STREAMING GIRLS AND WOMEN INTO STEAM EDUCATION, INNOVATION AND RESEARCH

STREAM IT

D4.2 Toolkit for the establishment and maintenance of the National Inspiration Hubs

31.10.2024

STREAM IT

Project full title

STREAMING GIRLS AND WOMEN INTO STEAM EDUCATION, INNOVATION AND RESEARCH

Project acronym

STREAM IT

Project Agreement no.

101131843

Deliverable title

Toolkit for the establishment and maintenance of the National Inspiration Hubs

DOCUMENT CONTROL SHEET

AUTHOR(S)	Bridget Burger (STEM Ísland)
REVIEWER(S)	Sunrise Tech Park
DISSEMINATION LEVEL[1]	PU
START DATE OF PROJECT	01.01.2024
DURATION OF THE PROJECT	36 months
SUBMISSION DATE	31.10.2024
ORGANISATION NAME OF LEAD CONTRACTOR FOR THIS DELIVERABLE	STEM Ísland

[1] This project has received funding from the European Union's Horizon Europe programme under grant agreement No 101131443

PU – Public (fully open, automatically posted online on the Project Result platforms);
SE – Sensitive (limited under the conditions of the Grant Agreement);
CO – EU classified : EU restricted, EU confidential, EU secret under Decision 2015/444

VERSIONING AND CONTRIBUTION HISTORY

VERSION	DATE	MODIFICATION REASON	MODIFIED BY
1.0	23.9.2024	First draft	Bridget Burger (STEM Ísland)
1.0	30.09.2024	Comments for quality evaluation	Evelina Salavejiene (Sunrise Tech Park)
1.0	17.10.2024	Incorporating consortium comments	Bridget Burger (STEM Ísland)

List of tables

List of abbreviations **7**
Executive summary **8**
Introduction **9**
Purpose of the toolkit 9
Aims of the National Inspiration Hubs 9
Addressing Gender Disparities in STEM. **9**
Empowering Educators as Change Agents. **9**
Fostering Collaboration and Community Engagement. **10**
Building a Sustainable and Scalable Network. **10**
Contributing to a More Equitable Future. **10**
Background **11**
Target Audience 11
Current State of Gender equality in STEM 12
Importance of Teachers as Change Agents 13
Collective Teacher Efficacy 14
One Example Of A Successful Intervention 14
Establishing The National Inspiration Hubs **15**
Concept Behind the Hubs 15
Key strategies for implementation 18
Align with local, regional, national and European STEM education policies **18**
Engage Diverse Stakeholders **19**
Establish a Governance Structure **20**
Identify Needs and Deliver Targeted Solutions **20**
Establishing Your National Inspiration Hub **21**
STEP 1: Form an NIH Steering Committee 21
STEP 2: Conducting a Needs Assessment 22
1: Define the Purpose and Scope 22
2: Review School Policies and Curriculum, and Formulate Research Questions 23
3: Design and administer a needs assessment survey 23
4: Collect and Analyze Data 23
STEP 3: Develop an Action Plan with Assigned Roles and a Timeline 24
STEP 4: Developing the webinar content 25
Utilise Peer Learning 25
Draw Upon Best Practices 25
STEP 5: Integrating with the Makerspace 25
Suggested ideas and Key Activities to support launching your NIH 26
Host a Kickoff event 26
Publicise Through Social Media and Professional Networks 26
Create Regular Press Releases. 26
Engage Across Professional Networks. 26

Conduct Ongoing Assessment 26
Summary **26**
References **28**
Annex 1: ADDITIONAL RESOURCES **31**

List of abbreviations

CTE	Collective Teacher Efficacy
EGES	Enhancing Gender Equality in STEM
NIH	National Inspiration Hub
NGO	Non-governmental Organisation
STEM	Science, Technology, Engineering, Math
STEAM	Science, Technology, Engineering, Arts, Math

EXECUTIVE SUMMARY

This toolkit serves as a call to action for stakeholders who recognize the transformative power of education and are committed to fostering a more just and equitable society. It was developed for the partners of the STREAM IT project, but is made available for anyone to use. This toolkit serves as a strategic framework for the development of sustainable and impactful National Inspiration Hubs. By providing a structured approach that includes needs assessments, action planning, and resource development, the toolkit enables educators and organisations to create environments where gender equality in STEM is prioritised and actively promoted. Additionally, the toolkit is designed with scalability in mind, offering a flexible model that can be adapted and replicated across different regions and educational contexts within Europe, thereby amplifying its impact.

Introduction

Purpose of the toolkit

The purpose of this toolkit is to serve as a practical resource for organisations, higher education institutions, educators, and policymakers across Europe who are dedicated to advancing gender equality in STEM (Science, Technology, Engineering, and Mathematics) through the establishment of National Inspiration Hubs (NIHs) of teachers. While this toolkit was delivered as part of the STREAM IT initiative, it is also made available for others outside of the project to utilise.

The National Inspiration Hubs are envisioned as critical infrastructures to support and *collectively* empower educators in their role as agents of change, with the goal of supporting teachers to address the persistent gender disparities in STEM education and careers. Thus, any stakeholder can convene a National Inspiration Hub.

Aims of the National Inspiration Hubs

Addressing Gender Disparities in STEM.

Despite ongoing efforts to promote gender equality in STEM, women continue to be significantly underrepresented in many STEM fields across Europe. This underrepresentation is not merely a consequence of individual choices but is often rooted in systemic barriers, such as gender biases, cultural stereotypes, and a lack of accessible female role models (European Commission, 2020; UNESCO, 2017). The toolkit is designed to mitigate these challenges by providing educators with the necessary tools, strategies, and resources to collectively dismantle these barriers within the classroom and beyond. By fostering an inclusive learning environment, the toolkit aims to challenge and change the traditional narratives that often discourage girls from pursuing STEM pathways (Reis, 2021).

Empowering Educators as Change Agents.

Teachers hold a pivotal role in shaping students' attitudes, self-efficacy, and career aspirations, especially in STEM fields where gender stereotypes are deeply entrenched (Mujtaba & Reiss, 2013). The toolkit emphasises the role of educators not merely as transmitters of knowledge but as active participants in social change. It provides evidence-based strategies to help teachers foster gender-inclusive teaching practices, thereby encouraging greater participation of girls in STEM. Furthermore, by helping partners of STREAM IT to establish National Inspiration Hubs, the toolkit seeks to create a collaborative platform where educators can exchange best practices, share resources, and develop innovative approaches to STEM education that promote gender equality.

Fostering Collaboration and Community Engagement.

The creation of systemic change in STEM education requires a collective effort that transcends individual classrooms. Teachers should be supported to implement gender equality in their classrooms. This toolkit underscores the importance of collaboration among various stakeholders, including educators, governmental bodies, non-governmental organisations (NGOs), industry partners, and local communities. By fostering partnerships and creating networks of support, the toolkit aims to build a robust foundation for the National Inspiration Hubs, ensuring that they are well-resourced and have the necessary institutional backing to effect long-term change. Engaging the broader community is crucial for sustaining these efforts and ensuring that gender equality becomes an integral part of the STEM education landscape.

Building a Sustainable and Scalable Network.

This toolkit is more than just a collection of guidelines; it serves as a strategic framework for the development of sustainable and impactful National Inspiration Hubs. By providing a structured approach that includes needs assessments, action planning, and resource development, the toolkit enables educators and organisations to create environments where gender equality in STEM is prioritised and actively promoted. Additionally, the toolkit is designed with scalability in mind, offering a flexible model that can be adapted and replicated across different regions and educational contexts within Europe, thereby amplifying its impact.

