough, but not really boys oriented." SK2

4.3 Emphasising (gender) differences in arguing for dedicated support to girls in STEM education

"In my opinion, it is necessary to give additional attention to this topic because girls think in a completely different way than boys. They are more creative, more structured, more disciplined, and work much better in teams, which is evident. When we combine the opportunity for new knowledge through STEAM, we merge their strengths, and consequently, they are capable of achieving much greater things in this way. Let's not forget that a significant percentage of researchers are women, and thanks to them, we owe many collective successes and saved lives." BG5

"Yes, I think so (girls need more encouragement), because there is a bit of internal resistance as well. And young women have a natural desire to start a family, which is

stronger than the desire to participate in science. Balancing these is not easy individually, and help is needed to manage it." HU10

"Starting this year, we also visit high schools and participate in programs like "Girls' Day." We focus on developing the soft skills of female students, boosting their confidence, and demonstrating that this field is suitable for them. We emphasise that having diverse perspectives in a team is valuable. Female students often excel in social and communication skills, which are critical in group settings. Their presence can significantly enhance group dynamics, fostering better collaboration and integration." HU12

"I believe that girls should be encouraged to study in STEAM centres and pursue STEAM specialties in order to complement the technologically oriented boys in the same field. The essence of STEAM requires a combination of natural sciences and technology, which can be achieved through the collaboration of both genders, as each brings unique opportunities to the respective field. It's beneficial to have gender equality and complementarity." BG5

"Because various studies, for example in the context of mathematics, show that, for example, we are dealing with a phenomenon of fear of mathematics. And it occurs more often in girls than in boys. It is often transmitted by teachers of early education, who experience this fear themselves. It is reproduced, right? It is transmitted from generation to generation. And these beliefs are also so present, that girls are better at Polish, boys at mathematics, girls at history, boys at physics. We have this stereotype. This is probably also why you are conducting this research. And we really want these girls from an early primary school, from the middle of the primary school, I would say, to somehow show them that they can do something else, not only to be polite, a thumbs up, and learn history, but that they can build. And these are often hands-on workshops, where girls build something, something is created, they do something, they have helmets, sometimes even more. It meets with a lot of interest from the boys, because they also want to participate." PL7

"What I have experienced from working with my students, when it comes to motivation, girls tend to like more working in groups, projects, where they exhibit great organisational and leadership skills, whereas boys tend to like more hands-on activities and have more competitive spirit, so somethings related to games is always very motivating for boys. But these differences, once again, are not that big, both boys and girls enjoy similar activities. It is the general tendency that I am talking about. We don't have typical competitions, but we do have student work on assignments and projects for the industry and in some cases like code fests or bootcamps, we can organise some teams' competitions, but that is on an ad hoc basis. I haven't seen a particular gender difference in participation in these activities either." MKD1

"And they're very good at it: soldering, building, sanding, doing everything that needs to be done. And I think they are, if you show them that they can do it, to make them feel that they can do it, I think that's a very good thing. Or somehow I think society should not come from the outside, it takes years, it's not something that you can do, so that you don't think first of all about a girl that she can't be an engineer or a doctor or a physicist or a famous inventor because she's going to have a family or that it's not a girl thing. And if we teach them at a young age that they can do the same thing, then they will. So they have to believe in themselves. And if they believe it, then they can do it, because they're actually no dumber or less than boys at all. In fact! They have different personalities, but they can do everything a boy can do practically. Mental abilities, because obviously it's harder for me to lift 50 kilos than for a man my age, but there are no differences in mental abilities. I feel that, in general. Of course, everyone has different abilities and abilities, but I think that the more you

reinforce in them that they can do it, and that they have activities and competitions, and that you praise them and highlight them if they do well." RO LIC2

"To motivate students, I use active learning, mentorship, competitions, and create an inclusive environment. Girls often have structured study habits and are motivated by intrinsic factors, while boys might be more confident and driven by competition. Encouraging girls to participate in STEAM competitions and providing targeted support can help bridge participation gaps and ensure all students have the opportunity to succeed. It requires a lot of organisational skills, something that we males are not as good as females, because you have to design the solution accordingly, so definitely the young women are outperforming us in this area." MKD2

4.4. Building confidence through empowering girls

"Yes, definitely, girls and women need to be encouraged about STEM fields and especially in being steered into the sciences, the natural sciences, because really in the humanities they participate more readily, whereas in the natural sciences I think they have some barrier, some fear, maybe they lack enough technical and mathematical skills. And yes, and I think they should be helped in that direction." BG9

"We strive to address these stereotypes by including female students and instructors in our events to show that women can thrive in IT. Although some professions have a more balanced gender ratio, the idea that IT is more suited to men is just a stereotype. Women have made significant contributions to the field, and it's essential to debunk the myth that men are inherently better at IT. Overall, these events are about reinforcing the message that women are equally capable and needed in IT. By providing relatable examples and supportive environments, we aim to help female students see themselves in IT careers and overcome any lingering doubts they might have." HU12

"So what I see is that it's complex. So I see that a girl is much more insecure, and she only dares to admit that if she succeeds in 80-90 percent, the boy may not have as much knowledge, but she herself is sure that there will be something, and then she will solve it there, so I think such a tendency can be detected from the outset." HU9

"... it would be interesting to have some kind of.... personal development to convince oneself more than as a career support as such, but as a support to say to girls or teenage girls, hey, you are self-sufficient, you can... a bit of that kind of encouragement. Yes, I imagine that in the end there are, like everything else in life, some people who are more inclined to be a bit more forward and maybe girls who are not so much so that they lose a bit of shame. It is true that I think that especially in adolescence the typical things that you are in a group of friends, girls and girls, and maybe you are ashamed to do things because the boys are going to say and they probably don't have the same point of view, so that kind of thing and it's OK to... go over it." ES8

"We strive to address these stereotypes by including female students and instructors in our events to show that women can thrive in IT. Although some professions have a more balanced gender ratio, the idea that IT is more suited to men is just a stereotype. Women have made significant contributions to the field, and it's essential to debunk the myth that men are inherently better at IT. Overall, these events are about reinforcing the message that women are equally capable and needed in IT. By providing relatable examples and supportive environments, we aim to help female students see themselves in IT careers and overcome any lingering doubts they might have." HU12

"And for the opening ceremony from the 12 students involved, I had to determine who would go up with the Slovenian flag, because there are now 98 countries. And I chose this girl. And her mom called me how proud she was of it, that I trusted her. And I've said it too, ... Yes, it is.... I'm kind of trying to give these girls confidence, in the sense that some knowledge is measurable by tests, but there's a lot of knowledge and skills that she has that will come in handy in life. Unfortunately, we can't include them in school grades. She's an outstanding organiser. She has a great overview of the situation. She's inclusive, she's reliable, she's capable, she's brilliant, she has insight into things. But she always has a hand-tightened because she has 2 boys in the group. And she rolls her eyes when they are going in the wrong direction. But she doesn't take action." SI4

"Creating an environment where girls feel encouraged and empowered to explore technical and creative pursuits has been an ongoing goal. It's rewarding to see how they excel and contribute their unique perspectives and skills to our sessions." HU14

4.5 Methodological renewal: innovative and gender-sensitive methodologies for supporting girls in STEM education

"Another thing would be encouraging activities. So for example, current competitions like they have Lego or they have those remote controlled cars within STEM competitions. These topics are not attractive for girls to join the competition. So I would think as a teacher, as a school principal in different ways how girls can bring their creativity and the girl side to creating something technical, but still they can relate to, which probably they don't play with cars controlled. And then yeah, I think these two things would be probably the most important in terms of breaking the gender stereotypes." SK2

"Next, I guess we will need to improve the curriculum design and classroom dynamics as well; developing curricula that integrate real-world applications and highlight the societal impact of STEAM, and encouraging project-based and collaborative learning that can help girls build confidence and interest in STEAM subjects. ... As for what other types of programmes are needed, I've already tackled them in previous questions, thus changes in curriculum, classroom dynamics, dealing with teachers' biases, community support, networking, mentoring, role models, etc. So different programmes for different sets of challenges, cultural, societal, educational, institutional, and alike. And definitely more training of educators in these regards." MKD4

"To motivate students, I use active learning, mentorship, competitions, and create an inclusive environment. Girls often have structured study habits and are motivated by intrinsic factors, while boys might be more confident and driven by competition. Encouraging girls to participate in STEAM competitions and providing targeted support can help bridge participation gaps and ensure all students have the opportunity to succeed. It requires a lot of organisational skills, something that we males are not as good as females, because you have to design the solution accordingly, so definitely the young women are outperforming us in this area." MKD2

