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GENDER AFFAIRS 161

Public policies for gender equality in science, technology, engineering and mathematics (STEM)

Challenges for the economic autonomy of women and transformative recovery in Latin America

Carolina Muñoz Rojas

UNITED NATIONS

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Abstract

The fields of science, technology, engineering and mathematics, commonly referred to by the acronym STEM, have emerged as a promising area in which to address the current digital revolution and accelerated technological change, exacerbated and complicated by the coronavirus disease (COVID-19) pandemic. Can STEM serve as a path to gender equality and economic autonomy for women in Latin America? The question is gaining ground. This report addresses an ongoing debate in the region in recent decades that must be reframed to meet an urgent need for new solutions and, above all, to transcend one-dimensional approaches to gender inequalities. This document identifies both potential and evident links between gender equality and STEM, along with trends observed in public agendas. Key issues addressed here include the ways in which links between STEM and gender equality are visible in the region; the problems they recognize or address; conclusions to be drawn from developed policies and initiatives; and the potential of STEM fields and skills to overcome the structural challenges of gender inequality in a post-pandemic context.

Introduction

The fields of science, technology, engineering and mathematics, commonly referred to by the acronym STEM, have emerged as a promising area in which to address the current digital revolution and accelerated technological change, now exacerbated and complicated by the coronavirus disease (COVID-19) pandemic. Can STEM serve as **a path to gender equality and economic autonomy for women in Latin America?** The question is gaining ground.

In recent decades, international organizations, regional governments, academic institutions and women's and feminist organizations have taken positions on this question and made proposals to foster greater gender equality in this area through policy and other public action. One issue that has stood out is the underrepresentation of girls and women in these fields —an ongoing concern for both researchers and policy makers (Stoet and Geary, 2018) given the low percentage of women in these types of careers and the progressive decline in the number of women who transition from studies to employment in this area, a phenomenon referred to as a "leaky pipeline".

Waldman (2018) notes that several metaphors are used to explain the low participation rate of women in the sciences: a lack of "stretch assignments" for women; "glass cliffs"; "sticky floors"; "polycarbonate ceilings"; "glass escalators"; "non-events"; "crystal labyrinths"; "leaky pipelines"; and "chilly climates", to name a few. While metaphors are often evocative and capture some elements of the problem, there are many pitfalls in relying too heavily on them as accurate portrayals of a problem, as they obscure "power relations and underlying structural conditions" (p. 24). It is therefore important to investigate the various examples of gender inequality in STEM and identify those recognized as public problems[1] on international, regional and national agendas, the scope of which is addressed in this report.

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[1] The term 'public problem' is relevant in public policy analysis. Joan Subirats points out that once identified, problems can lead to action by public authorities (Subirats, 1996). For the author, a distinction is made in specialized literature between 'problems' and 'issues', 'questions' or 'matters'. 'Problems' are sufficiently relevant to be considered as such by public authorities and are therefore likely to appear in the programmes and agendas of the latter, becoming, as such, public problems or issues.

In the context of the COVID-19 pandemic and the widespread health, social and economic crisis affecting the countries of the region, recovery efforts identify STEM —once again— as key to facing current challenges and global change for a post-pandemic future. In the Latin American and Caribbean region in particular, this needs to occur within the framework of an urgently needed shift to a development model that puts equality and gender equality at the centre (ECLAC, 2019a). The question arises: **is STEM an opportunity to overcome the structural challenges of gender inequality? Or do we run the risk of deepening them and reinforcing existing gender inequalities in the region?**

This report addresses a debate ongoing in the region for the last few decades but which must be reviewed to accommodate a world that requires urgent and profound change and new solutions, most importantly to transcend one-dimensional approaches to gender inequalities or others focused solely on increasing the number of women in STEM as the only way to advance equality and economic autonomy. A structural approach to gender inequalities recognizes that the exclusion of women from these fields, more than a problem in itself, is an effect or symptom of a deeper problem: scientific and technological knowledge has been foundational in the construction of an unequal gender social order that justifies women's inferiority, normalizes their exclusion and sustains systems of privilege.

The notion of epistemic violence proposed by Fricker (2007) helps conceptualize the underlying problem, given that "violence is exercised in relation to the production, circulation and recognition of knowledge: the denial of epistemic agency for certain subjects, the unacknowledged exploitation of their epistemic resources, their objectification, among many others" (Pérez, 2019). This entails looking at various aspects: who generates knowledge, for whom and for what purposes? Which subjects are recognized as legitimate generators of knowledge, and are therefore also legitimate subjects for study and inquiry?

The predominance of androcentric biases in the generation of knowledge sustains unequal gender relations and other forms of social inequality, and STEM has been a prime area in which hegemonic representations of gender, but also of class, race, ability, among others, have dominated. Long-standing feminist debate on this issue has levelled significant criticism of science and technology and taken issue with the different approaches to gender problems or issues in public policy.

Pioneering feminist theorists and activists like Sandra Harding and Londa Schiebinger in the United States, Eulalia Pérez Sedeño in Spain, Diana Maffía in Argentina (among other key figures) have contributed greatly to this debate. Sandra Harding (1986) makes a distinction between the exclusion of women from science —and the inequality faced by the few who manage to break into scientific fields— from more fundamental structural problems. Two questions prevail: the "woman question in science", and how women can be treated more fairly both in and by science, thus enabling the possibility of change and reform within; and the "science question in feminism", which raises the deeper issue of how science —so profoundly anchored in traditionally male-centric endeavours— could be used for emancipation, applying a more sceptical approach to such changes without transforming the scientific view of the world. Taken from this perspective, incorporating more women into scientific —and technological— fields is not enough: more comprehensive approaches are needed which have an impact on public policy proposals in these areas.