Contributing to a More Equitable Future.

Ultimately, the toolkit aims to contribute to a more equitable and inclusive future in which gender identity does not constrain a student's potential or career trajectory in STEM. By empowering educators and fostering collaborative networks through the National Inspiration Hubs, this toolkit seeks to inspire systemic change that will benefit not only the current generation of students but also future generations. This aligns with broader European and global objectives to close the gender gap in STEM and to harness the full potential of all individuals for innovation and economic growth (European Institute for Gender Equality, 2021; World Economic Forum, 2020).

Through this initiative, Europe can set a precedent in demonstrating how targeted educational interventions can drive social progress and economic development by ensuring that all students, irrespective of gender, have equal opportunities to excel in STEM fields.

This toolkit thus serves as a call to action for stakeholders who recognize the transformative power of education and are committed to fostering a more just and equitable society. This toolkit is more than just a collection of guidelines; it serves as a strategic framework for the development of sustainable and impactful National Inspiration Hubs. By providing a structured approach that includes needs assessments, action planning, and resource development, the toolkit enables communities, organisations, and educators to create environments where gender equality in STEM is prioritised and actively promoted. Additionally, the toolkit is designed with scalability in mind, offering a flexible

model that can be adapted and replicated across different regions and educational contexts within Europe, thereby amplifying its impact.

Background

Target Audience

The primary target audiences for this toolkit are organisations (NGOs), community groups, higher education institutions, companies, and educators, specifically secondary school STEM teachers, university educators, and educators of other organisations who are directly involved in delivering education and shaping the pedagogical frameworks and curricular content within schools. These individuals are uniquely positioned to influence the next generation of students, particularly in their perceptions and engagement with STEM subjects. Research has demonstrated that teachers' beliefs and practices significantly impact students' self-efficacy and interest in STEM, with gender biases in the classroom contributing to the persistence of gender disparities in these fields (Sadker, Sadker, & Zittleman, 2009). Therefore, this toolkit aims to help you, regardless of your background, to build a NIH that can convene stakeholders in your community, identify barriers and needs surrounding gender equality in STEM, and collaborate to deliver evidence-based strategies and resources to equip educators with the resources they need, and thereby foster gender-equitable teaching practices that can mitigate biases and encourage greater participation of girls in STEM disciplines. This toolkit seeks to catalyse systemic change within educational institutions, ensuring that gender equality becomes an integral part of the school culture and curriculum.

Beyond educators, the toolkit also targets a broader group of stakeholders, including policymakers, non-governmental organisations (NGOs), industry partners, administrators and academic researchers who are invested in advancing gender equality in STEM. Policymakers play a vital role in shaping national education policies and funding initiatives that prioritise gender equality, while NGOs and industry partners can provide critical resources, mentorship opportunities, and real-world applications of STEM education that reinforce the importance of diversity and inclusion in these fields. Academic researchers, on the other hand, contribute to the ongoing discourse on gender equality in STEM by providing empirical evidence and theoretical frameworks that inform best practices in education. Additionally, educational leaders and administrators are crucial in creating institutional policies and professional development opportunities that support gender equality in STEM education. By engaging this broader ecosystem, the toolkit aims to build a collaborative network of stakeholders who can collectively address the multifaceted challenges of gender inequality in STEM and work towards creating a more inclusive and supportive environment for all students.

Within an organisation, there is not a set requirement for who creates the National Inspiration Hub. It should be a champion of the work. This can mean different hubs may have very different leaders. The key is that the champion is able to convene the stakeholders and organise the collective effort. There is no requirement for using English over a native language when creating the hub. The point is to have impact- so hub leaders should use the language that is most effective.

There is no remuneration given for members to join a National Inspiration Hub. Members should be able to see the value to them of collaboration toward the goal, and each member may have a unique reason for joining, and that is acceptable. The time commitment will vary from hub to hub, depending on the goals and activities the hub members set up. The important point is that the member is committed to the process and to creating positive change.

Current State of Gender equality in STEM

The current state of gender equality in STEM (Science, Technology, Engineering, and Mathematics) and STEAM (which incorporates the Arts) in Europe reveals a complex and uneven landscape, characterised by significant disparities in participation, retention, and advancement between men and women. Despite concerted efforts over the past decades, women remain underrepresented in many STEM fields, particularly in engineering, technology, and computer sciences. These disparities are further compounded at the professional level, where women are less likely to advance to senior positions in STEM careers, often due to systemic barriers such as unconscious bias, lack of mentorship, and work-life balance challenges (European Institute for Gender Equality, 2021).

The gender gap in higher education STEM degree programs across Europe remains a significant issue, with women still markedly underrepresented in many disciplines, particularly in engineering, technology, and physical sciences. Recent data from the European Commission's She Figures 2021 report shows that women make up only 34% of graduates in STEM fields within the European Union, with especially low participation in engineering (15.5%) and information and communication technology (ICT) (19.2%) (European Commission, 2021). This gap not only limits the diversity of perspectives in STEM fields but also perpetuates broader gender inequalities in the workforce and society at large.

In the context of research and academia, the gender gap persists, albeit with some variation across countries and disciplines. Women constitute approximately 41% of the total research workforce in Europe, but their representation diminishes at higher academic levels, where they hold only 24% of full professorships (European Commission, 2020). This phenomenon, often referred to as the "leaky pipeline," highlights the attrition of women from STEM careers as they progress through the academic ranks (Blickenstaff, 2005).

Moreover, women in STEM fields often face disparities in research funding, publication rates, and recognition, which further hinders their career advancement (Elsevier, 2020). The gender gap is also reflected in leadership positions within research institutions and scientific bodies, where women are underrepresented in decision-making roles, thus limiting their influence on shaping research agendas and policies (European Commission, 2019). These ongoing challenges underscore the need for targeted interventions and policies that not only promote gender equality in STEM education but also address the structural barriers that women face in their professional trajectories within STEM and STEAM fields.

Several contemporary studies provide insight into the persistence of these gender gaps in STEM higher education. One key factor is the enduring influence of gender stereotypes,

which continue to dissuade young women from pursuing STEM degrees. Research indicates that societal expectations and cultural norms often position STEM fields as male-dominated, which can discourage women from engaging with these disciplines from an early age (Gonzalez-Perez, Mateos de Cabo, & Sainz, 2020). Furthermore, the lack of female role models in STEM exacerbates this issue, as women are less likely to see themselves reflected in these careers, leading to a lack of identification with STEM fields (Smith, Cech, Metz, Huntoon, & Moyer, 2014). Additionally, recent studies highlight the impact of the academic environment on women's persistence in STEM programs. Women often report experiences of bias, microaggressions, and a lack of support within their academic institutions, which contribute to higher attrition rates (Cheryan, Ziegler, Montoya, & Jiang, 2017). These environmental factors, combined with ongoing stereotypes, create significant barriers to women's participation in STEM higher education at every stage.