"And maybe we can also discover interesting themes for children that are not the ones that are in books and that have been around for 50 years for a completely changing generation. I believe that this is fundamental. Fundamental also, and I am convinced of it, are the methodologies. Methodologies that allow for collaborative work often work very well with girls, where they can collaborate with others to achieve results. They work really well. And I would say that's basically it..." ES6

“In my opinion, precisely, by encouraging, by ensuring that STEM does not appear as difficult disciplines, as disciplines that require who knows what commitment, who knows what basic skills, that is, by making them known better in some way, in the sense that if I realise that the STEM disciplines are not more difficult than the humanities, perhaps, let's say, in some way I am not inclined to exclude these disciplines a priori, so in my opinion the objective is to make them better known, also using a lot the method, for example, experimental, i.e. therefore laboratory, for example, so this can be, let's say, the objective and ensure that, precisely, eliminate many stereotypes that still persist, which, I repeat, less and less but still exist in our society.” IT2

“The girls definitely have quite a serious imagination, they have a lot of ideas, they are consistent, they are focused, they are goal-oriented. But at high school age somehow their minds are occupied with other things and boys are better entrepreneurs. That's why I think it might make sense to fund and organise contests for themed ideas that are created by girls.” BG8

“Yeah, we toyed, played with that idea for a long time, where to isolate girls, where to join girls and boys. And from my opinion, separate competitions are dangerous because that's not the real world. When a girl goes to tech studies or enters the tech world, she will probably still be in a minority and it's good to adapt to that. But isolating girls from our experience is very viable and good at their technical beginnings when they have really low self-confidence. For example, we do coding camps for girls only and they tell us that if there were boys allowed, they wouldn't attend because they have an experience from school that when they say something incorrect, boys laugh because they are a little bit ahead sometimes. And then they stop speaking up and they stop developing. So having them isolated for the beginning to gain self-confidence and theoretical knowledge is good, but then it's really, really efficient to mix them as we do during the year. We have coding lessons for youth and we mix girls and boys. There are more girls still. And we have lecturers trained how not to support any gender biases. And that works. And that works. And I think it's really good also for boys to see girls that are good in tech because it also breaks their biases. And for the competitions, I have the same opinion that it's fine to have the mixed competition, but maybe focus the competition should be broad enough so that the girls can also bring their ideas that are creative enough, but not really boys oriented.” SK2

“There were no girls in the technical faculty for the first two years, so no girls came. Due to Covid, we didn't organise any of them, we organised such getting-to-know sessions this year, and one specifically for girls, so sometimes girls feel that boys are better at computers or science, which is not the case, usually. But there was an occupation where only girls could come, and it was very popular.

(Interviewer: What is the attitude of the institution to this?

So what we really want them to do is to be admitted based on knowledge, so I think we don't have to differentiate because they're girls or they're not girls, but we encourage girls to the point where we show them what's going on and test themselves to see if they're interested in it or if they're able to do it, because if they don't, then it's not a favour to come there just because. because she's a girl. But let him see that she has goals, that she cares. So what I'm trying to do is provide an opportunity for that. The reason why we organised a separate girls' workshop is once again because in many cases we find that I am not saying that they are afraid of boys, but they are more restrained when boys are present, because there is such a stereotype that boys know maths, computers and physics better.” HU9

“Is there a STEAM guideline - yes there is, is there what should be strengthened in it - yes there is, is there distinguishing of girls - it was the choice of the working group not to separate because the wish is to have everyone included.” LT2

“So, the thing is this, in high school, as perhaps in all places, people work better when there is good gender equality. If there are too many kids or too many kids it's not very easy to work. On average, we compete with each other better, especially when dealing with kids. They are not the most adult working environments, I couldn't say this, if it makes sense, but with kids, yes. With the kids it's better to have good equality, you actually work better, there's a more serene climate, so mainly for this reason too.” IT4

“I am convinced that it has to be done. The support has to be systematic, with roles, with themes that are interesting for the girls, discovering what they are. What are the themes that are interesting for the girls?” ES6

“And so as a dean, I would first realise that the reason why there are not enough girls is not that they don't have enough brain capacity, but it's because of the gender stereotypes. I would treat them as underrepresented and disadvantaged, which means that there can be some kind of support which is not positive discrimination, but it's supporting someone who is disadvantaged by maybe giving them some kind of lead roles in projects and putting them as role models for other girls who kind of would have feelings that they will be worse than boys and treat them equally and create an environment where they will be treated equally and maybe also provide a little bit bigger encouragement than boys receive when they are good.” SK2

“That's a good question. Basically, I think the task here would be that those who have talent for this and want to do this should not be discouraged from this field, because it is not that girls are not interested in this field, and in fact I have read a lot of literature on this topic, that they are practically equally talented in these fields, but they are influenced by many that... They think they don't belong there. I think parents have a great responsibility here, including public education, to see positive role models.” HU5

“So I think that there are many activities that can help to orient a girl towards STEAM topics. Among them, I would mention, for example, talking about science and talking about science as a process, encouraging them, encouraging their curiosity and asking questions, showing good examples of successful females in STEAM and also promoting problem -solving skills or supporting their education and future career. ... There is also something I have already mentioned, and it's the female role models in STEAM education and showcasing the good examples. And what is also possible is to run the mentorship programs that can connect female students with female professionals in STEAM to provide them with guidance and insights.” SK1

“So that in the country, I don't know how many workplaces they can say... They await girls with open arms, and everyone talks about it, and whoever receives the girls at their workplace, goes home and tells them that there was Girls' Day, and there were little girls, and I don't know, and this has a huge significance. It cannot be appreciated enough. Yet when it started, there were very few compared to this. ...During events like "Girls' Day," we specifically asked female students about their thoughts on pursuing an IT career, and they generally did not report significant concerns. It was encouraging to hear them say that while there may be more boys from their class going into IT, they felt confident about their own choice as well. Some even mentioned having role models, like their mothers, who were programmers, indicating that they could see themselves in similar roles.” HU10

"By the way, this living library is not just listening, it is not only for high school students, and this is a very good initiative, but it is also a mentoring program for the young teachers, for our researchers." HU10

"Well, I think from the educational side, if they receive similar classes and workshops in school as what we do, and if there are enough resources and expertise—sometimes that's lacking—if they personally meet successful women working in these fields, achieving results, and if they see that female labour in this sector is equally well paid as male labour, I think these examples could be motivating factors." HU14

"I think then the first thing they, as I would say, I would put it this way, is that we need a good education for boys and girls, so we need to change how we do the teaching process without thinking especially about girls or boys. But for the girls, I think the most important would be to provide them with their role models so they can see this as a good opportunity or a path for their life for the future."

"I mean, she's a huge role model. And then we have a lot of female entrepreneurs that are doing a lot of interesting things and maybe not everybody knows about it, but when you start talking to this one and that one and so on, it becomes apparent that there's always a female on board that elevates the project." IS2

"More women role models!" IS IMP2

"We need mentorship programmes that connect young women with female professionals in STEAM which can provide guidance, support, and inspiration. We should think about creating support networks within schools and communities, conducting outreach programs that target girls and showcase the diversity of STEAM careers that can broaden their perspectives and aspirations." MKD4

"On the other hand, what we sort of do additionally, which we think might also encourage high school girls more, is, for example, we make a game like this, where they learn about women scientists. It's kind of a role model that we show. Or we organise meetings with our women scientists. So that they see these scientific career paths in the STEM sciences, that women are pursuing this and, for example, they are able to talk about it in an interesting way, to encourage simply girls to join one path or another. We try to make sure that they have just to deal not only with men, but with women who are just pursuing such a scientific path." PL2

