Chapter 1
A Model for Bridging the Gender Gap in STEM in Higher Education Institutions

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Abstract Women present a historic and worrying gap in science and technology-related disciplines, generally knowns as STEM (Science, Technology, Engineering, and Mathematics), except in the case of health professions. A holistic approach is needed to support policymakers worldwide in bridging the gender gap in STEM, in which higher education institutions have a crucial role. Promoting this active implication of the universities in this problem, in the European project Building the future of Latin America: engaging women into STEM (W-STEM), a model to modernise the government, management and operation of higher education institutions in Latin America to improve attraction, access to and retention of women in STEM programs has been developed. This situation is not exclusive to Latin American countries, it is a global problem, so the results of the W-STEM project are also applicable to European partners and transferrable worldwide. The main goal of this chapter is to describe the W-STEM model based on three years of working on strategies and mechanisms to improve the attraction, access, guidance, and retention processes to engage more women in STEM programs. The model has been thoroughly tested in eleven institutions in Chile, Colombia, Costa Rica, Ecuador, and Mexico, involving public and private institutions with different gender equality situations.

Keywords Gender gap · Higher education · Gender equality plan · Self-assessment · Women · STEM

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1.1 Introduction

Gender equality refers to the equal rights, responsibilities and opportunities of women and men and girls and boys. This means that women's and men's rights, responsibilities and opportunities will not depend on whether they are born male or female (OSAGI, 2021). It is goal 5 in the 2030 agenda for Sustainable Development, but also gender equality cuts across all 17 Sustainable Development Goals (SDG) and is reflected in 45 targets and 54 indicators for the SDGs (Dugarova, 2019; Inter-Agency and Expert Group on SDG Indicators, 2017; Pradhan et al., 2017). Gender equality is also part of the European Union (EU) policies so that gender equality and women's empowerment are promoted and financially supported worldwide.

Higher Education Institutions (HEI) have a major role in contributing to the SDGs, not only in their internal policies but also in preparing students for the challenges of the twenty-first century. HEIs are a key element to ensure the sustainability of the SDGs. Besides goal 4, ensure inclusive and equitable quality education and promote lifelong learning opportunities for all, HEIs define processes and actions related to poverty (SDG 1), health and well-being (SDG 3), gender equality (SDG 5) or climate change (SDG13), among others.

According to the Global Gender Gap Report, no country has yet to achieve full gender parity. The Global Gender gap score in 2021 is 67.7%, which means that the remaining gap to close stands at 32.3% (World Economic Forum, 2021). This index measures the gender-based differences in four key dimensions and tracks the narrowing of these gaps over time: economic participation and opportunity, educational attainment, health and survival and political empowerment. Each subindex provides a score related to gender parity. In particular, 95% of educational attainment gaps have been closed already. However, there are gender gaps in higher education worldwide, although the enrolment rates in tertiary education achieved full gender parity in most of the countries (UIS. Stat, 2016).

Women are persistently underrepresented in science, technology, engineering, and mathematics (STEM) (Directorate-General for Research and Innovation Horizon, 2020; OECD, 2015; Tomassini, 2021; UNESCO, 2007; UNESCO Institute for Statistics, 2018). Although most countries have more women than men enrolled in tertiary education, the number of women in tertiary education who choose STEM is around 15% (UNESCO. Director-General 2009–2017, 2017). For example, only 13.76% of women in tertiary education choose STEM compared to 35.12% of men in Colombia (0.39 gender gap score). The situation is worst in Spain, with a gender gap score of 0.33, Finland with 0.25 or Ireland with 0.38.

The STEM labour force is a fundamental tool for responding to the needs of twenty-first- century society; it has a crucial role in sustainable development. Moreover, market forces are transforming industries (World Economic Forum, 2016), not only in favour of technology skills development, but also the need for STEM skills such as critical thinking, problem-solving or innovation (World Economic Forum, 2020). Besides the lack of women in STEM, there is also a lack of workers to fill the needs of the STEM labour force.