Science historian Londa Schiebinger's work has focused on demonstrating gender, class and racial biases in science and has contributed substantively to demonstrating how scientists, as privileged members of society, build images and explanations of nature that reinforce their own cultural references and values (Maffia, 2006). Similarly, Eulalia Perez (1995) points out that a critical analysis of science from a feminist perspective calls into question the very nature of scientific knowledge and the power it yields, in addition to analysing gender and women's theories specifically, together with the processes of their development.

In Latin America, the fundamental work of Diana Maffía establishes two approaches to the problem: a liberal proposal that frames the absence of women in science as a matter of access to education and employment, solvable through affirmative action measures, and another, more radical approach based on the notion that it is not enough for women to be scientists if science does not change. Opening science to women must be accompanied by a willingness to change science itself, which leads to the next question: Should women adapt their values and methods to science, or will science adapt its methods and practices to women? (Maffía, 2006).

Critical approaches are also found in the field of technology. For Judy Wajcman (2004, p. 15), a prominent figure in the feminist analysis of technology and technofeminism, "the very definition of technology is cast in terms of male activities. We tend to think about technology in terms of industrial machinery and cars, for example, ignoring other technologies that affect most aspects of everyday life". The concept of technology "is itself subject to historical change, and different epochs and cultures had different names for what we now think of as technology" (Wajcman, 2004). For example, the terms information and communication technologies (ITC), as well as biotechnology, nanotechnology, robotics and artificial intelligence, are relevant today.

Vergés (2013) points out that feminist theories of technology are the theoretical expression of a series of diverse and controversial social and political movements, philosophies and practices that share an opposition to, and a desire to overcome sexism and androcentrism in the relationship between gender and technology. Although in recent years technology has gained ground in recent feminist movements in the form of cyberfeminism (and cyberactivism), theoretical debate began much earlier, in the 1970s, with research exploring the relationship between women and technologies, and continued to develop in the following decades.

Wajcman (2004) analyses the different ways in which technology —in general— is gendered, both in design and use, and highlights these two sides: technology can serve as a tool for social transformation, but also for political control where oppression and violence against women can proliferate and be reinforced. According to UNESCO (2021a), as technologies powered by artificial intelligence (AI) increasingly permeate our lives, the link between AI and gender issues becomes steadily more important in the struggle for gender equality. Among other issues, "male predominance in AI education and workforce, algorithmic bias and discrimination, 'outing' LGBTI individuals in violation of their rights to privacy, stereotypes in the creation of 'female' voice assistants, issues around the sex robot industry, and the invention of 'deepfake' pornography are some of the concerns that arise with the advent of AI technologies" (p. 128).

Technology presents a paradox: on the one hand, it has the potential to improve the lives of women and girls. With the right interventions and levers, it can be geared towards the achievement of social goals (United Nations, 2019). In particular AI holds the potential to develop new solutions to counter some of the issues that it raises, or even to further progress towards gender equality (UNESCO, 2021a). "Without regulation and appropriate policies, however, it could serve to deepen gender inequality and vulnerabilities" (United Nations, 2019). Therefore, similarly to the science question in feminism raised by Harding (1986), Wajcman (2004) is critical of solutions focused only on getting more women into scientific and technological fields and of the idea that it is simply a problem of equal access to education and employment.

Feminist debate is rich, prolific and far-reaching, and reflects a complex issue that requires solutions that respond to this complexity. This report, which refers to certain elements of this debate, focuses on how public policies in the region address this complexity and whether they are aimed at overcoming the structural challenges of gender inequality. These challenges exacerbate each other and generate complex socioeconomic, cultural and belief systems that hinder and reduce the scope of policies on gender equality and women's autonomy (ECLAC, 2017c) and can equally effect gender and STEM policy.

This report therefore seeks to analyse the links between gender equality and STEM, identifying the gender inequalities expressed therein, as well as trends observed in public agendas. To guide the debate, the report addresses certain key questions: how are links between STEM and gender equality visible in the region? What problems do they recognize or address? What conclusions should be drawn from developed policies and initiatives? What potential do STEM fields and skills hold in overcoming the structural challenges of gender inequality in a post-pandemic context?

The document has four sections: an introduction to what is meant by STEM and why it must be analysed from a gender perspective; a review of the international gender agenda and STEM at the global and regional levels; an examination of public policies on gender and STEM that explores the findings of national assessments, as well as more recent national policies, with a distinction made among the links between gender and STEM in equality plans, specific policies on gender and STEM, along with other initiatives on gender equality in these fields. Lastly, a fourth section presents an analysis of public policies, identifying major challenges and recommendations for gender equality in STEM in the context of post-pandemic recovery.

I. Science, technology, engineering and mathematics (STEM): what are we talking about?

A. More than an acronym, a high-priority field with transformative potential

The emergence of the acronym STEM[2] has gathered momentum, and its use has spread over the last few years. It has even acquired visibility as a term in its own right. However, it brings together differing fields of knowledge and does not have a single meaning or scope, which can result in different interpretations. The term STEM is linked to disciplines or fields of knowledge, areas of training, as well as educational skills and approaches.