Annex 3

Recommendations collected from Interviewees

Skill development	
Problem solving	"Well, I believe the central focus should definitely be problem-solving. It forms the basis of engineering thinking, ideally addressing as real-world problems as possible, with the available tools and resources at hand. From this perspective, I would emphasise the availability of tools and equipment." HU14
Research skills	"Also, the surveys of students that they fill out in the end, show that a

	significant percentage of them choose to study STEAM based on this activity. And also, that it changed their minds about science, better understanding the research process. But this is not limited to women, it is targeted at the high school student population in general." SI3
Leadership skills	"They take tremendous initiative, they finish everything brilliantly, they are very focused, they work very well, so perhaps now the next challenge would be to try to ensure that in these mixed groups, whoever leads the activities from time to time, is also the girls, that they not only take the boys in the lead, but that the girls also take the lead in these classes."ES3 "What I was saying before is important at this level, but I think it is much more important at primary and secondary level that they see that they are capable of doing projects for themselves, or in this case for themselves. I have some friends who are secondary school teachers and so whenever I see things in which they can participate in projects that sometimes come up and I think it is important that a woman is put in front of them to direct if it is a group of five students who have to organise themselves, for example a woman who can direct this type of thing that traditionally for one reason or another has been given more to men, well, give them that opportunity as well." ES8 "I would treat them as underrepresented and disadvantaged, which means that there can be some kind of support which is not positive discrimination, but it's supporting someone who is disadvantaged by maybe giving them some kind of lead roles in projects and putting them as role models for other girls who kind of would have feelings that they will be worse than boys and treat them equally and create an environment where they will be treated equally and maybe also provide a little bit bigger encouragement than boys receive when they are good." "Develop programs that focus on building leadership skills and self-confidence in girls. Encourage them to take on leadership roles, especially in research initiatives." MKD 1
Improving technical skills (technical confidence)	"Yeah. So we met those obstacles regularly. So they vary based on the phase where the girls or women are. So I can conclude those for girls. It's usually gender stereotypes that obviously play a role, but I don't think that they realised it that much. So based on our research, it was obvious that it is either lack of technical confidence or lack of technical skills from the school because the level of informatics taught at schools really differs." SK3
Need for teacher training	
Teacher's training: - training on innovative tools, methods - the of "need well-trained teachers" HU8 - sensitivity training: not to reinforce stereotypes, learn on avoiding	"Not to reinforce that little girls are like, well, you weren't good enough..." HU7 "For instance, a brilliant female mechatronics student cried to me because a teacher made a derogatory comment about her blonde hair, suggesting she would receive easier tasks because of it. Despite the student's excellence and the lack of laughter from her peers, she found the remark demeaning, and rightfully so, even though the teacher may have intended it as a joke." HU1 "There are still teachers, so to speak, of a certain age who may still have certain prejudices, if I think about it, it's also a matter of age. Those who are now approaching retirement or are now retired somehow still have a bit of an attitude of superiority towards female students and

sexism/sexist language, learn to recognize unconscious bias	probably in contexts like this they would end up prioritising male artists and not female artists...” RO6 “What I do try to influence a lot is that they perceive what they do unconsciously about gender differences. That is, because they see it from the moment they start school. So, you ask a science question and the first one to answer is the boy, and you give the boy the floor instead of waiting for the girls to give their answer.” ES6 “Because, at the end of the day, you are in a culture, which is a macho culture, and what I was saying is, if you raise your hand.... I only realised this after studying. So, now, when I have girls and boys, I expect answers from one or the other, but I didn't know that. You raise your hand to the boy and hit him, and you don't realise that he's silencing the girls in your class. So, that's... In other words, there are micromachismos.”ES6 “Yeah, if I was the principal of a school, I would definitely first train the trainers, so the teachers, and put in place a code of conduct that is strict in treating girls as equal, as this is really coming from many stories we heard from girls that some teachers really split the classes to boys and girls and let boys program and girls can play or go to internet and some microaggressions and inappropriate comments. This is something that a school should have in control, how the teachers treat students.”SK UBB1 “We implement comprehensive educational solutions and train teachers on how to work and support children in STEM environments.” BG8 “We can also think about providing training for teachers and staff to recognize and mitigate unconscious biases that may discourage girls from pursuing STEM.” MKD 1 “If we want to encourage more girls to take up STEM studies at tertiary level, we need to first improve the educational environment, starting from the teachers. Teachers' attitudes and biases can significantly influence students' perceptions of their abilities in STEAM subjects. Girls benefit from encouragement and positive reinforcement in these areas.” MKD 4
Involvement of young teachers	“Many of the IT professionals are of a similar age to me, some slightly younger or older. Now, a significant number of them have retired. Many, I dare say, have remained stuck with old knowledge and outdated curriculum. They did not live IT; they taught what they were taught. It would be extremely important to have young people teaching IT and computer science in our schools.” HU14
Involvement of female teachers	“It would also be good to have both genders represented because if girls see a female teacher teaching IT, robotics, and everything else, they might be motivated sooner.” HU14 “Well, when we have a conflict, it is always true that, for example, in UbuMaker, which is the mixed programme for boys and girls, we have four female monitors. This is also important, I haven't mentioned it before, but it is important that the people close to them, that is, those who are giving them classes, also see that they are girls, because that makes a lot of difference. Or, for example, when they are going to talk to them about science, that women talk about it.” ES3 “The second actors are the teachers, and here I think the particularly female educators in STEAM play a role in shaping the attitudes and aspirations of their students. And it can be done again in several ways through expertise and leadership. There is also the possibility that the female teachers are becoming a kind of agents of change, breaking

	down stereotypes and fostering a welcoming environment for girls and for all the students, of course." SK1
Being aware of the hidden curriculum (eg., images in textbooks)	"Girls can get more involved. Secondly, that they perceive what the issues are. In other words, the themes...They understand them from subjects that are interesting for everyone and that they realise the differences in textbooks. At the moment I am not thinking about primary school textbooks, but I am thinking about my secondary school textbooks or my daughters' secondary school textbooks. In physics there is always a boy who is driving a motorbike or driving a car and it's the mum who is driving a trolley. It has never changed. And so it's nonsense, but it corresponds to the kind of problems you're raising. It corresponds to issues that have to do with what is in everyone's interest." ES6
Follow the dynamics between girls-boys to avoid discriminatory situations for girls	"... above all, to be very aware of the feedback they give each other, that is, to make sure that a boy is not saying something to a girl, like, no, you're not going to do this, I'm going to do it. So, you often have to keep an eye on things, because when they work in pairs, for example, and they are boy-girl, the boy takes the computer, so you have to be very careful that the computer is shared out, that the boy doesn't have it alone or that the girl doesn't have it alone." ES3
How to create mixed groups?	"I don't let them join, unless they have behaved very well or it is a special activity, I don't usually let them join the groups they want to join. This year we have introduced a system whereby at the beginning of the year, well, after a month or two, when they knew each other a bit better, we interviewed them. Then, we knew more or less with whom they got on better and with whom they got on less well. So, we started to work with some base groups at the beginning of each session in which they got to know each other, and then they worked throughout the session with other children. I have a document in which I have been recording how I have seen them, if they have worked well, if they have treated each other well, for example. So, in principle, we don't let them function as they want because they are with their friends." ES3
Tecahers' role in motivating	"There need to be well-trained, very competent elementary school teachers who can stimulate all neurons from a young age. Because I can assure you that one of the reasons my daughter eventually enrolled in classical high school was that her teacher never gave her problems to solve. When she did give them, she said she had to explain how to solve them, because otherwise there would be a difference between those who had help from their parents and those who didn't. So, she would give the problem and the solution. In a rather dull manner too, because I believe teaching maths can be very creative if a teacher is well-prepared. It can be very fascinating and stimulating." IT 3
Methodology (tools, subject, content, focus)	
Creative pedagogy	"It's completely hands-on; something is always created. They always write programs, operate equipment, design something, print it out, cut it out—we have a laser cutter and several 3D printers. So, there's always a product in our lessons. I think that's what creative pedagogy is." HU14 "We need to make sure that STEM is a good game, a good game to play, otherwise there is no way, in my opinion, to solve the problem. I know because I've done it, I've been doing it for years." IT1 "The rare times I went to someone's house, I took the Legos as if they

	were the most beautiful thing in the world. Yes, however this creation thing is also important in my opinion." IT 1
Visiting company/female engineers, engaging companies	"There was a day when we visited the Huawei headquarters together, where we heard very interesting presentations, and of course, there were female speakers engaged in various areas of IT. We also visited the Huawei factory in Páty, where not only the girls but myself were amazed by the technology they use. It was very impressive to them and to us. So, I think this experience really motivated them." HU14 "We should also partner with local businesses and organisations to provide resources, support, and opportunities for girls interested in STEM." MKD 1
Applying methods for experimenting (practice, groups work instead of learning concept)	"And where you have to teach this one hour a week, I think it's extremely difficult for one hour a week, because it's simply not enough for you to understand, to remember, to learn, to see enough experiments, to do enough experiments, because that's another thing that's important for students to learn through their own experience, so they don't just hear what's happening. If not, you can try it. You can be satisfied, you can measure it, and the rest would be important." HU8 "But there's no other way, than to get people involved with all sorts of interesting ideas, or experiments, or whatever. That's for the best way, I think. Otherwise, I don't know how I could do it. Exactly what they do in the House of Experiments. They are worth their weight in gold, not only for physics, but for all natural sciences and technical directions. To attract children. Now, to target the girls especially, ... Of course, it would be nice, of course. But now I can't quite imagine how I would differentiate. What would we be specifically targeting girls, but not so many boys, or what?" SI3 "Which is, I think, the most positive part. So, one thing we have to do is to make them fall in love with science again. What you hear when you are with the students, especially when you listen to them, what they tell you is that they told me that I was no good at science and I liked it, but they told me that it was useless. This is like a fish that eats its own tail, isn't it? So what I do, and what my group and other researchers in specific didactics at the university have started to do in parallel, has been to work with active methodologies. In other words, the boys get the girls and boys to do research, to learn how engineering design is applied. In other words, on the one hand, they should acquire the ability to work and not be afraid if they don't know a concept. But above all, they should learn methodologies that can engage children to work in science. Science is fascinating - it is a constant search for answers. Not science as it is sometimes taught here, which is nothing more than repeating formulas or repeating definitions that you may not understand. I always think it's impossible for a primary school child to understand Ohm's law. The law of the relationship between voltage intensity and electricity. And here it is given with a formula. It is impossible. There are three variables. Or floating. It cannot be understood. In other words, conceptually, 0.01% of the population at the age of 11, 10, 11 has the capacity for abstraction to understand this. The rest do not. The rest reach it at 15, 16, 17. So that's why we have to change methodologies. Change to try to understand science from the experimental side. It's a bit like incorporating it. Incorporate the meaning of the concept. There will be time for them to learn formulas. There will be time for them to be able to define better, to use the concepts better. But you can't abort it as you are doing at the moment