On the other hand, evidence shows that increasing gender diversity in STEM may lead to more effective problem-solving and improved innovations (Kahn & Ginther, 2017), and can have long-term effects not only on gender equality but also on economic development (World Economic Forum, 2017). According to Quirós et al. (2018), more women in digital jobs would benefit the European Gross Domestic Product (GDP) by up to 16 trillion euros per year in the European context.

Increasing diversity in STEM, with a particular focus on women, is on the agendas of governments and public and private entities. Foster social inclusion and increasing the female participation in STEM is one of the key challenges of the European Union (García-Holgado et al., 2020a). The EU support actions through initiatives such as the European Platform of Women Scientists (EPWS) or funding projects like INGDVIS (Increasing Gender Diversity in STEM) (Ballatore et al., 2020) or Coding4Girls (Hoić-Božić et al., 2020).

A holistic approach is needed to support policymakers worldwide in bridging the gender gap in STEM. Many factors contribute to this problem, including self-perception, self-efficacy, interest in science, expectations of results, previous educational experiences, family and social context (Lent et al., 1994). According to the SAGA project (STEM and Gender Advancement) (UNESCO, 2016, 2018), the gender gap in STEM should be faced through seven macro objectives covering not only social norms but also educational and professional pathways, and research and decision-making (Fig. 1.1):

- Change perception, attitudes, behaviours, social norms, and stereotypes towards women in STEM in society.

Fig. 1.1 SAGA gender objectives. Based on (UNESCO, 2018)

- Engage girls and young women in STEM primary and secondary education, as well as in technical and vocational education and training.
- Attraction, access to and retention of women in STEM higher education at all levels.
- Gender equality in career progression for scientists and engineers (S&E).
- Promote the gender dimension in research content, practice and agendas.
- Promote gender equality in STEM-related policymaking.
- Promote gender equality in science and technology-based entrepreneurship and innovation activities.

In this holistic approach, higher education institutions have a major role. They directly impact primary and secondary education because they prepare future teachers, so HEI can work on training pre-service teachers for fostering STEM vocations with an emphasis on engaging girls and young women. Likewise, HEI should work on measures to ensure gender equality in career development for staff. Furthermore, HEI plays an important role in research, so they can implement strategies and mechanisms to ensure the gender dimension in research content and develop studies that reduce the gender gap in STEM in a feedback loop. On the other hand, HEIs indirectly impact policies and entrepreneurship and innovation activities because they prepare future professionals and decision-makers.

In this context, the European project Building the future of Latin America: engaging women into STEM (García-Holgado et al., 2019; García-Peñalvo, 2019; García-Peñalvo et al., 2019) has developed a model to modernise the government, management and operation of higher education institutions in Latin America to improve attraction, access to and retention of women in STEM programs.

This chapter describes the W-STEM model for bridging the gender gap in STEM in higher education institutions. The chapter has been organised in the following way. Section 2 introduces the W-STEM project. Section 3 presents the W-STEM model. Section 4 describes the main results after piloting the W-STEM model in 10 Latin American universities. Finally, the last section summarises the main conclusions.

1.2 The Project

There is a lack of contribution of Higher Education Institutions to face the challenges related to reducing the gender gap in STEM, as most actions remain at the public policy level. HEIs need to face specific demands:

- Access to data and better analytical methods to establish the real dimension of gender inequality.
- To define the problem scope determining the real margin of influence and action to improve access and participation of Women in STEM.
- To involve leadership and management in mid and long-term strategies ensuring intended actions and resources to make them sustainable.

- To map in a clear way the processes and mechanisms that are potentially blocking and bias in attraction, access, retention, guidance of Women in STEM.
- To develop effective tools to achieve an increase in enrolment rates.
- To improve policies to attract, enrol, support, guide and monitor students in a differentiated manner.