Importance of Teachers as Change Agents

Teachers play a pivotal role as change agents in the pursuit of gender equality in STEM education. Their influence extends beyond the simple transmission of knowledge; they shape students' perceptions, self-efficacy, and future career aspirations. Research consistently highlights that the attitudes and expectations of teachers can significantly impact students' academic choices and achievements, particularly in subjects where gender stereotypes are prevalent, such as STEM (Beilock et al., 2010). Teachers who actively challenge gender norms and foster an inclusive classroom environment can counteract societal stereotypes that often discourage girls from pursuing STEM fields. By adopting gender-sensitive teaching practices, teachers can help break down the barriers that contribute to the underrepresentation of women in these disciplines, making them essential drivers of change in the educational landscape (Good et al., 2010).
One critical way in which teachers act as change agents is through the implementation of gender-inclusive pedagogies. These pedagogies involve using teaching methods that are conscious of gender dynamics and that actively promote equal participation among all students. For example, research shows that when teachers make a concerted effort to call on girls as frequently as boys, and to provide equitable feedback, girls' participation and confidence in STEM subjects increase (Sadker & Zittleman, 2009). Additionally, teachers who incorporate diverse role models into their curriculum—highlighting the achievements of women and other underrepresented groups in STEM—can inspire students to envision themselves in these roles. Such practices not only improve the classroom climate but also contribute to the gradual dismantling of deep-seated biases that have traditionally sidelined women in STEM fields (Riegle-Crumb et al., 2012).

Moreover, teachers as change agents have the unique ability to influence the broader school culture, extending their impact beyond individual classrooms. By advocating for gender equality initiatives, such as professional development focused on gender inclusivity, teachers can foster a school-wide commitment to these values. Teachers can also lead by example, mentoring other educators and collaborating to develop curricula and school policies that support gender equality. Thus, the role of teachers as change agents is not only crucial in influencing individual student outcomes but also in driving systemic change within educational institutions, thereby contributing to a more equitable and inclusive society.

Collective Teacher Efficacy

Collective Teacher Efficacy (CTE), defined as the shared belief among educators in their collective ability to positively influence student outcomes, serves as a framework for addressing complex educational challenges, such as changing school dynamics and achieving gender equality in schools. Grounded in Bandura's social cognitive theory, CTE emphasises the importance of collaboration and mutual support among teachers, leading to improved instructional practices and a positive school climate. Schools with high levels of CTE are more likely to see teachers who are committed to adopting innovative practices, setting high expectations, and persisting in the face of challenges, all of which are crucial for effectively addressing and overcoming gender-based inequities (Bandura, 1997; Goddard, Hoy, & Hoy, 2000). CTE shifts the focus from individual teacher efforts to a collective responsibility, making it a robust approach for systemic change.

Integrating CTE into a toolkit designed to promote gender equality is a strategic choice because it leverages the collective power of educators to address deeply ingrained biases and systemic barriers. Gender equality is not a challenge that can be resolved by isolated actions; it requires coordinated, sustained efforts across the entire school community. By fostering a sense of collective efficacy both within schools and by engaging stakeholders in the broader community, the toolkit encourages teachers to work together to implement strategies that challenge stereotypes, develop inclusive curricula, and ensure supportive environments for all students (Tschannen-Moran & Barr, 2004; Eells, 2011). This collaborative approach ensures that the responsibility for promoting gender equality is distributed across the entire teaching staff, increasing the likelihood of meaningful and sustainable change. CTE, therefore, provides the necessary foundation for a toolkit that aims to transform schools into equitable spaces for all genders.

One Example Of A Successful Intervention

Teacher-centred interventions have proven to be effective in addressing gender disparities in STEM education by equipping educators with the tools and knowledge to create more inclusive and supportive learning environments. One exemplary case study is the *Let's Talk Science* program in Canada, which, although outside of Europe, offers valuable lessons for European contexts. This initiative focuses on professional development for teachers, aiming to improve their confidence and competence in teaching STEM subjects with an emphasis on gender inclusivity. The program provides educators with training workshops, resources, and ongoing support to integrate inquiry-based learning and gender-sensitive pedagogies into their classrooms. As a result, teachers report increased confidence in addressing gender biases and creating more engaging STEM experiences for all students, leading to improved student outcomes, particularly among girls (Hughes, 2012). The success of *Let's Talk Science* demonstrates the importance of empowering teachers with professional development opportunities that directly address the challenges of gender equality in STEM education.

Establishing The National Inspiration Hubs

Concept Behind the Hubs

The concept behind the National Inspiration Hubs is to use a multi-stakeholder approach to developing the capacity of secondary school STEM teachers/ university educators/ educators of other organisations, and institutions with a particular focus on deconstructing gender stereotypes and bias in teaching and learning real case scenarios of applying STEAM approaches into teaching.

The National Inspiration Hubs are an informal network of stakeholders from different sectors of a society. This multi-sector network approach enables the group to identify needs and barriers to gender equality that are specific and relevant to that group, and to work collaboratively to develop solutions. Therefore, the aims and goals of each National Inspiration Hub will be different, and unique.

Within the context of the STREAM IT project, the project will undertake several coordinated activities to further support the impact of the National Inspiration Hubs, such as hosting an online platform for information sharing within each National Inspiration Hub and also between them. These activities will be addressed at a later date among the partners working in the project. It is recommended that others outside of the STREAM IT project endeavouring to establish a National inspiration Hub could use a similar online platform (such as Basecamp) to share information and best practices.

Analysis of Current STREAMIT Partners´Capacity

In order to ensure that this toolkit is useful in expanding the capacity of the STREAMIT partner organisations, a survey was conducted to better understand the current capacity of the partners.

Consortium Survey Conducted June 2024

In June 2024 a survey was conducted by STEM ísland of the STREAMIT project partners to identify current capacity, and barriers to implementation of those organisations participating in the project. The survey collected relevant background information about each partner participating in this project. The Toolkit and the strategies proposed within it were written based on the survey responses. Thirteen organisations provided information through the survey tool. Figures 1-4 provide graphic illustration of survey data from the consortium. This information is included here to inform the reader about the background of the organisations involved in this project.

The initial project survey of STREAM IT project partners identified a consortium of 17 partners representing diverse sectors (Higher Education, Museums, Research Centers, Industry, Nonprofit organisations). On average, the partners of the consortium have been in operation for 17.5 years, indicating a mature organisational state. (See Figure 1.)