First, it refers directly to disciplines and fields of knowledge: science, technology, engineering and mathematics. While these share certain characteristics, they are neither identical nor homogeneous; within them, other specific fields or sub-fields can be distinguished. Based on the UNESCO International Standard Classification of Education (ISCED-F) 2013,[3] STEM-related disciplines are recognized as broad

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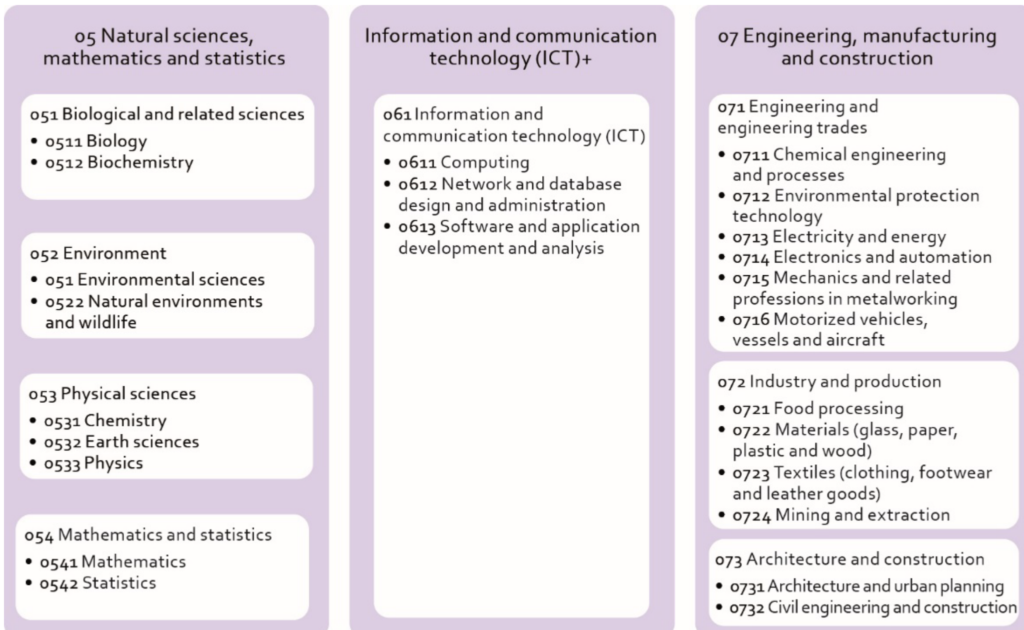
[2] According to Cifuentes and Guerra (2020) and EducarChile (2021), the acronym STEM was coined in the 1990s by the National Science Foundation of the United States to refer to the disciplines of Science, Technology, Engineering and Mathematics. Furthermore, the acronym itself ('STEM') suggests the notion that new solutions could emerge, or stem, from these four disciplines to boost competitiveness.

[3] The International Standard Classification of Education (ISCED) is a framework for assembling, compiling and analysing cross-nationally comparable statistics on education. ISCED is a member of the United Nations International Family of Economic and Social Classifications and is the reference classification for organizing education programmes and related qualifications by levels and fields of education. The United Nations Educational, Scientific and Cultural Organization (UNESCO) began developing the ISCED in the 1970s. The latest revision, ISCED 2011, concentrated primarily on changes to the levels of education of programmes (ISCED-P) and introduced, for the first time, a classification of levels of educational attainment based on qualifications (ISCED-A). During the review process which led to the 2011 revision, it was decided that the fields of education should be examined in a separate process to establish an independent but related classification which could be updated according to a different frequency, if appropriate, from any future revision to the levels of education and educational attainment. The classifications of levels and fields will remain part of the same family of classifications. Accordingly, this new classification will be referred to as the ISCED Fields of Education and Training (ISCED-F), which was updated most recently in 2013 (UNESCO, 2014).

fields of training (Bello, 2020; UNESCO, 2014), including: natural sciences, mathematics and statistics (05), Information and communications technologies (ICT) (06), Engineering, industry and construction (07). These fields are then subdivided into specific and detailed fields, shown in diagram 1.

Diagram 1
STEM fields according to ISCED F-2013, UNESCO



Source: Prepared by the authors, on the basis of United Nations Educational, Scientific and Cultural Organization (UNESCO), *ISCED Fields of Education and Training 2013 (ISCED-F 2013). Manual to Accompany the International Standard Classification of Education 2011*, Quebec, UNESCO Institute for Statistics, 2014.

It should be noted that the classification of fields of study was updated in 2013, yielding this configuration of fields and sub-fields for the areas related to STEM. In previous classifications (ISCED 1997 and ISCED 2011), computer science, for example, was considered a sub-field of science, and information and communication technologies did not appear (they were added in 2013). The update included the Fields of Science and Technology 2007 (FoS 2007), which classifies research and experimental development (R&D) and is part of the Frascati Manual[4] of the Organisation for Economic Co-operation and Development (OECD). These six major fields are divided into approximately 40 subfields. Major fields include natural sciences, engineering and technology, medical and health sciences, agricultural sciences, social sciences and the humanities. The first two are linked to STEM, as shown in diagram 2. This 2007 classification incorporates emerging new fields like information and communications technology, biotechnology, nanotechnology, as well as the emergence of inter-disciplinary sciences, which are still included in the seventh version published in 2015. It should be noted that while the FoS 2007 was used in the 2013 ISCED-F update to identify new emerging fields, the two have different purposes, however and there is no direct link between them (UNESCO, 2014).