W-STEM project, "Building the future of Latin America: engaging women into STEM" (Reference 598,923-EPP-1–2018-1-EN-EPPKA2-CBHE-JP), is a European project funded by the European Union through the Erasmus + program, capacity-building in Higher Education call. The project is a structural project that seeks a systemic impact in the Latin American region by promoting reforms in higher education systems, modernising policies, governance and strengthening relations between higher education systems and the economic and social environment (García-Holgado et al., 2019).

The project provides strategic intervention affecting gender equality policies, with a special focus on the attraction and guidance of women in STEM careers, important for current and future society. While some European countries are at higher developmental stages, culture on gender equality is embedded in the universities. Thus, they have mature procedures, experiences, regulations, etc., which can be transferred to Latin American institutions through this project. On the other hand, the gender gap is a global problem, so the European institutions will also learn how to improve their processes.

The funding period started in January 2019 and will finish in July 2022, although the network will continue reducing the gender gap in STEM (https://wstemproject.eu/). The consortium consists of fifteen HEI, five from Europe and ten from Latin America:

- University of Salamanca – USAL (Spain) as coordinator.
- Universidad del Norte – UNINORTE (Colombia).
- Oulu University – OULU (Finland).
- Politecnico di Torino – POLITO (Italy).
- Technological University Dublin – TUD (Ireland).
- Northern Regional College – NRC (United Kingdom).
- Tecnológico de Monterrey – ITESM (Mexico).
- Universidad de Guadalajara – UDG (Mexico).
- Universidad Técnica Federico Santa María – UTSM (Chile).
- Universidad Pontificia Católica de Valparaíso – PUCV (Chile).
- Universidad Tecnológica de Bolívar – UTB (Colombia).
- Tecnológico de Costa Rica – ITCR (Costa Rica).
- Universidad de Costa Rica – UCR (Costa Rica).
- Universidad Técnica Particular de Loja – UTPL (Ecuador).
- P15 Technical University of the North – UTN (Ecuador).

Furthermore, each university has also involved secondary education schools as associated partners to work with them in the attraction processes of girls and young women to STEM studies. Finally, UNESCO also participates as associated partner and Columbus Association as external evaluator.

1.3 W-STEM Model

Higher Education Institutions can directly impact the attraction, access to and retention of women in STEM higher education at all levels (UNESCO, 2016, 2018). First, the attraction processes can impact before the students get to university. Later, the access processes mainly affect the application and enrolment activities when women students try to join STEM programs.

There is a critical issue regarding guidance and retention when women are at university due to dropout rates, both while studying and when they join the labour market. Previous studies identify the support received by the STEM students from their academic institutions and teachers is low (García-Holgado et al., 2020; Peña-Calvo et al., 2016). For this reason, HEIs must improve these processes.

The W-STEM model proposes a workflow with different tools and guidelines to impact these three processes, attraction, access and guidance/retention from the HEIs. The workflow involves four phases (Fig. 1.2). The first phase, situation analysis, is review and self-assessment tasks focused on reflection and insight. It is necessary to identify the current state of women in STEM programs because the rate of women in each program depends on different factors; it is not the same for science, technology, engineering or mathematics-related degrees.

The second phase starts once we know the real situation of our institution. This phase focuses on defining the Gender Equality Action Plan (GEAP) to define the