	by requiring 10, 11 year olds to learn definitions that are complex, that are not simple.“ ES6
Bringing art as a tool for expression, better understanding of complex theory, etc.	“I never focused on talent training, but on the average, how to use computers in everyday life. So I thought that we had to deviate from these mathematical lines, and I preferred to make fairy tales, so I found it very difficult to decide whether I should be an artist or a programmer mathematician, and after all, I was standing with 2 feet on the ground and that's why I became a computer scientist, but I still love art and I bring it into computer science this way, and that's the way girls can be approached. To try from the social side and this is fairytale making, so I want to say something, I want to show something. And that's why there's always all kinds of products that I've made, how we can make fairy tales, how we can portray, how we can express ourselves, and that's very close to girls.” HU4 “For example, educational programming environments with which children can create and program not only mathematics, but all kinds of other things. I tell fairy tales, art. By the way, I also deal with Origami, so a lot of other things that can be done by hand are in the lab..”. HU4 “So I really took everything, even in the Vasarely museum there was an exhibition on how to make vasarely pictures, but programming is basic, so everything I say in everything. And this is mainly for girls, but also for boys. So I'm just saying that and well the internet is full of these too logo programming languages, since they are a visual programming language I tried to push them at the beginning precisely in order to visually plan. Which brings it closer to the girls.” HU4
Involving companies in extracurricular activities	“I think that's the key, as much involvement as possible of the community and companies or other extracurricular actors will also determine a change in society.” RO6
Incorporating specific topics the girls are interested in into curriculum (but it can be questioned at the same time if specific focus should be used - note by Katalin)	“I would do an experimental thing anyway. So the permanent playhouse in Cluj-Napoca, I would definitely do that (laughs). And then maybe we could think about experiments where we could have, say, kitchen physics, where he can make mayonnaise, and then we could look at it under the microscope and see what it looks like, or I don't know. So to tie things to what otherwise interests a girl more than a boy. It is certainly possible to find such things, I don't know what kind of physics is hidden in batik, I don't know what kind of physics is hidden in fabric dyeing, what kind of physics is hidden in book dyeing, so it is certainly possible to find such things. Yes, it was interesting, on one of these Hungarian days I took out a bucket of water and we threw the vegetables and fruit in it to see which ones floated and which ones sank, so that we could talk about density, and the girls were more interested in throwing the fruit and vegetables into the water than the boys. I'm sure you could find those, which would be more related to their interests, baby-making and things like that.” RO5 “But there's no other way, than to get people involved with all sorts of interesting ideas, or experiments, or whatever. That's for the best way, I think. Otherwise, I don't know how I could do it. Exactly what they do in the House of Experiments. They are worth their weight in gold, not only for physics, but for all natural sciences and technical directions. To attract children. Now, to target the girls especially, ... Of course, it would be nice, of course. But now I can't quite imagine how I would differentiate. What would we be specifically targeting girls, but not so

	much boys, or what?" SI3 "The support has to be systematic, with roles, with themes that are interesting for the girls, discovering what they are. What are the themes that are interesting for the girls?" ES5 "Another thing would be encouraging activities. So for example, current competitions like they have Lego or they have those remote controlled cars within STEM competitions. These topics are not attractive for girls to join the competition. So I would think as a teacher, as a school principal in different ways how girls can bring their creativity and the girl side to creating something technical, but still they can relate to, which probably they don't play with cars controlled." SK3 "And for the competitions, I have the same opinion that it's fine to have the mixed competition, but maybe focus the competition should be broad enough so that the girls can also bring their ideas that are creative enough, but not really boys oriented."SK3 "The girls definitely have quite a serious imagination, they have a lot of ideas, they are consistent, they are focused, they are goal-oriented. But at high school age somehow their minds are occupied with other things and boys are better entrepreneurs. That's why I think it might make sense to fund and organise contests for themed ideas that are created by girls." BG8
Incorporating informative elements, knowhow on the STEM professions, breaking down the misconceptions	"I think what has kept women out of technical universities for a while is the working conditions. But they have changed a lot recently. At this level it's another one where it's really harder for a woman to work in some places than a man. When you have to lift, there are things like that, but it's very easy to do. It's no longer a problem to lift with a crane and not a man. In most places I've seen that, that's not the case anymore." RO4 "And it is also needed. So, well, there has to be a bit of everything. And above all, I think that what is important is that everyone should be allowed to do what they like, but that everyone should choose what they like, knowing all the options beforehand. Because if you only know a few, what are you going to choose? In other words, people choose what they know." ES2 "Somewhere they learn programming. Somewhere during informatics they play with Excel and the internet. And that's not really encouraging that to apply for STEM, then it was a lack of information where they can study and what exactly they can study because they also had some biases about what work in ICT or STEM looks like. And after studying, they also had a lack of information about working in STEM, what it means, what roles can I have?" SK3 "What I would do is specifically the thing we already started doing, and that is first of all, to research the problem and get data on the root causes. There is undergoing research that will be followed up by an intervention on what the main reasons are behind girls not going into STEM education. So far, the data is telling us that there are these stereotypes that STEAM related jobs are still the dirty jobs and that this stereotype is still present there. So, first of all, making sure that career advisors in schools are well informed about what the options are for these kinds of jobs and that it's no longer a "you have to get oily and dirty" kind of a job or you can if you find one like that and that's what you prefer... but mostly we're talking about clean technical, data oriented jobs where you actually engineer solutions that help make the world better, or just help provide people with better services." SK2 "In my opinion, they should be shown prospects in the future. That is, if

	they study, what will happen next? That is, the prospects are that if they do not study at all, well, what awaits them in the future? ... And the prospects are that if they will be experienced, will study, will see prospects in their future, this, I think, is a big plus, when they will be shown where they will work in the future, what they will be able to achieve in the future. Current students especially value this when they are shown that this is where you can come to work, this is where you can continue your studies, or there is research, this is where you will have such a result, when you achieve that, here you will be. They need to show." UA6
Excursion/study trip/visiting university/company	"At our school, we organise an excursion to CERN in Geneva every year. 20 to 30 students attend. Typically, those who choose physics or other science subjects at graduation. In Geneva at CERN, in addition to the regular program that they prepare for us, we also meet every year with Slovenian scientists who work there. And for the last few years, I've been working on this with our... that is, with Anja Kranjc Horvat, who now works at CERN and she organises and invites colleagues who are there. And we meet women scientists who work at CERN, or go there from Slovenia or work there, more often than with men in recent years. That is, the students have experience from CERN that they are scientists at the top level, Slovenian, they work there and are highly recognized and respected and given positions that are respectable. Another example I wanted to give is about encouragement." SI5 "I think that basically everyone probably needs that help in general when choosing where to go. Because I remember myself in grade 12, there was a lot of hesitation and a lot of thinking about how to do better here, so everybody probably needs that help and advice. But that help could be like this - to give the opportunity to visit universities, to get to know the lecturers, to get to know the study programmes, to get to know the professionals who work in those fields, and I think the most important thing for girls would be to encourage them to go wherever they want to go, and to do whatever they want. It doesn't necessarily mean that if you are a girl, you can't choose engineering, that it's only boys, only men, and "what are you going to do here". The less of that attitude. And if there were initiatives like this, where girls can go to universities, to laboratories, to talk to people - women in this case - who are already working in the field, I think that would really inspire and encourage them." LT3
Creating gender mixed groups	"In the safe cracking competition, both national and international, we would like to see even more girls in the teams. And this has been expressed loud and clear in the international competition as well. And here we are... In the rulebook, we currently have... heterogeneity by gender can bring 2 percent to a team's performance. That doesn't mean that... For both genders. That is, if the group of five is of the same gender, they do not get an extra point. If the ratio is 4 to 1, the bonus is 1 percent, and if the ratio is 3 to 2 markup is 2 percent. By that... And that, in principle, is supposed to basically encourage more girls to compete... By doing so... The mentor of one of the groups has expressed doubts over the past two years when we spoke whether this is really encouraging or not... Don't the girls then get the impression that they are in the group just because the group gets 2 extra points? And she suggested that maybe that criterion should be omitted. So here, really, when encouraging, you need to be careful how you do it." SI 5