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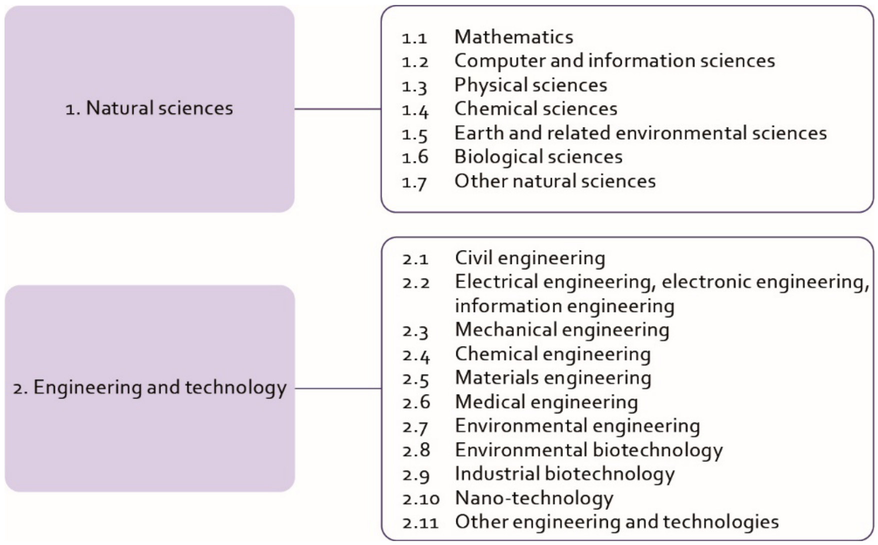
4 In 1963, OECD held a meeting of national experts on research and development (R&D) statistics at the Villa Falconieri in Frascati, Italy, which resulted in the first official version of a Proposed Standard Practice for Surveys on Research and Experimental Development, better known as the 'Frascati Manual'. The seventh version of this manual was published in 2015.

Diagram 2
STEM fields according to fields of R&D classification, OECD



Source: Organisation for Economic Cooperation and Development (OECD), 2015. *Frascati Manual 2015, Guidelines for Collecting and Reporting Data on Research and Experimental Development*, Paris, OECD Publishing, 2015.

The two aforementioned classifications give an idea of the complexity of STEM fields. On the basis of the disciplines recognized within STEM, specific areas of training can be distinguished, in the form of primary- and secondary-level courses or subjects, or post-secondary and higher education level degrees or programmes.

It is easier to identify STEM courses and degrees in academic or traditional education than it is in technical and professional (vocational) education. In this area of training, given the diversity of STEM careers across different country contexts, it is difficult to provide an overarching list of STEM careers (UNESCO/UNEVOC, 2020). In the United States, STEM careers are classified in relation to post-secondary education: research, development, design and practitioners, sales, technologists and technicians; In Australia, the list of STEM-related occupations includes farmers and farm managers; specialist managers, arts and media professionals, design, engineering, science and transport professionals, health professionals, ICT professionals, technicians and trades workers, as well as engineering, ICT and science technicians. Therefore, in addition to the fields identified in the ISCED-F 2013 classification listed in diagram 1 (05 Natural sciences, mathematics and statistics, 06 Information and communication technology, 07 Engineering, manufacturing and construction, UNESCO/UNEVOC (2020) links STEM to technical and professional education by including the field of Agriculture, forestry, fisheries and veterinary (08), pointing out that the majority of STEM fields used in various countries are within the scope of these four fields (this could be applied to the situation in Latin America).

STEM skills are considered to be linked to those developed in these fields, such as research, critical thinking, problem solving, creativity, communication and teamwork, and which aim to intersect with other educational fields. One example are digital skills, defined as "the ability to access, manage, understand, integrate, communicate, evaluate and create information safely and appropriately through digital devices and networked technologies for participation in economic and social life" (UNESCO, 2019b). Likewise, STEM education has been recognized as an interdisciplinary or pedagogical approach —a 'STEM approach'— defined as a "strategy that emphasizes the application of knowledge, skills and values from the disciplines of Science, Technology, Engineering and Mathematics in an integrated manner to help students solve problems encountered in the real world" (Asunda and others, 2016, cited in UNESCO/UNEVOC, 2020). STEM education has been recognized as an educational movement aimed at improving student learning, both in knowledge and skills (EducarChile, 2021). An example of this is learning experiences focused on innovation, the application of scientific-technological principles, and collaborative and peer-to-peer learning.

B. Why examine STEM from a gender perspective?

One of the main problems with regard to gender inequality in STEM has been the underrepresentation of women in these fields, where exclusion persists: despite a high rate of participation of women at all levels of education —post-secondary and higher education in particular— the percentage that go on to a career in STEM remains low (OEI, 2020; Bello, 2020; UNESCO, 2020b).

This low rate of participation of women is striking —and paradoxical— in several ways. Generally speaking, women now can access education without barriers — and they do so in large numbers. The region has achieved gender parity in enrolment up to lower secondary school level, and there is even "a disparity at the expense of males in upper secondary and tertiary education" (UNESCO, 2020a). Barriers to education are no longer the problem; the issue now are barriers to specific fields and educational paths. Access to education does not mean equal access to all fields and careers.

According to statistics compiled by UNESCO worldwide, when they reach higher education, women represent only 35% of all students enrolled in STEM-related fields. The lowest female enrolment is observed in information, communication and technology; engineering, manufacturing and construction; and natural science, mathematics and statistics. Women also leave STEM disciplines "in disproportionate numbers during their higher education studies, in their transition to the world of work and even during their career cycle" (UNESCO, 2019a).

Women enter all of these fields in low numbers, but analysis tends to assume that these fields are homogenous. However, differences in the participation rate of women also exist from one STEM field to another: women go into natural and health sciences in large numbers but are underrepresented in traditionally masculine fields such as engineering, technology and mathematics, the technological field in which women are still a minority. According to *The State of Science 2020* by RICYT,[5] in countries such as Brazil and Chile, women account for less than 13% of total enrolment in these fields (OEI, 2020). Statistics published by UNESCO show that as of 2018, the percentage of female post-secondary graduates in information and communication technologies was low in certain countries in the region, and the lowest in: Chile (12.7%), Brazil (14.6%) and Uruguay (17.7%). Among the countries with the highest percentages, only one —Peru— is close to 50% (49.6%), followed by Panama (43.9%) and the Dominican Republic (38.4%) (Bello, 2020).