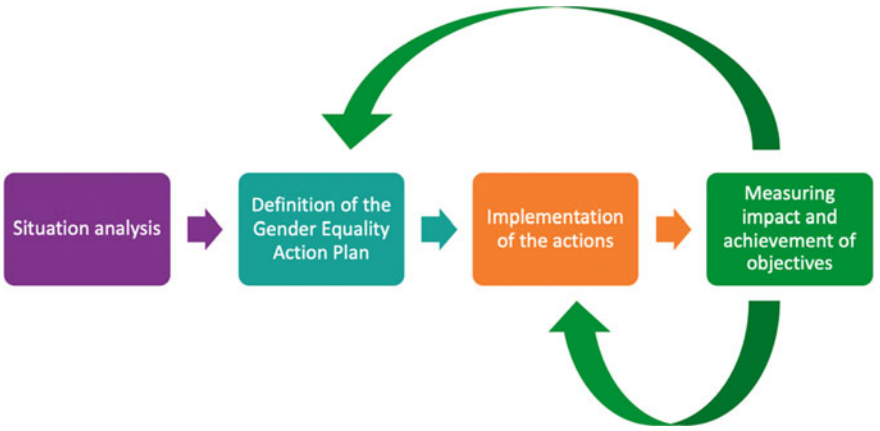

Fig. 1.2 W-STEM workflow to reduce the gender gap in STEM

strategy and the objectives, and design actions to achieve them. Despite Gender Equality Plans (GEP) being mandatory at the university level in most European countries, this is not always required in Latin American HEIs. Moreover, the GEP usually focuses on gender equality among the staff and academic community but not are directly related to reducing the gender gap in STEM.

The next phase covers implementing the actions defined in the Gender Equality Action Plan. These actions work on attraction, access, and guidance processes. Finally, the last phase ensures compliance with the objectives established in the GEAP. It implements mechanisms to measure the impact and achievement of the objectives, and the results are used to update the GEAP or improve the implementation of the actions.

1.3.1 Situation Analysis

The main objective of the first phase is to identify the current situation of women in STEM programs inside the HEI. The results associated with the situation analysis are three:

- Programs with a significant gender gap.
- Knowledge about the processes inside the institution regarding attraction, access to and guidance.
- Good practices inside and outside the institution.

This phase is also divided into three stages or sub-phases, each one with an instrument to collect the required information and a dataset that serves as input for the definition of the gender equality action plan in STEM programs. Moreover, each stage is focused on one of the mentioned results and is an input for the next stage. Figure 1.3 summarises the process.

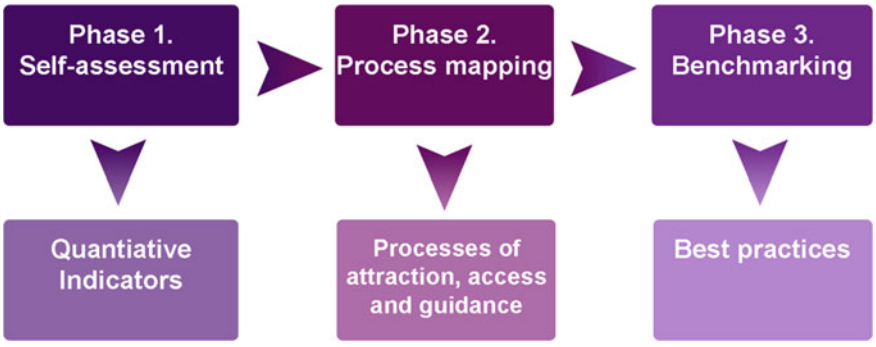

Fig. 1.3 Situation analysis stages

1.3.1.1 Self-Assessment

The first stage is "self-assessment". It focuses on measuring STEM gender equality in the university concerning attraction, access, guidance, retention and other processes, only on the quantitative side. The data collected is key for the rest of the process because it will determine the strategy defined in phase 2, the Gender Equality Action Plan.

We designed a survey to collect quantitative indicators related to undergraduate education level only (bachelor's degree or equivalent), although it is possible to use it for a master's degree or doctorate. The baseline of this instrument is the UNESCO SAGA Toolkit, which is a conceptual and methodological framework to provide a series of tools to integrate, monitor and evaluate gender equality in STEM and assist in the design of gender-sensitive and evidence-based policies to strengthen the gender policy agenda (UNESCO, 2017). The survey is made up of items from the SAGA Indicator Matrix, a tool with 45 indicators to assess on an institutional level the effects of policies and instruments in science, technology and innovation as well as availability and possible need to further develop such policies and instruments to advancing women's participation and career advancement in STEM fields (UNESCO, 2017).