Collaborative work	“Methodologies that allow for collaborative work often work very well with girls, where they can collaborate with others to achieve results. They work really well. And I would say that's basically it.” ES6
Science Hackathon	“Very close to young people: Science Jam Hackathon. Within 24 hours, scientists, that is, from Krka, researchers, or environmental topics researchers from the Jozef Stefan Institute, maybe also from Nova Gorica, from Velenje was also one, because one of environmental faculties is located there. And within 24 hours, they get acquainted with the research methodology. Mentors are also available to them via ZOOM. And they have to do some scientific part plus an entrepreneurial one, that is, some business plan. And I've found that suits young people very well. And this is also one of those forms that are then incorporated further into more serious research work.” SI4
Connection with real world problems	“Research projects, now a new orientation is science in the context of science in the service of humanity. Not only basic research, but above all useful value, direct utility. So now the scientific and entrepreneurial oriented projects, and of course the circular economy, sustainable development.” SI4
Connection with inventions already done - role models from the past	“And maybe some additional motivator for kids who are still in school to get excited about some things that have been invented in the past, and then perfected with time. And they see that without these inventions of the past, we wouldn't actually be where we are today.” SI3 “And maybe some additional motivator for kids who are still in school to get excited about some things that have been invented in the past, and then perfected with time. And they see that without these inventions of the past, we wouldn't actually be where we are today. But it's true that, even in exhibitions, in the Technical museum, it would be nice to focus more on good role models. We should present more women in science, who were probably often silenced and their life story is also not written anywhere. When, for example, we had the exhibition “Knowledge without Borders” years ago, we made an effort, and we also presented women in science. In astronautics, in physics, astrophysics, botany... But there are many more areas where children can be further inspired by science careers throughout history.” SI3
Science for active citizenship, sustainability	“One of those topics that we started in October before the Fall holidays was successful in the business category – entrepreneurship. They came into the finals and had a great defence. One such project is, I would say cute, because these are not just research tasks, this is natural science in the context of natural sciences for active citizenship. A reusable cup, just like when you go to a game and you get your drink in it. We decided to make the cup from some really recyclable material. Such packaging is already approved for food. And we found manufacturers in Germany and one company in Slovenia, Plastic Skaza, which makes polyethylene combined with bamboo fibre. We got in touch with the woodworking department. And we said, what bamboo fibre, because it's not sustainable. We have an abundance of wood waste. We will use wood fibre from waste wood. In addition, we made an application for the deposit system. In Stožice or if you go to an Eventim concert, you can buy a cup at the venue, that is dishwasher safe. They can also personalise it and at the bottom it has a QR code that is connected to the app. Which means, we follow the user exactly. We'll know exactly if they do not return it. And when the cup has done

	its job, if it is too much ... scratched, it is not ...hygienic anymore, it can be returned at any of the venues. Customers, however, are individuals. There will already be a few slogans and it so that you can recognize your glass even from far away. Then we got... Coldplay is a sustainable band. We got a Zaria band. It also has one wind piece and is now our house band, which will have a promotional piece and logo up on the cup. We have a house band, Plastic Skaza, that is interested in developing new material. In short, I find those are very useful ideas. It's not pure chemistry. This is where science is in context with all other sciences, including marketing, including media approaches. And it seems to me that this is the future." SI4
Use relevant, new topics, which are interesting for the new generations	"And maybe we can also discover interesting themes for children that are not the ones that are in books and that have been around for 50 years for a completely changing generation." ES5
Change technology to better engage girls	"No, girls already like it. What we have to change is the technology so that the image it gives also includes them and doesn't alienate them. Because if we advertise a video game and only boys appear in it, it is difficult for a girl to identify with that video game. And the solution is not to make the same video game painted pink. OK, this also happens a lot. So, well." ES5
Only girls groups/ activities only for girls - arguments in favour - arguments in opposition	"So, I think it is a question of finding a balance and of having activities for girls only because we have many factors to compensate for, i.e. another of the elements that we have seen, for example, is that girls speak less in the classroom. So, it is very difficult to get all teachers to be aware and to deal with their own biases and stereotypes and to get girls to speak in the same way as boys. So, we can have complementary activities where we encourage girls to have a little bit safer spaces where they can empower themselves without the fear of someone coming along and saying something outrageous to them and that they have that... we help them to develop that capacity. I think it's about finding a balance between those activities. So it's not not doing it." ES5 "The truth is that it is true that we are sometimes asked, and this is important and needs to be explained, why we have year groups for girls only. So, on many occasions, when they ask you, well, ten minutes before, the boys have been very heavy, and then you can tell them, look, because of this, because you have been very heavy before, because the girls keep quiet, because when we hand out the material you often monopolise it and you don't leave anything for them." ES3 "I don't know if you... For me, for example, here, you do the... the Maker Girls, yes. I don't know if you see the fact that it's only women as a success, that there are more girls who sign up than if it were a mixed group, or a mixed group in which it's mostly boys, because it's a sector that they like. I don't know, maybe girls like to be, let's say, in a group of women. And then, well, we could do activities, but I have doubts about doing things specifically for them." ES2 "That is, if there is a FPSTEM programme, it doesn't work very well, to be honest. In other words, they call us every year and then they don't do much with the students. But there is no initiative that goes much further. When colleagues ask us to give talks, they talk about the centre in general. They don't talk specifically to girls. So, in the future, I can tell you that I want to carry out this type of initiative, like the one we have

	seen from colleagues in other cities. Let's focus on the girls, because that's where we have it.... It's an open field where we don't have representation. But we also have a part of the faculty, in this case, that tells us why we are going to rule out boys. Because they come on their own, just like that. As they already come, there is no need to do anything. But even when we have taken a small measure like this, calling a meeting with the girls to explain to them that there is an accompaniment programme for them, the boys, both teachers and students, have complained. And why do you do things for girls, and why can't I? Well, because this programme is for girls, specifically. So, I can tell you, but it's for them. And if it's the other way round, if I told the teachers, hey, tell the girls in your group, the tutor, that there's a meeting I don't know where. So, they came to the classroom and said, "Girls, you have a meeting with the teachers. I know what. Has it created discomfort among girls and boys, but why? Why do you have to make separations? So, it is very difficult to try to make measures that do not disturb. In other words, on the one hand you have to promote them, but on the other hand it is very difficult not to bother them. And the girls in these cases have felt singled out and have not returned to these types of meetings. I mean, but, well, you have the thing about girls, they tell you. In other words, they immediately turn you around, they give you a negative view. Hey, not you, you've got the I don't know what about girls. And they have already made a split in the group. So it's very difficult to take action without offending everyone. And in that offence, the girls withdraw. Because the one who says, look, you're a donkey, it doesn't go with you, it's OK. But for the girls to withdraw and say, I'm not participating because then I'll be singled out. That's why I say we start much earlier, once they are already here in the centre. What they want, once they are here, is not to be distinguished. They want to go unnoticed, they want to be able to move forward and work and no one will give them any consideration because they are girls. This is very detrimental to the way they see themselves mentally." ES8 "Yeah, we toyed, played with that idea for a long time, where to isolate girls, where to join girls and boys. And from my opinion, separate competitions are dangerous because that's not the real world. When a girl goes to tech studies or enters the tech world, she will probably still be in a minority and it's good to adapt to that. But isolating girls from our experience is very viable and good at their technical beginnings when they have really low self-confidence. For example, we do coding camps for girls only and they tell us that if there were boys allowed, they wouldn't attend because they have an experience from school that when they say something incorrect, boys laugh because they are a little bit ahead sometimes. And then they stop speaking up and they stop developing. So having them isolated for the beginning to gain self-confidence and theoretical knowledge is good, but then it's really, really efficient to mix them as we do during the year. We have coding lessons for youth and we mix girls and boys." SK3 "But I think that having specific female-orientated classes is beneficial sometimes, especially for older females, because we start gender roles ourselves. And in the technical school here in Reykjavik, a couple of years back, they made in the evenings, a couple of weeks course, like a workshop just for girls or for women. On how to maintain your house, like how do you drill a hole in the wall and how do you do this and how to do that and so on. It was a very popular course and I heard an interview one time with one of the individuals that was the instigator of that workshop and the interviewer asked her "Why do the females need