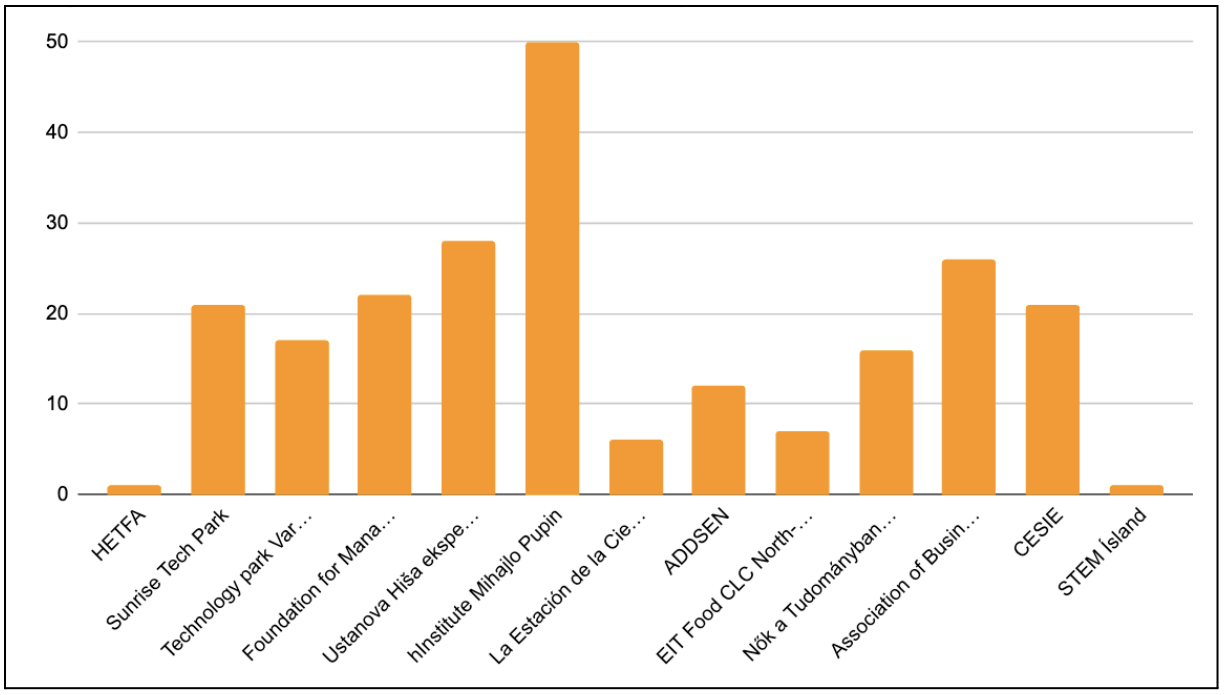

Figure 1. Number of years in operation, by partner.

The prevalence of partners from the Industry sector (29%), Higher Education (9.5%) and Research Institutes (9%) is a positive aspect to the project, providing the necessary pipeline for articulating project activities from the compulsory education system to higher education, and into research and a career, and providing feedback through each sector, in what is referred to as the STEM Talent Pipeline model, as described by Jobs for the Future (JFF, 2015).[2] (See Figure 2.)

[2] This model emphasises creating seamless, supportive pathways that guide individuals from education into the workforce, ensuring that the skills taught in academic settings align closely with the needs of the labor market. It is particularly focused on fostering a diverse talent pool, with an emphasis on supporting underrepresented groups, such as women, minorities, and economically disadvantaged individuals, in pursuing STEM careers.

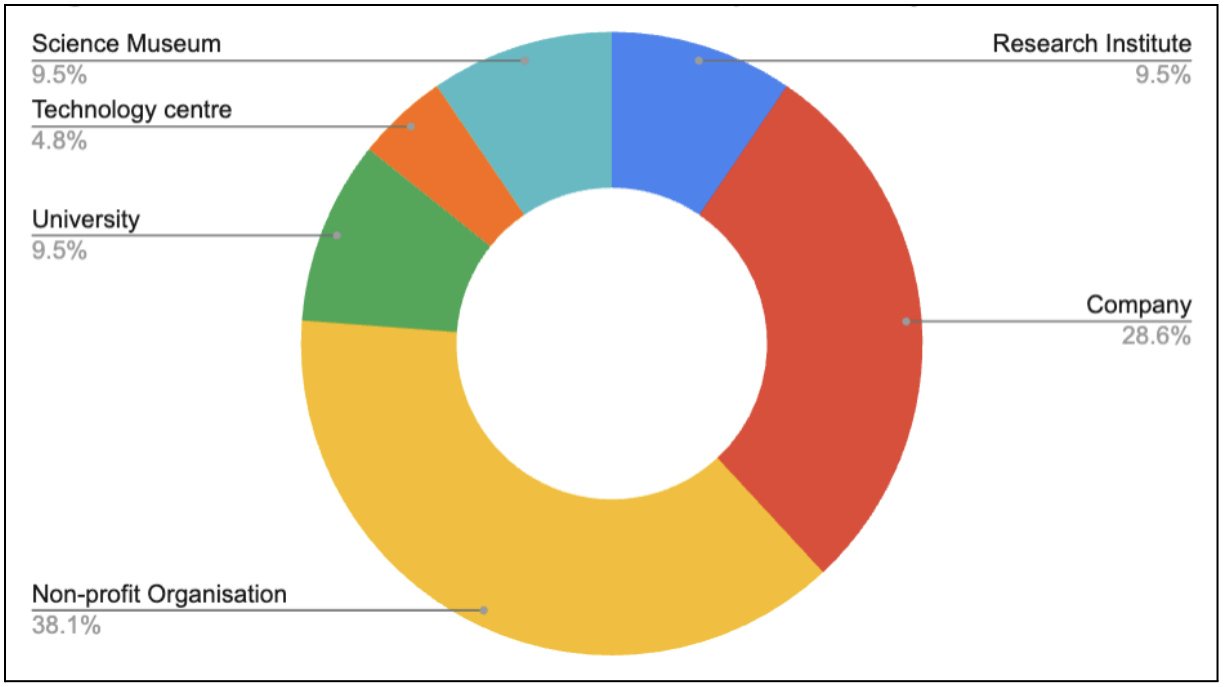

Figure 2. STREAMIT Consortium partners, by sector.

Another strength of the consortium is the already existing level of engagement of educators by the consortium partners. On an annual basis, the STREAMIT consortium engages more than 1,200 educators in STEM and STEAM activities, with one partner engaging more than 500 teachers. (See Figure 3.)

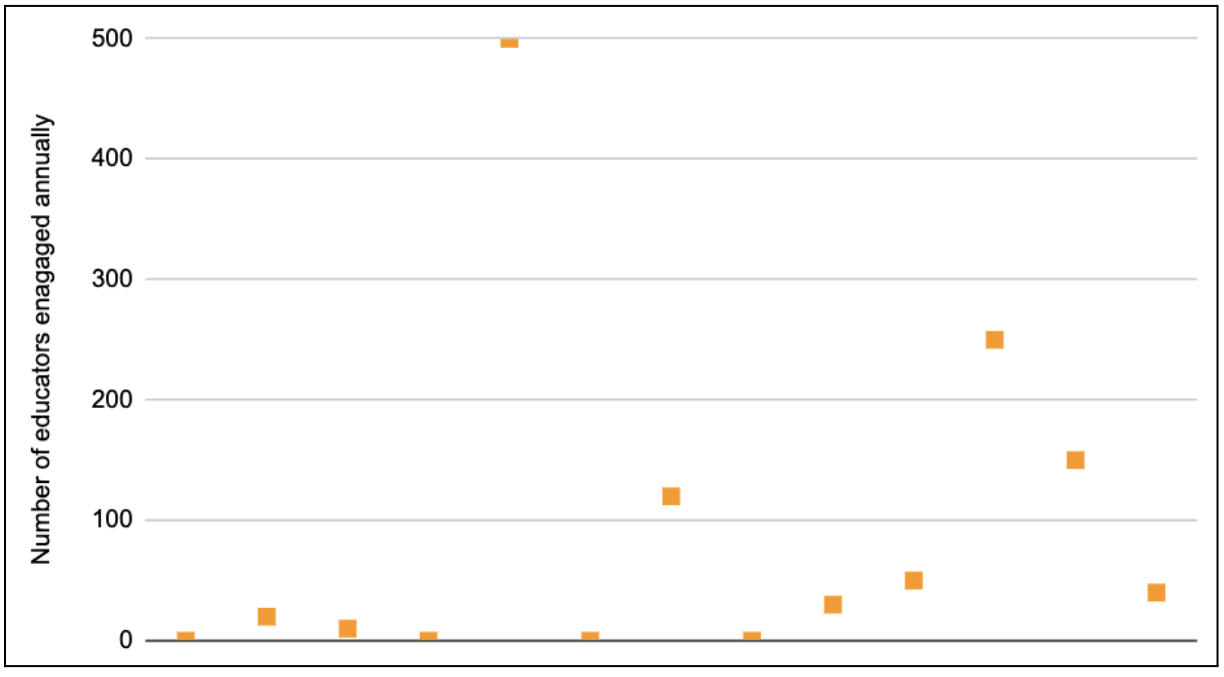

Figure 3. Number of educators engaged annually, by partners.