The indicators are organised into ten categories: institutional background information (total number of students and staff: males/females); STEM Programs according to ISCED 2013 classification—broad field; students; attraction; access; enrolment; discrimination; sexual harassment; guidance; dropouts.

The W-STEM self-assessment survey includes indicators from 4 to 26. Moreover, we modified indicator 9 "Total and share of women graduated from university programs by field of study and by educational level," replaced by "Total and share of women graduated from university programs by field of study". Besides, the survey includes two new indicators, 46 and 47. Indicator 46 is based on indicator 9, but focused on guidance of women enrolled and graduated in STEM programs, which also consists of four sub-indicators:

- 46.1. Provide the total number of applicants who enrolled in first year in your university who successfully completed first year by field of study.
- 46.2. Provide the total number of female applicants who enrolled in first year in your university who successfully completed first year by field of study.
- 46.3. Provide the number of students in your university who graduated in 2018 by field of study.
- 46.4. Provide the number of female students in your university who graduated in 2018 by field of study.

Concerning indicator 47, it measures female dropout in STEM programs, and it has two sub-indicators:

- 47.1. Total dropout at first year.
- 47.2. Share of the female dropouts during the first year.

Finally, some indicators are complemented with a set of questions to identify related policies. The survey template is available on (W-STEM Consortium, 2019a). The self-assessment must be applied at the beginning of the process, collecting information from the last academic year. Although covering more academic years is possible, one year is enough due to a challenge to feed the indicators with sufficient data (García-Holgado et al., 2020c). On the other hand, all indicators are important; however, not all are mandatory. At least the institution should complete the indicators, 4 to 8, 14, 15, 46 and 47.

1.3.1.2 Process Mapping

Higher Education Institutions are complex organisations due to the multiplicity of purposes, the involvement of multiple actors in the decision-making processes, the different organisational cultures that coexist within the organisation or the complex structure that derives from its nature. Even though the people working on the gender gap in STEM is part of the institution, most will not be aware of all the details of the institution's functioning unless they have been part of the management team.

This stage provides a clear map of all the steps and the involved stakeholders in the key processes of the project: attraction, access, retention, and guidance. It complements the results of the indicators found during the self-assessment from a qualitative point of view and allows identifying bottlenecks, deficiencies, possibilities and who are involved and their roles.

The definition of the process mapping template (W-STEM Consortium, 2019b) and the guidelines was supported by an external expert to ensure that data collection is carried out in a similar way regardless of the institution and that all necessary elements are covered. The mapping should include plans, strategies and policies, measures and initiatives, institutional framework at different levels (university, department, etc.), and any stage (planning/execution/evaluation or closing phases, in development, or already finished).

The template has four datasheets, one per macro-categories (attraction, access, guidance and retention). Each sheet provides a set of columns to organise the input information. Each macro category is divided into subcategories and activities. For example, the access category could be divided into admission to the first undergraduate semester, tuition payment, academic enrolment, etc. These subcategories will depend on the institution.

Moreover, each subcategory is divided into activities and the following information is provided: the name of the activity, a short description of the activity and the impact on the target groups. Finally, the departments, services or units in charge of each subcategory and/or activity should be provided (García-Holgado et al., 2020c).

The mapping process can be carried out after the self-assessment or parallel and should reflect the current situation. It is a snapshot of the institution's performance on gender gap issues with special attention to STEM. The output of this stage will be useful to involve decision-makers in the next phase, the definition of the Gender Equality Action Plan.

1.3.1.3 Benchmarking

The gender gap in STEM is not a new issue; many organisations and communities are working on reducing the gender gap in STEM. Initiatives such as Niñas Pro in Chile (Vidal et al., 2021), a Female Engineer in Every School in Spain (Cerezo et al., 2018) or Women in Science & Engineering (WiSE) in the United States (Paderewski-Rodríguez et al., 2017) are some examples of actions developed by Higher Education Institutions to engage more girls into STEM.