	to have a specific course for them? Can't they just go to the regular course?" And she was going, well, there's another atmosphere with the females. It sometimes becomes less competitive and nicer. But also, males have a tendency of wanting to take over these projects and finishing them for women. So they don't end up learning anything. I'll just do it. And so they felt that they needed to have a class that was just specifically made for females so that they could learn. So these gender roles didn't conflict and overtake." IS 2
To see how to apply what they learn / real-world application	"That's fine. You can look at all the technology from there and take the interest in science from that perspective. There are no studies that indicate that women tend, or that girls tend, to...Whether the issue of care is genetically determined or not. But what is true is that there are several studies that show that women tend to choose careers that have something to do with care. So we could rethink areas in which there is very little basic female participation, such as physics, or engineering, or computer science, as well as having more women teachers, in some way influencing this, influencing how these physical contents that are developed in the degree, or in computer science, have concrete applications." "In other words, I think that this is fundamental. It is fundamental for women, for girls, to see the application of what they are studying, and now I would say that it is fundamental for both boys and girls. What is the application of what I am seeing? ES6 And of course their applicability, because very often, especially in Bulgaria, we know traditionally we associate ourselves with very strong mathematical schools, but the truth is that very few of our very talented young adolescent mathematicians are able to imagine in purely applied terms how this mathematics can be implemented and how it can become an innovation that can reach every end person and change their lives." BG3 "In terms of encouragement, something that I see as working very, very well, something that we within our programs, specifically the hackathons that we do AI and IFactory, one of the first things when we bring the youth together, even before we've assigned them to different teams, before they start the mentoring sessions, basically our goal is and we get them into different science labs where first hand, not just reading and knowing that something is there and it clicks and it does and it follows and so on, but it has a lot of application, a lot of great application and it exists. ....So, it is that very applied and very direct input and accessible environment where the undergrowth can see in action, live, how a lab works, what the capabilities are, what the applied aspects of a particular scientific area that they are interested in, are some of the very key tools that should be used encouraging and attracting kids to STEM." BG3 "Offer opportunities for girls to engage in research projects and internships that give them hands-on experience." MKD 1 "Next, I guess we will need to improve the curriculum design and classroom dynamics as well; developing curricula that integrate real-world applications and highlight the societal impact of STEAM, and encouraging project-based and collaborative learning that can help girls build confidence and interest in STEAM subjects." MKD 4
Need assessment (exploring girls' needs) and	"Above all, the most important thing is to look for what they like, both with girls and with boys. What they like most, above all, is to listen to them, to give them examples of many things, that is, so that they have

evaluation	the capacity to decide on many things.” ES3 “It happens that educators and learners speak different languages, and there is a barrier between them. It would be good, before starting a project or training, to analyse the target group for their level of competence on the subject.” BG4
Gamification (make learning a play), applying different thinking on technology	“Then, they take them to the vocational training centre and for a few hours they teach them robotics or mechanics. Of course, it will be a very simple thing. It will be a very safe thing to do. But in the primary school they already know that they have the possibility of taking the girls to the VET centre for a week. And the girls are telling each other that they are actually playing, because in primary school, if they don't learn by playing, they are not motivated. And so they are programming a robot to play tic-tac-toe with them or to do things, but they are programming.” ES8 “I would not try to explain to these women that they just have to adapt to men to be successful here, only I would show them that there really is a place for different ways of thinking, for different thinking about technologies and also just presenting this social value of technology, should probably be equally important.” PL1
Using new tools, media	“No, we have to help teachers at the elementary school level to be better teachers, definitely one of the things we have to help them to learn how to teach with modern tools and prepare materials for students.” In the media, they are used to consume.If we really can't expect that kids in this DNA will learn just by reading the books, we really need to work on preparing multimedia materials, and also give them more hands-on opportunities to actually work in physics or in maths or chemistry. “SK HETFA 2 “Apparently, we can demonstrate the same chemistry, physics, natural sciences experimentally, children are visual, they perceive it more easily. We need to digitise, we need to switch to modern trends, platforms, because children now live with a touch phone in their hands, and not with a book very often, and we must, for sure, understand this and change our approaches, to make you interested in it.” UA4
Intersections	“First, when we talk about science, somehow we can no longer consider it one-sidedly. I'm only an engineer, I'm only a mathematician, I'm only a physicist, I'm only a biologist. The truth is that science is now multidisciplinary.” “So it's extremely important that children, adolescents who are involved in the subject, don't just focus on a particular area of science, but also get a little bit of a broader understanding of the other sciences and how they interact and what can come out of them.” BG3
Exciting and fun ways	“I would say increase the outreach, by organising workshops, summer schools or camps, or after-school programs that introduce girls to STEM subjects in a fun and engaging way...” MKD 1
Networking	“Next, creating networking opportunities through events, conferences, and alike.” MKD 1 “We should think about creating support networks within schools and communities, conducting outreach programs that target girls and showcase the diversity of STEAM careers that can broaden their perspectives and aspirations.” MKD 4

The significant role of role models	
Personally meet with successful women working in STEM fields	“Here, parents, teachers, the environment, the state, if we are looking at such a large scale, everyone has a role or a place to support, they can support, they can promote the increase in the stem area, the increase in the proportion of women, everyone at their own small level, as they can support girls, but it is very important to have positive examples. Because if girls hear about it or read about it or reports or research, that's all fine, but if they don't meet flesh and blood women researchers that they can actually talk to and believe or ask about difficulties, it's much harder. ... We had one of our winners who is from the countryside and has no children yet, she is still in the middle of her career, but now we have introduced the non-researcher award for two or three years, because the aim is to make engineers and technicians feel that women are doing such good background work at this level that without them, it would not be easy for a male researcher, and somehow they need to be brought to the attention and the girls need to be given these positive examples of the real proof, if you can use that word, and when they can meet the ladies in their own environment and talk to them or ask them how they really did it or what were the difficulties or what was the beauty of it, then the teacher, the parent, anybody, can say to the teenage girls, positive examples are the greatest strength from there.” HU3 “I think that in the same way, based on models, there should clearly be female models, to show that it is possible, but they should really be here and there should also be specialists to show what they have built with teams of girls, but also through models I would go, because I do not realise what else could influence as directly as possible. I mean, when you see someone telling you that's what I did, that's what I managed to do, here I had obstacles, it's better than any book, lecture or movie, at least I see it in our department, when we want to explain to students or future students what it means to come to the university and so on, we have an impact of, I don't know, 20-30%. If we bring in a guest from a company, from Bosch, from Emerson, the room is full, and everyone says "extraordinary" about exactly the same thing we said the week before. So, industry models are effective.” RO1 “At our school, we organise an excursion to CERN in Geneva every year. 20 to 30 students attend. Typically, those who choose physics or other science subjects at graduation. In Geneva at CERN, in addition to the regular program that they prepare for us, we also meet every year with Slovenian scientists who work there. And for the last few years, I've been working on this with our... that is, with Anja Kranjc Horvat, who now works at CERN and she organises and invites colleagues who are there. And we meet women scientists who work at CERN, or go there from Slovenia or work there, more often than with men in recent years. That is, the students have experience from CERN that they are scientists at the top level, Slovenian, they work there and are highly recognized and respected and given positions that are respectable. Another example I wanted to give is about encouragement.” SI5 “Well, for example, at the Science and Technology Station and the Scientific Culture Unit we have initiatives such as the Week of Women and Girls in Science, for example, where the public is mixed, but the people who teach these skills are women. Then we have initiatives such as talk with a researcher, for example, in which a large number of women from all over the University of Burgos participate. Then, apart from that, we, well, this year we have launched the programme of

	women scientists on the streets, in which we have decorated light boxes in the city of Burgos with examples of women scientists because many people don't know about them and we have seen that this is a problem.” ES3 “And another obstacle they had was the lack of female role models in their environment that would encourage them to think about studies in STEM.” SK3 “There is also something I have already mentioned, and it's the female role models in STEAM education and showcasing the good examples.” SK HETFA 1 “Of course, there are other good examples I can give exactly and I mentioned a little bit earlier already about the personal example. Sometimes when we do events and when inspiring women come forward who are extremely successful and tell the story especially about the balance of how to be a woman, how to be a mother, how to be a professional, how to be a scientist and how to be successful and happy, harmonised in this life, I see an extremely great interest from the ladies in the audience, which of course later on they often turn to us.” BG3 “It's a pattern that's well known, when people see a successful, significant, beautiful, healthy, happy person talking about what they love to do and that work is not a job, it's a way of life and it's a pleasure, then it seems like a lot of people want to be like them. So again, let's show good examples.” BG3
Recruiting girls from secondary education (event organised by HEI) - meeting with role models	“So what I mentioned, in aquaculture, fishing, or wildlife management, although there is also a positive shift in the direction, they are so masculine. And they have deeper roots in where we can start changing. Obviously, as women, we go to high school and promote that particular training, we talk about it in our own research. This matters a lot, many of us are at the education exhibition as women, we also try to support underrepresented majors in this respect, but I think that other programs are needed here to change this image.” HU6
"... to present bright careers of women researchers" HU11 / references of women from the past, increase visibility of successful women	“Another example: First of all, for example, when I teach the girls' groups I have taught, and the boys' and girls' groups I have taught, when I put references, I try to put female references so that, if possible, they get to know women who have dedicated themselves to science. For example, last year we did a project with a mixed group of boys and girls in which we decorated some cupboards at the station to store material and the cupboards were named after female scientists. Then, these groups of boys and girls did research on female scientists, created a script and recorded a video and then with a QR code you can access that video.”ES3 “In other words, young boys and girls want to be like someone they have seen. So, you have to look for examples. Of course, it's very easy to be an example when you're a footballer, because everybody is very attracted to that. When you are an engineer or a scientist, it seems boring. But you have to give it another perspective. Not everyone is going to be a footballer either, no matter how hard they try. So you have to look at other examples. In other words, people who are doing it and who are working.” ES8 “There is a lack of role models when it comes to women working in STEAM jobs. ...So, a part of the intervention that the Institute for Education Policy is writing a letter to a high school or primary school student from this perspective of like “hey, I'm a girl studying this field or