Within the consortium, the partners with well-established relationships with teachers, and already established modes of communication can leverage their experience to support

those partners who have engagement with few or no teachers, or do not have strong lines of communication established. In each case, there is opportunity to grow the networks, and it will be possible to foster collaboration and growth through open dialogue and mentoring among the partners.

When queried about the perceived barriers and concerns they have in establishing the NIHs, partners responded in clear terms, identifying three major perceived barriers: forming partnerships, engaging teachers, and sustaining the hubs. (See Figure 4.)

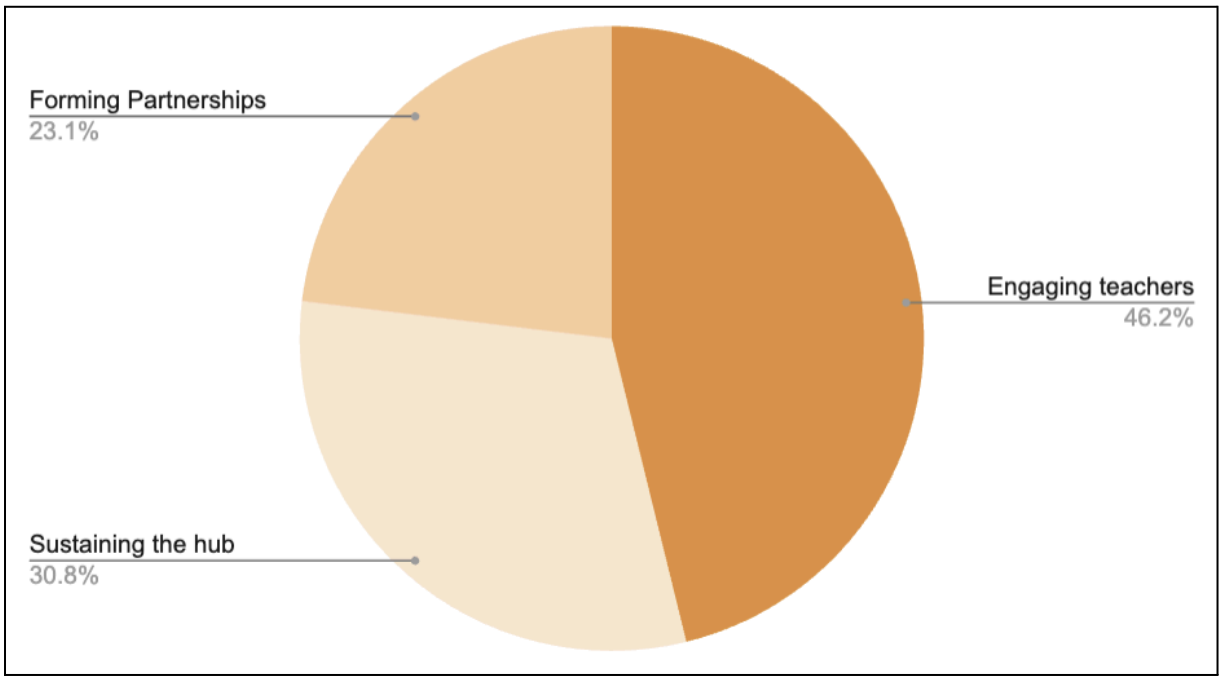

Figure 4. Perceived barriers to implementation.

KEY STRATEGIES FOR IMPLEMENTATION

Align with local, regional, national and European STEM education policies

The work of the National Inspiration Hubs should align with local, regional and national policies for STEM education and gender equality, as a strategy for strengthening the interest of teachers, administrators, engaging stakeholders, and supporting sustainability of the hub.

Aligning National Inspiration Hubs with local, European Union (EU) regional, and national policies for STEM education and gender equality is critical for ensuring their effectiveness, sustainability, and relevance. At the local level, these hubs must consider the specific educational needs and challenges of their communities, tailoring their initiatives to address local disparities in STEM participation and performance. For example, if a particular region has lower female enrollment in STEM courses, the hub's programs can be designed to target this issue directly, perhaps through targeted outreach and support initiatives. By aligning with local educational priorities, National Inspiration Hubs can gain the support of local governments, schools, and community organisations, making it easier to implement programs and achieve meaningful outcomes. Furthermore, this alignment ensures that the

hubs are addressing real and immediate needs within their communities, increasing their impact and fostering local ownership of gender equality initiatives in STEM.

On a broader scale, alignment with EU regional and national policies allows National Inspiration Hubs to contribute to wider systemic goals and benefit from broader support structures. The EU has established comprehensive frameworks for advancing gender equality and STEM education, such as the European Commission's Gender Equality Strategy and the Digital Education Action Plan, which emphasise the importance of increasing female participation in STEM fields and fostering digital competencies. By aligning their goals with these strategies, National Inspiration Hubs can ensure that their efforts are part of a coordinated, Europe-wide movement towards gender equality in STEM. This alignment also opens up opportunities for NIHs to access EU funding and participate in cross-border collaborations, which can enhance their resources, scale, and influence. Moreover, aligning with national policies ensures that the hubs are contributing to the country's broader educational and economic objectives, such as boosting innovation and competitiveness through a more diverse STEM workforce. This strategic alignment at all levels—local, regional, and national—ensures that National Inspiration Hubs are not only responsive to the needs of their immediate communities but also integral to larger, more comprehensive efforts to achieve gender equality in STEM education across Europe.

Engage Diverse Stakeholders

Stakeholder engagement is pivotal to the success of National Inspiration Hubs, as it ensures that initiatives are contextually relevant, widely supported, and sustainable. Engaging a broad spectrum of stakeholders — including educators, policymakers, industry leaders, community organisations, parents, and students — fosters collaboration and resource sharing, which are essential for effective implementation and long-term impact (Freeman, Harrison, & Wicks, 2007). Educators and school administrators play a crucial role in integrating the hub's programs into existing curricula and ensuring alignment with educational priorities (Bryson, 2004). Policymakers can provide necessary endorsements and align the hub's activities with broader national and regional educational goals, thus facilitating access to funding and policy support (Morris & Scott, 2019). Industry partners offer practical insights, mentorship opportunities, and career pathways, bridging the gap between education and employment and enhancing the real-world applicability of STEM education (Etzkowitz & Leydesdorff, 2000). Community organisations and parents help create a supportive environment for students outside of the classroom, reinforcing the hub's objectives at the grassroots level (Bray, 2003). Through active and ongoing engagement, stakeholders become advocates for gender equality in STEM, ensuring that the hub's initiatives are not only sustained but also scaled effectively (Greenwood, 2007).

As you begin to build your NIH, identify and invite diverse stakeholders to be a part of your NIH. This can include educators, government agencies, NGOs, universities, research agencies, and industry partners. Many STREAMIT partners already have strong engagement with diverse stakeholders. Some do not yet — but through a strong and diverse set of stakeholders you will find the critical mass to attract engagement with the NIH, and provide a networked approach to supporting and sustaining the activities of the NIH.