The situation analysis phase includes a stage to consider those actions that already work and learn from the previous problems and decisions. The W-STEM model proposes two ways to conduct this stage. On the one hand, a systematic research projects review (SRPR) (García-Holgado et al., 2020d) to identify funding projects related to the gender gap in STEM. For example, in the European Union, there is a strong investment in projects focused on gender in STEM (García-Holgado et al., 2020a). Those projects have outcomes that can be transferred to other institutions, such as educational materials, online courses, examples of good practices or software tools.

On the other hand, benchmarking rounds focused on attraction, access and guidance/retention. The methodology proposed to conduct the benchmarking round is based on the Columbus Association methodology. It is a process applied in companies and can be transferred to universities. It is a structured process—a series of actions, steps, functions or activities—that leads to comparing services-activities-processes-outputs-outcomes to identify and adopt good practices to improve university performance. In the W-STEM model, benchmarking rounds aim to identify policies, procedures and mechanisms that are considered good practices in attracting, accessing and mentoring women in STEM programs to be adapted to the needs identified in the institution.

The benchmarking can be conducted internally in large universities, for example, with different campuses, but it can also involve several institutions participating in the preparation process and the dynamics afterwards. Each institution has to collect examples of good practices that might be interesting and of novelty from an institutional point of view. This could be related to any of the three processes (attraction, access and guidance or retention); it may even impact more than one process at a time. Furthermore, the institution can identify lessons learned or problems encountered in implementing an action. The preparation process can follow the template prepared in W-STEM (W-STEM Consortium, 2019c). After collecting the information, each institution shares the good practices, lessons learned and problems in an event, face-to-face or online.

1.3.2 Definition of the Gender Equality Action Plan

Typically, a gender equality plan (GEP implies establishing and making effective a set of basic principles to safeguard gender equality in all the spheres of academic

life. It also establishes the core actions to be developed in the university, across its different levels: human resources practices and management processes, student services and institutional communication, research design and delivery, and institutional communication (Barros et al., 2018). However, the GEAP proposed in the W-STEM model is supplementary to GEP already developed in some HEI. Despite the GEAP implementing some measures to ensure gender equality inside STEM programs, the principal focus is reducing the gender gap in those programs through gender equality actions. Moreover, the GEAP works in attraction and access, which are not directly internal processes of the institution itself but seek to work outside the institution.

The GEAP includes specific actions to increase access, attraction and guidance of women in STEM programs. The results from the previous phase, situation analysis, are inputs to define the GEAP. First, indicators from the self-assessment will serve to identify the target STEM programs. Second, the process mapping will provide useful information about the processes already implemented in the institution, so the actions defined in the GEAP could change those processes or introduce new ones. Finally, the benchmarking results provide ideas and learning lessons to define some actions to achieve the GEAP objectives.

The definition of the action plan should follow three steps: define the strategy; design the objectives; and define the actions to achieve the objectives. The strategy definition should include a short text to contextualise the action plan. This is not a state of the art or theoretical introduction; its goal is to explain the plan's purpose.

Regarding the actions, it should be noted that each objective must be associated with more than one action; in another case, the objective is not well defined. The actions definition is not only the presentation of the action, but also the process to identify the person or persons responsible for each action, the services in the university that will help to implement the actions and achieve the objectives, and the persons that will support the implementation of the action. Furthermore, the description of the actions will include a timeline to establish the implementation timing for each action and identify the milestones.

1.3.3 Implementation of Actions and Measuring Impact and Achievement of Objectives

The implementation of the actions defined in the GEAP, and monitoring are the last phases of the W-STEM model. The implementation phase depends on the actions defined by the institutions. However, it is necessary to consider the monitoring phase when we develop those actions. For this reason, the actions should include mechanisms to measure the impact to assess the achievement of the GEAP objectives and the quality of the implementation process.