	I'm a woman studying, working in this field and this is why I'm glad I made this decision…" SK HETFA 2 "Role models and mentorship programmes are another incentive that I think is valuable as it can help girls to actually visualise their future in these areas." MKD 1 "I guess we should think about a more inclusive curriculum, to have more diverse examples and highlight contributions from women in STEM." MKD 4 "We should have initiatives that increase visibility of successful women in STEAM – this does not only increase girls' exposure to role models, but is also proven effective to challenge stereotypes and provide tangible examples of achievement." MKD 4 "On the other hand, what we sort of do additionally, which we think might also encourage high school girls more, is, for example, we make a game like this, where they learn about women scientists. It's kind of a role model that we show. Or we organise meetings with our women scientists. So that they see these scientific career paths in the STEM sciences, that women are pursuing this and, for example, they are able to talk about it in an interesting way, to encourage simply girls to join one path or another. We try to make sure that they have just to deal not only with men, but with women who are just pursuing such a scientific path." PL 2
Financial support	
Free after-school programme for girls	"Additionally, when discussing disadvantaged individuals, this could involve support in their home environments or in extracurricular activities and camps. Today, an equipment-intensive workshop can be challenging financially even for families with one child, let alone those with multiple children." HU14 "In other words, if we are thinking of developing an activity outside school hours, the families with the least resources are not going to bring their daughters or sons, even if the activity is free, because they do not have the capacity to bring them, nor are they linked in the same way. So does that mean that we don't have to do any activities aimed only at girls? No, it means that we have to see what we are doing in each case and it means that we have to find a balance between the type of activities. If we are only going to do one, all the recommendations and all the studies that exist tell us that it has to be done in the classroom, that is to say, the moment when we have all the students and social gaps related to the family situation cannot appear and also directed at both girls and boys because in this way they are also aware that this is a field for women. So, I think it is a question of finding a balance and of having activities for girls only because we have many factors to compensate for, i.e. another of the elements that we have seen, for example, is that girls speak less in the classroom." ES5 "Yes, for example, I have an example of two girls who live in a family with hardly any scientific culture, and when these two girls came to the station's programmes, it was because they were paid for and because the programmes had a grant, and because they could come with that grant, but now, for example, with that grant, this year they have not been able to come, to give an example. So in many cases families make the effort with boys, but not with girls. So maybe we have to see how to attract these girls and how to bring them to school, to external centres that are not schools or whatever." ES 3

Support is connected with storytelling/communication	"I think there is, likewise, through the specific programs we collaborate with, a CISCO program, CISCO Women Rock IT I think it's called, in which they tell stories about successes from different backgrounds, from different countries and from Africa, for example, how they managed to transform themselves by attending courses at CISCO Network Academy, but I don't think there are others or I don't know. Look, I declare myself again and I don't like to say "I don't know", I feel embarrassed not knowing." RO1
Scholarship, grant for girls	"Maybe some additional scholarships. Maybe that's also one segment – we can never get a complete insight into the family situation. ... Maybe it would be good to have an office at the level of a few schools, or at least a person the girls who would like to go further could turn to, and maybe we don't even know they have a financial problem, so let's encourage them in that way and say, here, we will pay for your education, just keep going." CR1 "For sure, providing scholarships and grants specifically for girls pursuing STEM degrees to reduce financial barriers. MKD 1 A big issue remains poverty, if women are not economically empowered, very little can be done when it comes to gender equality. Thus programmes in action for gender equality paired with economic development and empowerment of women is the right mixture, at least in my opinion." MKD 1
Giving information on scholarships, camps	"At the very beginning it was so that I did this Open Day only for girls indeed. In turn, we later went in such a direction that we do the Open Day for everyone, and for girls there were special stands, for example, with information about scholarships. What we do is give these girls information about what various scholarships or actions are available to them. There is a lot of it. Well, what the Perspektywy Foundation does and other institutions with which it cooperates. The Foundation just organises all these scholarships, camps and so on for girls. There are activities directed to girls and we just take advantage of this and inform our students about all these scholarships. "PL2
Community and parental engagement - creating a supportive environment	
Increase confidence in girls, self-confidence is a must	"We often see how many women feel uncertain when they start a career in informatics, sometimes feeling slower than their male peers or relating to the field differently. Therefore, it is crucial that we devised these programs to build confidence and emphasise that the goal is not a competitive race but rather the full development of each individual's talents in the realm of informatics." HU12 "So we have to try to give these girls the freedom, the possibility and above all to motivate them a lot, because when girls and boys are in the same space, the boys take on a very dominant role and the girls are left far behind, which is the main reason for Maker Girls, that they take two years in which they are learning about science and technology and that they are acquiring self-confidence and that when they get to the mixed programme they are not left behind and in fact our experience tells us that girls who have taken the two years of Maker Girls for example and this year they are in mixed courses, They take tremendous initiative, they finish everything brilliantly, they are very focused, they work very well, so perhaps now the next challenge would be to try to ensure that in these mixed groups, whoever leads the activities from time to time, is

	also the girls, that they not only take the boys in the lead, but that the girls also take the lead in these classes." ES3 "I think that basically everyone probably needs that help in general when choosing where to go. Because I remember myself in grade 12, there was a lot of hesitation and a lot of thinking about how to do better here, so everybody probably needs that help and advice. But that help could be like this - to give the opportunity to visit universities, to get to know the lecturers, to get to know the study programmes, to get to know the professionals who work in those fields, and I think the most important thing for girls would be to encourage them to go wherever they want to go, and to do whatever they want. It doesn't necessarily mean that if you are a girl, you can't choose engineering, that it's only boys, only men, and "what are you going to do here". The less of that attitude. And if there were initiatives like this, where girls can go to universities, to laboratories, to talk to people - women in this case - who are already working in the field, I think that would really inspire and encourage them." LT3 "My recommendation is to increase girls' motivation to pursue STEM education. This can be done with very good examples that are in the world and in Bulgaria, of course. This way, we can give them strength, confidence that they will be able to make it in this difficult profession." BG4 "Next, I guess we will need to improve the curriculum design and classroom dynamics as well; developing curricula that integrate real-world applications and highlight the societal impact of STEAM, and encouraging project-based and collaborative learning that can help girls build confidence and interest in STEAM subjects." MKD 4
Informative events on STEM subjects and professions	"I believe they appreciate any programs we introduce to high school students because a significant portion of them are still exploring their options and may not fully understand the potential of certain professions, such as IT. Many students attend open days and events, which are critical opportunities for us to open their eyes to these career paths." HU12
To show that certain fields are not male fields	"I think that basically everyone probably needs that help in general when choosing where to go. Because I remember myself in grade 12, there was a lot of hesitation and a lot of thinking about how to do better here, so everybody probably needs that help and advice. But that help could be like this - to give the opportunity to visit universities, to get to know the lecturers, to get to know the study programmes, to get to know the professionals who work in those fields, and I think the most important thing for girls would be to encourage them to go wherever they want to go, and to do whatever they want. It doesn't necessarily mean that if you are a girl, you can't choose engineering, that it's only boys, only men, and "what are you going to do here". The less of that attitude. And if there were initiatives like this, where girls can go to universities, to laboratories, to talk to people - women in this case - who are already working in the field, I think that would really inspire and encourage them." LT3
Encouraging girls to take roles in competitions	"In the safe cracking competition, both national and international, we would like to see even more girls in the teams. And this has been expressed loud and clear in the international competition as well. And here we are... In the rulebook, we currently have... heterogeneity by gender can bring 2 percent to a team's performance. That doesn't