Establish a Governance Structure

Effective governance and clearly defined roles are essential for the successful operation of National Inspiration Hubs, ensuring that their initiatives are well-coordinated, accountable, and aligned with their mission to promote gender equality in STEM. The governance structure should include a diverse board or steering committee comprising representatives from key stakeholder groups, including educators, policymakers, industry leaders, and community organisations. This body is responsible for setting strategic directions, overseeing the development of the NIH, implementation of six webinars offered during the project performance period, communicating activities to the STREAMIT consortium, and ensuring that the hub's activities align with national and regional STEM policies. Within this structure, depending on budget availability, specific roles should be delineated to manage various aspects of the hub's operations: for example, a program director might oversee daily activities and partnerships, while an outreach coordinator could focus on community engagement and communication strategies. Additionally, roles for monitoring and evaluation should be established to track progress towards the hub's goals and ensure continuous improvement. By defining these roles clearly and establishing robust governance from the start, the hubs can operate efficiently, maintain stakeholder trust, and effectively drive their mission of promoting gender equality in STEM education. Begin by establishing roles and responsibilities within your NIH.

Identify Needs and Deliver Targeted Solutions

Identifying needs and targeting solutions is a critical first step in developing effective interventions for deconstructing gender stereotypes and biases in STEM education. This process begins with a comprehensive needs assessment, which involves gathering data through surveys, focus groups, and reviews of existing curricula and policies to understand the specific challenges and gaps within educational settings. By analysing this data, NIH leaders can pinpoint where gender biases most significantly impact student engagement and performance, such as in classroom interactions, teaching materials, or institutional practices. Once these areas of need are clearly identified, targeted solutions can be designed to address them directly. This might involve revising curricula to include more diverse role models, implementing professional development programs that focus on gender-sensitive teaching practices, or creating support networks for underrepresented students. Targeting solutions effectively ensures that interventions are not only relevant and impactful but also sustainable, leading to lasting change in the educational environment (UNESCO, 2017; Bevan et al., 2010).

The National Inspiration Hubs can deliver value to educators and stakeholders in this way, and help to support teachers´growth and development. In education there are often multiple demands on educators for professional development and training. Investing in data collection at the outset from the teachers themselves to identify the specific needs, capacity, and interest levels surrounding gender equality in education is critical to making the NIH relevant to the teachers who participate. Engaging stakeholders to support these efforts also brings value to educators, and supports them in their teaching. Below are step-by-step instructions to launch your NIH for gender equality.

Establishing Your National Inspiration Hub

The next section provides step-by-step instructions for forming your National Inspiration Hub. The infographic below (Figure 5) provides a visual to help clarify the steps.

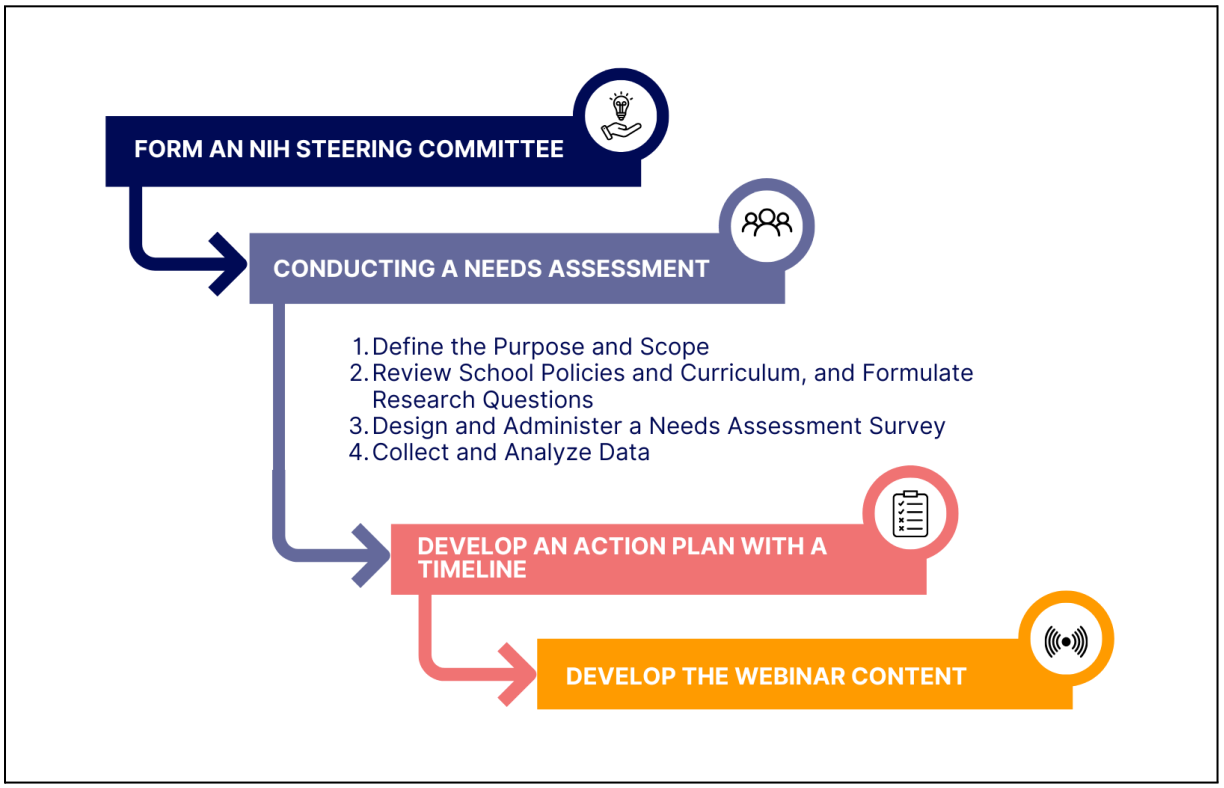

Figure 5. Steps to forming a National Inspiration Hub

STEP 1: Form an NIH Steering Committee

Using the multi-stakeholder approach, identify a core group of individuals you can invite to launch and steer the NIH. Aim to have one representative from each sector. Include also the upper compulsory school leadership in your school districts. Hold an initial meeting to review the goals of the STREAMIT project, and to gain a commitment from each committee member to help promote the NIH and recruit participation in the NIH from individuals and organisations in their network. The time commitment request for the steering committee could be estimated as quarterly meetings of one hour or less, with occasional efforts to disseminate emails and notices.

Table 1: Steering Committee List

Sector	Organisation	Name of Contact	Email
Schools			
Universities			
Industry			
Research Center			
Non-Profit Org.			
Government Agency/Policy Maker			
Other			

STEP 2: Conducting a Needs Assessment

Once you convene your core steering committee, you should conduct an initial needs assessment. This activity will help to support clear goal setting for the NIH, and will be the first step to launching the NIH publicly, and soliciting focused engagement of the broader members nationally. The needs assessment can also help to maintain the sustained functionality of the hub, ensuring the activities of the hub are relevant to the end-users by using a "bottom-up" approach to identifying needs and then targeting solutions to those needs.

1: Define the Purpose and Scope

The purpose of the needs assessment is to identify priority issues in gender disparity with respect to STEAM education in the operating geographic region of each hub. Define the geographic area and the population (e.g., schools, educators, students) that the NIH will aim to reach.

2: Review School Policies and Curriculum, and Formulate Research Questions

With your steering committee identify several key questions that will help to shape and focus the scope and scale of the efforts of the NIH. Consider questions such as:

- What are the current levels of female participation in higher education STEM subjects?
- What barriers do educators face in promoting gender equality in STEM in the classroom?
- What STEM and /or gender equality professional development is currently offered and what can be improved?
- What resources are currently lacking that could support gender-inclusive STEM education?
- How are our school policies and/or curriculum helping or hindering gender equality in STEM?