The factors that explain this underrepresentation have been widely discussed in the literature. No single cause explains the underrepresentation of women in STEM; several factors contribute, including gender socialisation in childhood and adolescence; lack of identity with these fields, gender biases and stereotypes, lack of support and role models (Sevilla and Farias, 2020), gender stereotypes about the type of people who work in STEM (Sáinz, 2020), the influence of family and school environments, as well as the barriers to paid employment for female graduates in these fields. For example, the following are some of the barriers faced by women at entry and for their development and success in scientific careers: family care, the majority of which falls to women; male predominance in the power structure of science; an androcentric construction that does not value knowledge generated by women in the same way, and the persistence of gender stereotypes rooted in the academic and scientific community (Bello, 2020).

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5 Ibero-American Network on Science and Technology Indicators (RICYT), of which all the countries of the Americas and Spain and Portugal are members. The network emerged from the First Ibero-American Workshop for Science and Technology Indicators, held in Argentina in 1994. RICYT was endorsed by the Ibero-American Programme of Science and Technology for Development (CYTED) as an Ibero-American network and by the Organization of American States (OAS) as an inter-American network.

At the educational level, the UNESCO 2020 Gender Report, part of the Global Education Monitoring Report, highlights that "at all education levels, girls show lower values in self-efficacy —that is, perceived as opposed to *actual* abilities— in mathematics and science subjects, aside from life sciences" (UNESCO, 2020b). Although this is a predominant factor, critical feminist perspectives call into question an approach that focuses the problem entirely on women themselves, whether in science or technology. For Wajcman (2004), for example, the more liberal feminist tradition "locates the problem in women (their socialization, their aspirations and values) and does not ask the broader questions of whether, and in what way, technoscience and its institutions could be reshaped to accommodate women".

A second issue that stands out is the gender-equality paradox both in STEM (Stoet and Geary, 2018) and in ICTs (UNESCO, 2019b). First, Stoet and Geary (2018) conducted a comparative analysis of enrolment rates by gender in STEM education programmes and found that countries with high levels of gender equality (according to the World Economic Forum's Global Gender Gap Index) also had some of the widest gender gaps in STEM in secondary and post-secondary education. Similarly, UNESCO (2019b) shows that there is no direct relationship between levels of gender equality in a country (also based on the World Economic Forum's Global Gender Gap index) and the percentage of women who pursue advanced level studies in digital skills or ICTs, noting that the lowest percentages of women pursuing post-secondary studies in computer science and related subjects are found in countries with higher levels of gender equality, such as countries in Europe. Conversely, the highest percentages of women obtaining advanced technology degrees are found in countries with low levels of gender equality, such as those in the Arab region. In this correlation, countries in the region such as Chile and Costa Rica are in the first group (performing worse than expected), followed closely by Argentina, Brazil, Cuba and Mexico. While none of the region's countries appear in the second group (performing better than expected), Peru gets the closest.

Third, a more fundamental aspect are androcentric biases in the creation and construction of knowledge that not only exclude, but actually justify the exclusion of women and perpetuate inequality. For Waldman (2018), science is "embedded in the political and economic structures of late capitalism", relying on, and reproducing male hierarchies —a situation that could be extrapolated to all STEM—related fields. This involves analysing how, by whom, and for whom knowledge is created, in addition to how biases manifest in employment in STEM. Castaño and Webster (2014) point out that analysing the rate of participation of women in science not only involves quantifying the presence of women but also looking at how gender bias impacts access, selection and promotion in careers in science and technology. Schiebinger (2007) distinguishes three analytical levels: the participation of women in science and technology, gender bias in the cultures of science and technology —despite scientific ideals of objectivity and neutrality— and gender in the actual results of science and technology.

This discussion is key given the growing role of STEM fields, careers and skills in a context of technological change and digital revolution that is influencing the world of employment or paid work, commonly analysed under the lens of the 'future of work'.

Technological advances, including artificial intelligence, automation and robotics, are expected to lead to massive change in all areas of life. Technological change is not gender neutral (United Nations, 2019). The technological revolution will inevitably produce changes in working arrangements, in the organization of jobs and in the execution of tasks (Weller, 2017), which will imply increasing demand for new and more advanced skills (ILO, 2017), which could either present an opportunity or new barriers for women in the face of changing economic scenarios (ECLAC, 2019a).

Lastly, in the aftermath of the pandemic, how each country deals with the crisis, together with post-pandemic recovery proposals in the region, present an opportunity to strengthen the links between gender and STEM. It is evident that the health crisis and lockdown measures are changing aspects of how we live, including communication, education, paid work, and consumption, all highly mediated by digital technologies that "have been essential to the functioning of the economy and society during the crisis caused by the coronavirus disease (COVID-19) pandemic" (ECLAC, 2020a), given that "communications networks and infrastructure are being used more and more intensively for productive, educational, health, and entertainment-related activities and to keep in touch with friends and relatives. Progress that was expected to take years to materialize has been made in a few months" (ECLAC, 2020a).

From this point of view, STEM as it relates to technology in general and digital technology in particular, will be enhanced. This is one of the fields in which women are most underrepresented in the region and may be one of the sectors that 'benefit' the most from the effects of the pandemic. Gender biases in both the design and use of technologies "set limits to innovation, reducing their positive effects" (ECLAC, 2021), and are therefore an area where a push for more public policy action in the region can support the transformation of the technologies themselves.

In the context of the pandemic, digital solutions in the areas of health, education, commerce and work play a leading role "because they facilitate physical distancing and allow the socioeconomic system to remain viable to a certain extent" (ECLAC, 2020a). This suggests a meeting point between areas of employment in which women are traditionally predominant and the development of digital technologies as a key factor in advancing gender equality and women's autonomy in these areas. According to data from household surveys, as of 2017, 22.1% of women were gainfully employed in the wholesale and retail trade sector and 27.7% in the care sector, which includes households as employers, teaching, and activities related to human health care and social assistance (ECLAC, 2019b). Will the digital push in these sectors in the aftermath of the COVID-19 pandemic take into account gender equality and women's autonomy in Latin America?