Actions must include surveys, observation mechanisms, evidence gathering, etc., to have enough data to support decision-making processes during the monitoring

phase. Furthermore, the measures will have an impact on the actions. Therefore, actions that are carried out on a regular basis will be updated or replaced by others if the expected impact is not achieved.

Finally, it is possible using benchmarking rounds as monitoring activities. These rounds can be organised internally, involving the stakeholders involved in the GEAP, to review the progress done, learn from the different actions implemented, and make decisions about the GEAP. Also, it is possible to invite other institutions to the benchmarking round, not only for identifying good practices, but also for sharing learning lessons and solving common problems.

1.4 Main Results

The results of the W-STEM models depend on each institution. However, this section summarises some relevant results obtained during the implementation and validation of the model in the Latin American institutions involved in the W-STEM project.

In addition to the resources and materials developed to support the implementation of the W-STEM model, there are four primary results associated with the process that can be used in other contexts:

- International Leadership Summer Camp.
- Women in STEM mobile app.
- Attraction campaigns.
- W-STEM Mentoring Network.

1.4.1 International Leadership Summer Camp

First, the International Leadership Summer Camp (also named International Leadership Summit) was organised face-to-face in Cartagena de Indias and Barranquilla (Colombia). It was an event on the global and regional outlook on gender equality at STEM education and women in science participation. The aim was to make the problem visible to the policymakers from the higher education institutions involved in W-STEM to integrate them in the definition of the GEAP as a strategy to ensure the sustainability of the plan. Each participant university involved at least one institutional leader (rectors, vice-rectors, deans of STEM programs, institutional decision-makers). Also, five experts from UNESCO, NRC (UK) and Liquid Galaxy Lab at FAÇENS (Brazil) participated in the event.

The Leadership Summit included sessions for building bridges between national/regional policies and the institutional level. Leaders, experts and the W-STEM team participated in a World Café, a set of roundtables focused on building bridges between public policy and institutional initiatives concerning the mechanisms and strategies about attraction, access and guidance of women in STEM programs (García-Peñalvo et al., 2019).

The second part of the Leadership Summit was focused on the first benchmarking round and a workshop to start the definition of the Gender Equality Action Plans.

1.4.2 Women in STEM Mobile App

The purpose of the W-STEM app is to give visibility to women in STEM careers, not only women of a very high level in STEM, but also young women with different profiles—last year students, PhD students, young researchers, developers, etc. The app is a tool for schools and high schools in Latin America to show young women in STEM since the books and materials used in the classroom only show examples of men. It is intended to give young people ideas about what it means or why to select a STEM program (García-Holgado et al., 2020e). The app is available for iOS and Android, both for smartphones and tablets (https://wstemproject.eu/app/).

The app has two types of content. On the one hand, short bios provide some useful information to potential STEM students and share with them similar concerns that other people have had (Marín-Raventós et al., 2020). We used a survey based on (Ballatore et al., 2019) to identify prospective students, successful graduates and current students, with key aptitudes correlated to STEM disciplines/professions. A total of 6358 profiles were collected, 2071 have finished their university studies, and 4287 are students (45.33% male, 54.03% female, 0.34% preferred not to answer, and 0.3% non-binary).

On the other hand, the app facilitates access to 335 interviews of women in STEM from different countries, cultural backgrounds, ages, and career stages (not only senior positions). The goal was to show diversity in STEM and avoid stereotyping. The interviews duration is between 3 and 7 min, and the original language is Spanish or English with subtitles. Figure 1.4 shows a sample of the videos available on YouTube (W-STEM Consortium, 2020).

1.4.3 Attraction Campaigns

The original plan was to conduct the attraction campaigns inside the secondary schools to engage the young women students and support them to enrol in a STEM program. However, the COVID-19 crisis impacted on education (García-Peñalvo, 2021; García-Peñalvo et al., 2020, 2021; Knopik & Oszwa, 2021) and forced the transformation of the attraction campaigns into virtual campaigns.