As part of this step, examine the existing school curricula and policies to identify any content or practices that may reinforce gender stereotypes. This review can help in designing targeted interventions (Blickenstaff, 2005).

3: Design and administer a needs assessment survey

Using the research questions you list above, working with your Steering Committee, add, edit, and revise the suggested survey provided below. You can choose to conduct focus groups, interviews, or other means of data collection. You may decide to create different surveys or questionnaires tailored to different stakeholders (e.g., teachers, industry, higher education), or you can use the same survey for everyone. Ensure the questions are clear, unbiased, and aligned with the research questions. Be sure to document your chosen method of data collection.

Suggested survey here: https://forms.gle/ouJKrayaPQisGTGDA

4: Collect and Analyze Data

Use your existing network of stakeholders, and your expanded network through your steering committee to reach out and query your potential membership in the National Inspiration Hub.

Send out your survey using email lists from previous projects, tapping into your steering committee´s networks, and contacts with local school leaders. Send the survey to all the educators who you will aim to engage in your NIH, asking relevant Steering Committee members to assist with this task, making introductions as needed. Teacher emails can often be found on school websites, or through department heads and school administrators. By including teachers from the start by asking them to contribute information and perspective will help to engage them with buy-in and ownership over the process.

Ensure that all data is collected and recorded systematically, maintaining confidentiality and ethical standards. Use the sample survey provided, and add to, edit or amend as needed. Make the link shareable so respondents can share with their colleagues.

The survey responses will provide an overview of the issues and barriers to gender equality in STEM in your region. From a triangulated analysis of the open-ended questions, cross-referenced with the ranked checklist, and your analysis of your school policies, you should be able to identify six top priorities. These will become the topics for the six webinars your NIH will offer over the course of the STREAMIT project.

Schedule a second meeting with your Steering Committee to analyse the results of your Needs Assessment surveys. From your responses you should be able to identify the key themes that help you decide on the 6 topics for the webinars.

Webinars can highlight a best practice within the network, or address an issue or challenge that is identified among many respondents. Your webinar offerings will be unique to your NIH, and the needs identified by your community. Keep in mind that aligning the choice of webinars to your local, regional, or national policies will help you to engage participants and sustain the NIH.

STEP 3: Develop an Action Plan with Assigned Roles and a Timeline

Use the findings from the needs assessment and policy analysis to develop a targeted action plan for your National Inspiration Hub. This plan should include regular meetings of the NIH members, and a plan for offering six webinars that address the six priority issues identified in your initial survey. The plan should include answers to questions such as:

- How often will the NIH meet live online?
- When will you meet?
- When will you offer the first webinar?
- What are the 6 webinar topics?
- Who will lead/co-lead each webinar?

These steps provide a template to effectively launch your NIH. By forming your steering committee you will gain representation from your community to provide a basic structure to your NIH, and ensure diverse stakeholders participate. By conducting a needs assessment you will ensure that your efforts are focused on identified needs, and providing value to your community. By collecting data you will be able to measure and track your progress. Lastly, in developing your action plan with roles assigned and a timeline, you will effectively be launching a diverse yet structured NIH that is working together in a well thought out way and providing valuable solutions to identified needs in your region.

To support you in launching your NIH, STEM Iceland will host quarterly meetings for the partners to discuss and share their updates and challenges. STEM Iceland will offer a workshop for all members of the NIHs in Year 2 of the project, once the NIHs are established and operating.

STEP 4: Developing the webinar content

Utilise Peer Learning

For each of the 6 webinars you offer, you will draw upon the expertise within the NIH to address one of the current issues and/or highlight a current best practice as identified in your Needs Assessment. At first, the presenters and content may come from within the resources of your organisation to start the momentum, but eventually presenters and content should come from within the network as they gain more interest and engagement with the NIH and the members. Utilise the strengths and experience from within your network to leverage peer learning. In your monthly NIH meetings you will begin to build relationships with members, and can recruit presenters as your NIH develops. In the Needs Assessment survey you will have respondents who offer to co-host a webinar. You can either team up two members, or offer to support them by co-hosting with them.

Draw Upon Best Practices

Among the best practices you may use are three key thematic areas listed below. You will need to adapt them to your specific needs identified by your community.

- **Gender Awareness and Sensitivity Training**: Design modules that educate educators about the impact of gender stereotypes on student participation and performance in STEM. This should include an exploration of unconscious bias and its effects on teaching practices (Beilock et al., 2010).

- **Inclusive Pedagogical Strategies**: Provide training on teaching methods that promote gender equality, such as the use of inclusive language, diverse role models, and collaborative learning environments. Educators should be encouraged to adopt strategies that actively counteract stereotypes (Cheryan et al., 2017).

- **STEM Curriculum Review and Redesign**: Offer guidance on how to revise existing STEM curricula to ensure they are inclusive and free from gender biases. This might involve integrating examples and case studies that highlight the contributions of women and underrepresented groups in STEM (González-Pérez et al., 2020).

Some additional resources are offered in Annex 1 that can help you create and offer high-quality, data-driven relevant training within your NIH are below. In addition, other publications of the STREAM IT project have identified best practices in promoting gender inclusive education. Utilise these and explicitly build upon them as you develop your webinars.

STEP 5: Integrating with the Makerspace

The STREAMIT National Inspiration Hubs will be hosted within an online makerspace such as Basecamp. The online platform will be a storehouse for your ideas, webinars, events, articles, and any other resources and best practices you wish to share across your network.

Suggested ideas and Key Activities to support launching your NIH

Host a Kickoff event

An in-person kickoff event serves as the formal introduction of the National Inspiration Hub to the broader community, including educators, policymakers, students, and potential partners. This event is not required but can be a support in engaging more people, and make the NIH visible. The event should be designed to not only announce the launch but also to highlight the hub's objectives, goals, and the importance of gender equality in STEM education. Invite key stakeholders, including representatives from local education authorities, industry leaders, and gender equality advocates, to speak at the event. Their involvement can lend credibility and draw attention to the hub's mission.

Publicise Through Social Media and Professional Networks

Effective media communication is critical to the success of the hub’s launch. Publicising the event and the hub itself through not only your media channels but also your steering committee´s and stakeholders´various media channels will ensure that the initiative reaches a wide audience.

Create Regular Press Releases.

Distribute regular press releases to local and national media outlets, focusing on the hub’s objectives and its activities and impact on gender equality in STEM. Highlight any unique aspects of the hub, such as its partnerships, international STREAMIT consortium, and webinar content.

Engage Across Professional Networks.

Leverage networks like LinkedIn, academic forums, and educational associations to share information about the hub. Engaging with these networks can also help specifically attract educators and industry professionals to the hub.

Conduct Ongoing Assessment

Plan for ongoing assessment and evaluation to ensure that the hub's initiatives continue to meet the evolving needs of the community. You may want to send out follow-up surveys to receive feedback for your webinars, for example, or if teacher engagement begins to fall off. You can refine content and delivery based on your ongoing assessment. By following these steps, the needs assessment will provide a solid foundation for the National Inspiration Hubs, ensuring that their programs are high quality, well-targeted, relevant, and impactful in promoting gender equality in STEM education.

Summary

The toolkit for National Inspiration Hubs is designed to provide the steps needed to form and sustain a multi-stakeholder network for STEM education. Within the process, stakeholders gain insights into the needs and resources within their reach, and can use

them to collectively take action to promote gender equality. The toolkit can be seen as a flexible tool that can be adapted across different regions, and can be used to adapt to changing circumstances as National Inspiration Hubs grow and expand.