	mean that... For both genders. That is, if the group of five is of the same gender, they do not get an extra point. If the ratio is 4 to 1, the bonus is 1 percent, and if the ratio is 3 to 2 markup is 2 percent. By that... And that, in principle, is supposed to basically encourage more girls to compete... By doing so... The mentor of one of the groups has expressed doubts over the past two years when we spoke whether this is really encouraging or not... Don't the girls then get the impression that they are in the group just because the group gets 2 extra points? And she suggested that maybe that criterion should be omitted. So here, really, when encouraging, you need to be careful how you do it." SI 5
Involving school/girls from the county (disadvantaged areas)	"But it is very important that schools know about it even the smallest schools and that they get there. So for these children, the fact that a little girl from Berzsenyi High School can go to Budapest is not a big deal, because public transport is there and it's there. But to do all this from Kisvárda is not certain. Where do they come from, how do they get there?" HU7 "In Iceland we need to focus on rural areas to reach more girls and their parents." IS4
Mixed group work - attention of assigning girls non typical roles	"I mean, instead of... At least that's what I'm trying to do. Or that, I don't know, the issue of group work, that the roles are distributed, not that the girl is always the secretary, but that there is a role, roles that rotate." ES6
Motivating/ encouraging girls	"Well, or motivate them in some way, or give talks at the school, at the educational centre, so that women like you, who have been through this, can come and, in short, motivate them in some way." ES2 "...we would have to be very careful because there is a risk that others might feel a bit excluded and we don't want the opposite effect either but it would be interesting to have some kind of.... personal development to convince oneself more than as a career support as such, but as a support to say to girls or teenage girls, hey, you are self-sufficient, you can... a bit of that kind of encouragement. Yes, I imagine that in the end there are, like everything else in life, some people who are more inclined to be a bit more forward and maybe girls who are not so much so that they lose a bit of shame. It is true that I think that especially in adolescence the typical things that you are in a group of friends, girls and girls, and maybe you are ashamed to do things because the boys are going to say and they probably don't have the same point of view, so that kind of thing and it's OK." ES8 "So, if that motivation is awakened or it is seen as a normal thing, if the motivation does not have to be awakened. In other words, the same way you like to take care of the doll, the same way you like to programme the robotic arm to play with you." ES8 "I would treat them as underrepresented and disadvantaged, which means that there can be some kind of support which is not positive discrimination, but it's supporting someone who is disadvantaged by maybe giving them some kind of lead roles in projects and putting them as role models for other girls who kind of would have feelings that they will be worse than boys and treat them equally and create an environment where they will be treated equally and maybe also provide a little bit bigger encouragement than boys receive when they are good." SK3 "So somehow we will ignite the flame for this field for the future. There is no flame, there is no... then the kids will just not choose this career

	because it's a lot of work." SK2 "My recommendation is to increase girls' motivation to pursue STEM education. This can be done with very good examples that are in the world and in Bulgaria, of course. This way, we can give them strength, confidence that they will be able to make it in this difficult profession." BG4 "Also to help them unleash and develop their potential. So a relatively good way to support would be to share good examples. It should be a well realised STEM field to visit universities and give motivational lectures to students." BG8
Raising girls' attention towards STEM - putting extra effort into it	"I think it all starts from the beginning, from birth, basically. Maybe unconsciously, but we direct girls and boys to certain areas - girls have pink clothes, they play with dolls, with little kitchens, and boys have blue clothes, they play with little cars, with some kind of constructors. Well, that's sort of where the gender divide starts. I think that, realistically, from infancy, from childhood, the toys should not be boyish or girlish. A girl can play with a toy car, a boy can play with dolls. Just give the child a choice. It's all well and good if a girl only wants to play with dolls, but she should have that opportunity to choose what she wants to play with. In the same way, later on, after school activities start. There are all sorts of afterschool activities, but usually if there is a design, something in that direction, a healthy eating topic, it is usually the girls who attend, not even that they go, but still the parents often make that decision about where to put their child. Boys are more attracted to after school activities like all kinds of construction, coding and so on. So I think that for a child, and then for a more mature person, to choose a certain field, they have to have at least some exposure to it first. Because it is unlikely that anyone is going to go in that direction and plan to work in a field that they have only heard about but not touched. This is again to create opportunities to try out activities. ... So I think the more different things you can try, it doesn't have to be an afterschool activity that you have to attend to for half a year, it could be maybe a visit to the STEAM centre, some practical work done at school, a trip with your parents to, I don't know, to Ventės Ragas [ornithological station] - getting interested in birds, ornithology. It's just to give the child opportunities to learn about the world and to find an area of interest, because of course the work is important as a financial basis, but the work has to be enjoyable as well, because we do spend a lot of hours in it. We have to find something that we really enjoy, and then it will be more fun to work." LT 3
Mentioned as a successful program	"So, since then, this association has been fantastic, with which this association came forward, and it surely has a huge impact. ....I can't think of anything better than Girls' Day. Perhaps something like Researchers' Night could help, but there the participation is sporadic. Girls' Day is good because a few girls go, and they are sure to talk about it to their classmates who weren't there. So, it's like a kind of infection, in the literal sense of the word, to inoculate the young people with this idea. It's a very, very good initiative." HU10 "I really like this movement, the girls' day movement. So the fact that you can appear as a girl at different universities doesn't even bother to tell you what this story is about. So she's the one tearing down walls and shattering misconceptions. This is very important. This is a way of getting into universities, but this should be strengthened already in grammar schools, and it is high school students who come here that

	could safely be moved to an even earlier date. So there are such career guidance tasks in primary schools as well. It could be used there to make it work, and many more schools should know about it." HU7 "We see this in the Girls' Day event, which is now happening twice, because there is one that is happening now, April 25. It is always the last Thursday in April, and there is the Girls' Day festival, which we invented three years ago, and there we have to change the location, because we have outgrown the aquarium club, and we can offer 500 girls a day with several companies, companies, universities, research centres, who can meet these 500 girls in one place in the framework of lectures, workshops and creative activities. And it's good for the girls because it's a standard girls' day where you pick an institution and spend a day there. And the following year she can look at another institution, but this festival is such that she can meet 20-26 partners in one day and get a mass of information from which she can decide whether she wants to go to university or whether she wants to work as an engineer or laboratory technician after high school, either in industry..." HU3
Supporting university female students/PhD candidates	"So, back in my time, when I was a university student, which was ages ago, there was a female associate professor in one of the departments who specifically said, "Girls, you need to try harder, because for you..." And she emphasised that we need this support because of the environment. It surprised us at the time, and I don't even remember anything else, just this one... She taught biochemistry, and it felt strange because no one had told us this before, but she put it this way. Later on, I realised... as a university student, you don't think about it because you're writing a thesis, and the boy sitting next to you might want to cheat off you, so you don't feel this boy-girl difference, and it surprised me that this teacher pointed it out. Then I realised she was right. Later, as a vice-dean, and now in the doctoral school, there are countless opportunities to have personal conversations with young people, and I also consciously try to offer support if someone doubts their ability to pursue a doctorate. I tell them they are capable of it. So, I try to help the upcoming young women individually based on my own experiences." HU 10 "Offer specialised counselling services that help girls navigate their academic and career paths in STEM, including advice on course selection, internships, and job opportunities." MKD 1 "What usually bothers me is that, especially coming from higher hierarchical circles to lower ones, attention is demanded and understanding is required and to ask for goodwill even in cases of emotional fluctuations, usually from men to women, but the reverse is by no means a given." RO3 "And I think that, in the end, any environment in which one can gain a bit of pragmatic experience in these areas of work and in which one can get in touch with a person, who might be interested in the same directions, just 2-3 steps ahead, and I can say that I felt it on my skin that when the age difference between me and the students increased around 10 years old, I don't think that I have less availability, although I may not be as understanding as a person with exactly the same emotional background and with about the same cocktail of hormones specific to my age, but I think that I no longer receive the same openness or trust from younger people and that simply this solidarity that is facilitated by close ages is very important." RO3 "The other question is to create, perhaps, groups for.... In the careers,

	especially technical ones, discussion groups of female students. In other words, to create groups to see what are the elements that are preventing them from working, right?" ES6
Educating parents	"Yes, we will need to increase awareness of parents of all genders on the possible pathways and STEM education in Iceland, involve parents and home in the education/after school to be comfortable with STEM fields (if parents are not in STEM/STEAM) ... We aim to have more events for parents to get engaged in STEM." IS4 "We should educate parents about the importance of supporting their daughters' interest in STEM and how they can help foster this interest." MKD 1 "It should start from the parents. I am very pleased to see that we are moving from the paradigm of making distinction between sons and daughters in a sense of valuing more boys and looking at them as our heirs. That is quite positive." MKD1 "Similarly, encouragement from parents and society can boost girls' confidence and interest in these fields." MKD 4

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State-of-the-Art Approach

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