II. STEM and the international agenda on gender equality

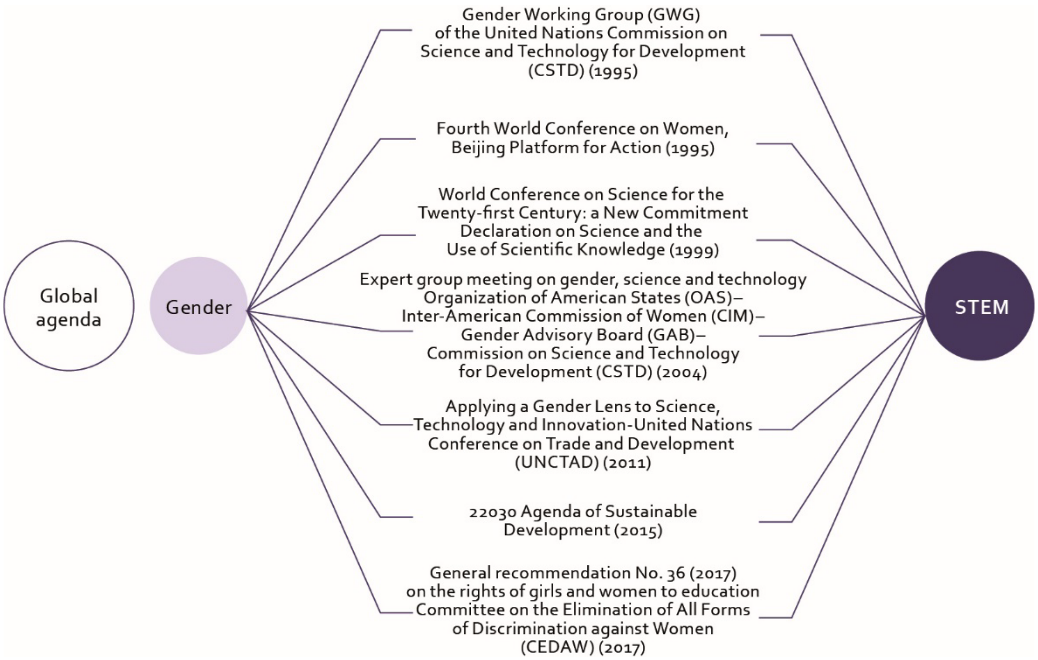
The public policy process, or 'development cycle' —for analytical rather than practical purposes— begins with the identification of public problems and by building a public agenda that assembles issues of legitimate concern which then receive the attention needed for them be addressed through public policy. Subirats (2013) points out that a public issue or problem is defined by its inclusion on the agenda, and the formulation of this agenda is characterized by three main elements: an assessment of the level of support that the issue or question can garner; an assessment of its importance or level of impact on a social reality; and the feasibility of the anticipated or foreseeable solution (Subirats, 1996).

Therefore, in order to investigate the public agenda on gender and STEM, we must identify existing consensus or agreements on the subject at the international and national levels, identified problems, policy proposals and recommendations, as well as the stakeholders in this process. This section will review the global and regional framework in which this issue has been addressed in recent years, including United Nations system entities and other international and intergovernmental bodies, as well as the respective parties involved in the process.

A. STEM and the global gender agenda

Worldwide, a number of milestones and intergovernmental forums have addressed gender and STEM issues. This section provides a chronological account of certain forums, presented in diagram 3, that reflect the global agenda.

Diagram 3
STEM and the global gender agenda



Source: Prepared by the authors.

In 1995, in tandem with the Fourth World Conference on Women of the United Nations, two initial milestones in STEM and gender were reached. A Gender Working Group (GWG) was established within the United Nations Commission on Science and Technology for Development (CSTD) to produce the report Missing Links: Gender Equity in Science and Technology for Development, and generate recommendations for the Fourth Conference, including the Eight Transformative Actions of the Gender Advisory Board (GAB) (Waldman, 2018):

(i) Gender equity in science and technology education.

(ii) Providing enabling measures for addressing gender inequalities in the scientific and technological careers.

(iii) Making science responsive to the needs of society: the gender dimension.

(iv) Making the science and technology decision-making processes more "gender-aware".

(v) Relating better with "local knowledge systems".

(vi) Addressing ethical issues in science and technology: the gender dimension.

(vii) Improving the collection of gender disaggregated data for policymakers.

(viii) Equal opportunity for entry and advancement into larger-scale science, technology, engineering, mathematics (STEM) disciplines and innovation systems.

The Beijing Declaration and Platform for Action, also established during the Fourth World Conference on Women, includes among its strategic objectives to "improve women's access to vocational training, science and technology, and continuing education" (Strategic objective B.3) and among its proposals for action by governments in cooperation with employers, employees and trade unions, and with international and non-governmental organizations (including women's and youth organizations and educational institutions) to: "diversify vocational and technical training and improve access for and retention of girls and women in education and vocational training in such fields as science, mathematics, engineering, environmental sciences and technology, information technology and high technology, as well as management training" (Action 82.e) (United Nations, 1996).

Twenty-five years after the establishment of the Beijing Platform for Action, close to 60% of States reported initiatives to remedy the underrepresentation of girls and women in STEM learning. Specific measures included digital empowerment programmes and training in partnership with industrial companies and the information and communications technology (ICT) sector, together with initiatives to combat stereotypes and increase women's interest in and access to STEM-related training and education (United Nations, 2019).