References

Aguirre, J. M., Zavala, M. R., & Katanyoutanant, T. (2013). “Developing robust forms of pre-service teacher pedagogical content knowledge through culturally responsive mathematics teaching analysis.” *Mathematics Teacher Education and Development, 15*(2), 23-43.

Anderson, L. W., & Gilbride, K. A. (2003). “Pre-university outreach: Encouraging students to consider engineering careers.” *IEEE Transactions on Education, 46*(2), 47-52.

Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York, NY: W.H. Freeman.

Beilock, S. L., Gunderson, E. A., Ramirez, G., & Levine, S. C. (2010). “Female teachers' math anxiety affects girls' math achievement.” *Proceedings of the National Academy of Sciences, 107*(5), 1860-1863.

Bevan, B., Dillon, J., Hein, G. E., Macdonald, M., & Turner, S. (2010). *Making science matter: Collaborations between informal science education organizations and schools*. Association of Science-Technology Centers.

Blickenstaff, J. C. (2005). “Women and science careers: Leaky pipeline or gender filter?” *Gender and Education, 17*(4), 369-386.

Bray, M. (2003). *Community partnerships in education: Dimensions, variations, and implications*. UNESCO.

Bryson, J. M. (2004). What to do when stakeholders matter: Stakeholder identification and analysis techniques. *Public Management Review, 6*(1), 21-53.

Cheryan, S., Ziegler, S. A., Montoya, A. K., & Jiang, L. (2017). “Why are some STEM fields more gender balanced than others?” *Psychological Bulletin, 143*(1), 1-35.

Eccles, J. S. (2011). “Understanding women's educational and occupational choices: Applying the Eccles et al. model of achievement-related choices.” *Psychology of Women Quarterly, 35*(3), 460-474.

Eells, R. J. (2011). *Meta-analysis of the relationship between collective teacher efficacy and student achievement*. Dissertation Abstracts International Section A: Humanities and Social Sciences.

Elsevier. (2020). *The research gender gap: Addressing the imbalance*.

Etzkowitz, H., & Leydesdorff, L. (2000). The dynamics of innovation: From National Systems and “Mode 2” to a Triple Helix of university–industry–government relations. *Research Policy, 29*(2), 109-123.

European Commission. (2019). *Horizon Europe: A new framework programme for research and innovation*.

European Commission. (2021). *She Figures 2021: Gender in Research and Innovation*.

European Institute for Gender Equality. (2021). *Gender Equality Index 2021: Health*.

Freeman, R. E., Harrison, J. S., & Wicks, A. C. (2007). *Managing for stakeholders: Survival, reputation, and success*. Yale University Press.

Goddard, R. D., Hoy, W. K., & Hoy, A. W. (2000). Collective teacher efficacy: Its meaning, measure, and impact on student achievement. *American Educational Research Journal*, 37(2), 479-507.

Good, C., Rattan, A., & Dweck, C. S. (2012). "Why do women opt out? Sense of belonging and women's representation in mathematics." *Journal of Personality and Social Psychology, 102*(4), 700-717.

González-Pérez, S., Mateos de Cabo, R., & Sainz, M. (2020). "Girls in STEM: Is it a female role-model thing?" *Frontiers in Psychology, 11*, 2204.

Greenwood, M. (2007). Stakeholder engagement: Beyond the myth of corporate responsibility. *Journal of Business Ethics, 74*(4), 315-327.

Jobs for the Future (JFF). (2015). *Building the STEM workforce of the future: Encouraging girls and underrepresented minorities to pursue STEM careers*.

Morris, Z. S., & Scott, C. (2019). Developing leadership in higher education: Perspectives from the UK. *Leadership, 15*(2), 211-233.

Mujtaba, T., & Reiss, M. J. (2013). "What sort of girl wants to study physics after the age of 16? Findings from a large-scale UK survey." *International Journal of Science Education, 35*(17), 2979-2998.

National Research Council. (2015). *Identifying and supporting productive STEM programs in out-of-school settings*. National Academies Press.

OECD. (2015). *The ABC of Gender Equality in Education: Aptitude, Behaviour, Confidence*.
Reis, S. M. (2021). "Women in STEM: Talent at the crossroads." *Gifted Child Quarterly, 65*(3), 208-219.

Riegle-Crumb, C., King, B., Grodsky, E., & Muller, C. (2012). "The more things change, the more they stay the same? Prior achievement fails to explain gender inequality in entry into STEM college majors over time." *American Educational Research Journal, 49*(6), 1048-1073.

Sadker, D., Sadker, M., & Zittleman, K. R. (2009). *Still failing at fairness: How gender bias cheats girls and boys in school and what we can do about it*. Scribner.

Smith, J. L., Cech, E., Metz, A., Huntoon, M., & Moyer, C. (2014). "Giving back or giving up: Native American student experiences in science and engineering." *Cultural Diversity and Ethnic Minority Psychology, 20*(3), 413-429.

Smith, J. M. (2010). "Gender, science, and persistence in engineering." *Research in Higher Education, 51*(3), 254-282.

Smith, W. S., & Erb, T. O. (1986). "Effect of women science career role models on early adolescents' attitudes toward scientists and women in science." *Journal of Research in Science Teaching, 23*(8), 667-676.

Traphagen, K., & Traill, S. (2014). *How cross-sector collaborations are advancing STEM learning*. STEM Learning Ecosystems Initiative.

Tschannen-Moran, M., & Barr, M. (2004). Fostering student learning: The relationship of collective teacher efficacy and student achievement. *Leadership and Policy in Schools*, 3(3), 189-209.

UNESCO. (2017). *Cracking the code: Girls' and women's education in STEM*.

World Economic Forum. (2020). *Global Gender Gap Report 2020*.

ANNEX 1: ADDITIONAL RESOURCES

United Nations Women (UN Women)

- **Gender Equality and Women's Empowerment Resources**: UN Women offers a wide range of free reports, guidelines, and training materials on gender equality. You can adapt these resources to create your own training content.
    - UN Women Resources

UNESCO

- **Gender Equality Resources**: UNESCO offers a range of free publications, guidelines, and educational resources on gender equality, which can be adapted for educational webinars.
    - UNESCO Gender Equality

European Institute for Gender Equality (EIGE)

- **Gender Equality Training**: EIGE offers free reports, statistics, and training materials that focus on gender equality in various sectors, particularly in Europe. These resources are valuable for creating data-driven content.
    - EIGE Resources

World Economic Forum

- **Global Gender Gap Reports**: The WEF provides detailed reports on the global gender gap, offering insights into gender disparities across different regions and sectors. These reports can provide the statistical backbone for your training content.
    - Global Gender Gap Report 2023

AAUW

- **Reports on Women in STEM**: This US-based nonprofit has been advocating for gender equality for women and girls since 1881. AAUW offers comprehensive reports and recommendations on promoting gender equality in STEM fields.
    - Women in STEM Resources

UN Global Compact

- **Women's Empowerment Principles (WEPs)**: This resource provides a framework for businesses on how to empower women in the workplace, marketplace, and community. These principles can be integrated into your webinar content.
    - Women's Empowerment Principles

STREAM IT

facebook.com/profile.php?id=61558486186687

instagram.com/projectstreamit/

youtube.com/@projectstreamit

linkedin.com/company/projectstreamit

Funded by
the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or European Research Executive Agency. Neither the European Union nor the European Research Executive Agency can be held responsible for them.