The involvement of the schools during the lockdown period in 2020 hindered the organisation of some activities. For this reason, the attraction campaigns also involved awareness-raising campaigns. Moreover, all the events were online, so a common schedule was prepared to avoid overlapping. Although there were many activities, the attraction campaigns guidelines included the following type of events:

Fig. 1.4 Women in STEM interviews available on the W-STEM YouTube channel

- Awareness webinars: the objective is to raise awareness among schoolgirls about the gender gap in STEM fields.
- Informative webinars: the objective is to provide relevant information about the different STEM areas, their fields of action, their importance for society, etc.
- Webinars aimed at training in STEM knowledge: applications of the STEM areas that are compelling and that can be taught to girls while addressing real problems. For example, data analysis, programming principles.
- Activities with professional women from different countries: such as Q&A sessions (live questions from participants) or panels/talks about the differences between careers and their fields of application.
- Talks with guests on the experience of studying and/or practicing STEM, as well as the role that women have had in the history of that field.
- Coffee with a STEM woman: more informal conversations with a guest.
- Virtual Poster Fair: exhibitions of women who have contributed to STEM areas with Q&A.
- Film forum: girls are encouraged to watch a film that addresses the gender gap in STEM or highlights a STEM woman's story and then virtual discussion space is opened.
- Vocational orientation: smaller spaces where a specific career is addressed. In these activities, the idea is to explain the most relevant aspects of each STEM career but separately and in smaller groups so that the doubts and questions of most of the attendees can be answered.

1.4.4 W-STEM Mentoring Network

We have created a network of mentoring programs with pilot experiences the eleven HEI from Ibero-America (Chile, Colombia, Costa Rica, Ecuador, Mexico, and Spain).

The Mentoring Network aims to empower women and encourage their active participation in STEM programs. The mentoring model implemented uses a three-way relationship. It involves a mentor teacher, the peer-mentor and the mentee (González Rogado et al., 2021). The guidelines for implementing the mentoring programs are common for all the network, but each institution has adapted them to its own contexts and needs according to its GEAP.

First, mentor teachers and peer-mentors receive cross-cutting training in leadership, women's empowerment, inclusive language and creating inclusive environments. Depending on the institution, mentor teachers and peer-mentors are men and women or only women. Regarding the mentees, they are first-year STEM female students. The goal is to support and empower them during their first year of studies.

1.5 Conclusions

The gender gap in STEM is a reality that affects to a different extent by countries. Although there are countries with less gender gap in STEM, such as Oman, Myanmar, Morocco, Mauritania, Gambia or Benin, most countries have a remaining gap to close stands at 60–70% (World Economic Forum, 2021).

Higher Education Institutions have a major role in reducing the gender gap in STEM because they impact before, during and after tertiary studies. For this reason, HEI must implement gender equality action plans based on their gender equality situation. This chapter presents the W-STEM model, a proposal based on three years working on strategies and mechanisms to improve the attraction, access, guidance, and retention processes to engage more women into STEM programs.

The W-STEM model has been fully tested in eleven institutions in Chile, Colombia, Costa Rica, Ecuador and Mexico, involving public and private institutions with different gender equality situations. Each institution has adapted the model and the resources to develop the different context.

However, several caveats need to be noted regarding the W-STEM model. Although work has been done on the three processes of attraction, access, guidance and retention, the actions associated with access are lower than others. The main problem is that national education laws and policies regulate the access processes, so the institution could influence the support provided to the students during those processes but not in the process itself.

On the other hand, concerning the situation analysis, some important limitations need to be considered. First, the self-assessment and mapping process require the collaboration of different services and units, so there is a high risk of not achieving

all information. HEI does not have a unique service that centralises statistical information.

Finally, there is a definite need to transfer the W-STEM model to other HEI, with a particular focus in Latin America. For this reason, the W-STEM project is developing a set of online training modules on policies, mechanisms and processes, as well as on the implementation of the W-STEM model to enhance the attraction, access and guidance of women in STEM.

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