In 1999, the Declaration on Science and the Use of Scientific Knowledge, adopted by the World Conference on Science held in Budapest, stated that "science education, in the broad sense, without discrimination and encompassing all levels and modalities is a fundamental prerequisite for democracy and for ensuring sustainable development", adding that "the practice of scientific research and the use of knowledge from that research should always aim at the welfare of humankind, including the reduction of poverty, be respectful of the dignity and rights of human beings, and of the global environment, and take fully into account our responsibility towards present and future generations". Among the points addressed by this declaration, it was noted that:

- The difficulties encountered by women in entering and completing scientific careers, and in accessing decision-making positions, must be addressed through institutional mechanisms and measures that achieve these goals.
- Equality in access to science is not only a social and ethical requirement for human development, but also a necessity for realizing the full potential of scientific communities worldwide and for orienting scientific progress towards meeting the needs of humankind.
- The difficulties encountered by women, constituting over half of the population in the world, in entering, pursuing and advancing in a career in the sciences and in participating in decision-making in science and technology should be addressed urgently. There is an equally urgent need to address the difficulties faced by disadvantaged groups which preclude their full and effective participation.

In 2004, the Meeting of Experts on Gender and Science and Technology of the Office of Education, Science and Technology of the Organization of American States (OAS), the Inter-American Commission of Women and the Gender Advisory Board (GAB) of the United Nations Commission on Science and Technology for Development (CSTD), proposed a series of recommendations for "Integrating Gender in Science and Technology Policy in the Americas" (OAS, 2004). These included:

- Institutional strengthening: ensuring that the gender perspective is integrated in the science and technology policies and programmes of the member States, supported by an adequate budget allocation, so that women and men can achieve equal representation and advancement in science, technology, engineering and innovation in the workplace, including industry and academia, as well as in national, regional and international policy- and decision-making bodies and fora. This involves:
  - Strengthening institutional coordination with science and technology ministries.
  - Sensitizing and training those charged with the formulation of science and technology policies and programmes to integrate a gender perspective.
  - Strengthening networks and organizations in the field, through training, resources, dialogue and planning for common tasks, and establishing channels for systematic dialogue among science and technology researchers, specialists in gender studies,

policy- and decision-makers, and pertinent social organizations, in order to plan actions, evaluate their execution, and encourage the participation of representative civil society institutions related to science, technology, engineering and innovation in policy discussion.

- Education and training: in conjunction with the ministries of education and research institutions, including academia, it was recommended that initiatives be encouraged to ensure equal opportunity for men and women to access to scientific education at all levels, and in particular, to increase the participation of girls and women in scientific activities from childhood; renovate curricula, teaching materials and train teachers to integrate the gender perspective at all levels, in order to provide high quality scientific and technological education; create public awareness programmes on the importance of science and technology.
- A Gender-Equitable science and technology workforce: collect sex-disaggregated data on women's participation in the science and technology workforce, including by discipline, sector, salary and level, as well as longitudinal data; initiate employment and performance assessment policies which address women's life responsibilities, sexual harassment, and career development; recommend action policy to support women's increased representation in research teams and in governing bodies of science and technology; implement policies and programmes to support women's re-entry into the workforce through bridging, retraining and updating programmes; implement programmes, awards and fellowships to recognize and promote women's achievements in science and technology, including at the international level.

In 2011, UNCSTD published Applying a Gender Lens to Science, Technology and Innovation, at the request of the Economic and Social Council, as a contribution to the fifty-fifth session of the Commission on the Status of Women (CSW). In this report is "recognition of the need for specific interventions to implement gender equality through programmes and support structures and of the need for capacity development, institution-building and partnerships to ensure that policy implementation takes place" (Waldman, 2018, p. 43). It notes a need for "the integration of a gender perspective throughout the policy-making process —from analysis and design, to implementation, monitoring and follow-up" (UNCTAD, 2011).

In 2015, as part of the 2030 Agenda for Sustainable Development, Goal 4: quality education, proposes to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. The Goal includes ensuring equal access for all women and men to affordable and quality technical, vocational and post-secondary education, including university; substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship; eliminate gender disparities in education and ensure equal access to all levels of education and vocational training for the vulnerable, including persons with disabilities, Indigenous Peoples and children in vulnerable situations (United Nations, 2015). Digital literacy in particular is recognized as a specific objective linked to the following indicators: 4.4.1, on the proportion of youth and adults with information and communications technology (ICT) skills, by type of skill, and 4.4.2 on the percentage of youth and adults who have achieved at least a minimum level of proficiency in digital skills (UNESCO, 2019b). Target 5b of Sustainable Development Goal 5 proposes to "Enhance the use of enabling technology, in particular information and communications technology, to promote the empowerment of women" (United Nations, 2015).

In 2017, the Committee on the Elimination of Discrimination against Women (CEDAW) submitted general recommendation No.36 (2017) on the right of girls and women to education (United Nations, 2017). In relation to STEM, the Committee recommends that States parties:

- Institute measures to increase the participation of women and girls in science, technology, engineering and mathematics programmes, at all levels of education, by providing such special incentives as scholarships and adopting temporary special measures, in line with article 4 of the Convention and the Committee's general recommendation No. 25 (2004) on temporary special measures.
- Adapt the options and content of girls' and women's education, in particular at the higher levels to increase their participation in scientific, technical and managerial courses of study, and thereby their qualifications, in order to ensure access to high-level jobs and decision-making positions, in particular in male-dominated professions and jobs (paragraph 81.b).
- Recognize the importance of empowering all women through education and training in government, public policy, economics, information and communications technology and science to ensure that they develop the knowledge and skills needed to make full contributions in all spheres of public life (paragraph 81.d).
- Improve and broaden women's access to information and communications technologies, including e-government tools, in order to enable political participation and to promote engagement in broader democratic processes, while also improving the responsiveness of such technologies to the needs of women, including those of marginalized women (paragraph 81.f).

B. STEM and the regional gender agenda

Consensus and agreements that emerged from the ECLAC Regional Conference on Women in Latin America and the Caribbean are reflected in the Regional Gender Agenda (ECLAC, 2017b), in which reference is made to gender and STEM in the Brasilia Consensus (2010), the Santo Domingo Consensus (2013), the Montevideo Strategy (2016) and the Santiago Commitment (2020). These documents progressively addressed gender issues, starting with the need to promote women's access to STEM as a policy position and moving on to promoting affirmative action to reduce barriers, eliminating sexism and gender stereotypes in the education system and in teachers' perceptions of girls' and boys' abilities in STEM, promoting equal participation and ensuring that girls and women remain and succeed in STEM.

Diagram 4
STEM and the regional gender agenda

Source: Prepared by the authors.

The Brasilia Consensus of 2010 included an agreement to "promote women's access to science, technology and innovation, encouraging the interest of girls and young women in scientific and technological fields" (ECLAC, 2017a). In 2013, the Santo Domingo Consensus specifically addressed the links between gender and technology. It is the Regional Gender Agenda agreement with the most recommendations regarding gender and STEM, including those to:

- Design measures to build a new technological, scientific and digital culture for girls and women to bring them closer to and allow them to become familiar with new technologies and integrate them in their daily lives, and facilitate the strategic use of these technologies in their different spheres of development and participation, and encourage the implementation of national projects and programmes to promote and strengthen the pursuit of scientific and technological vocations by women (agreement 33).
- Strengthen the mainstreaming of gender across all areas of public policy in connection with information and communications technologies, ensuring full access to these technologies and their use by women, girls, adolescent girls, young women, older women, Indigenous and Afrodescendent women, rural women, LGBTTI persons[6] and women with disabilities on an equal and equitable basis for the social appropriation of knowledge, bearing in mind the associated regulations, costs and coverage issues and with respect for cultural and linguistic diversity (agreement 34).
- Adopt public policies that include affirmative measures to promote the lowering of barriers to access, a better grasp of the use of information and communications technologies and the local-language adaptation of applications and content related to these technologies, and that foster the engagement of women, girls, adolescent girls, young women, older women, Indigenous and Afrodescendent women, rural women and women with disabilities in vocational training in the sciences, including mathematics, engineering, environmental technologies and information and communications technologies, and in all areas of scientific research and knowledge production (agreement 35).
- Ensure that the education system, at all levels and with respect to all forms of teaching, provides timely information to women, girls, adolescent girls, young women, older women, Indigenous and Afrodescendent women, rural women, LGBTTI persons and women with disabilities on the benefits, applications and availability of vocational training opportunities in science and technology that could contribute to their personal, economic, social and political autonomy (agreement 38).
- Promote, conduct and disseminate studies and research on women in science, including mathematics, technology and engineering, as well as science fairs and congresses, in order to showcase the skills, innovation and contributions of women, girls, adolescent girls and young women in these fields (agreement 39).
- Advocate legislative and educational measures by the State and the private sector to eradicate and punish sexist, stereotypical, discriminatory and racist content in the media and in software and electronic games, promote the use of positive images, appreciating women's contributions to society, and encourage, also at the State level and in the private sector, egalitarian relations and responsibilities between women and men in the field of science and technology (agreement 46).

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[6] The Santo Domingo Consensus uses this acronym to refer to and include lesbian, gay, bisexual, transsexual, transgender, transvestite and intersex persons.

- Seek ways to bring sciences and the new technologies closer to the specific situations of women, appreciating the dimensions of race, ethnicity, sexual orientation and age, with a view to helping to eradicate poverty in areas with the worst social exclusion, promote development and democratize education (agreement 50).

The seventh implementation pillar of the Montevideo Strategy (2016), on technology, includes measure 7.d., to: design and execute specific programmes to close the gender gaps in access, use and skills in science, technology and innovation, and encourage the parity-based participation of women in this area (ECLAC, 2017b). In 2020, the Santiago Commitment included an agreement to "promote public policies that include affirmative action measures to foster educational participation, progression and achievement by girls, adolescents and women in the areas of science, technology, engineering and mathematics, including information and communications technologies and emerging and sustainable technologies" (agreement 18), as well as to "encourage women's labour participation in the fields of science, technology, engineering and mathematics, eliminating occupational segregation and ensuring decent work and wage equality, in particular in emerging sectors, including the digital economy, that are key to structural change with equality and the decarbonization of economies" (agreement 19).

As noted above, the Santo Domingo Consensus went the furthest in addressing links between gender and STEM, albeit with a focus on technology. It is important to note that the Regional Gender Agenda addressed these issues from the 2010s onwards — after the global agenda, which emerged in the mid-1990s. However, as they developed, consensus and agreements in Latin America progressively included specific public policy recommendations on gender and STEM, which highlighted, for example, the diversity of women and girls in the region (Indigenous, Afrodescendent, rural, LGBTTI and women with disabilities). They also examined policy issues and recommendations ranging from access, with a focus on encouraging women and girls and promoting STEM careers, to affirmative action to reduce barriers, and mainstreaming gender in science, technology and education. They included fewer recommendations or agreements on STEM careers, as summarized in table 1.

These agreements are important as valuable input for the construction of national public agendas, which take shape on the basis of national discussion, mobilization and pressure from stakeholders. They also refer to international consensus, an instrument of broad scope and reference for governments and public policy makers, as well as for women's and feminist movements and civil society organizations, which leverage them as tools for advocacy.

The following section will address the assessments and instruments developed at the national level in certain Latin American countries in relation to gender equality and STEM.

Table 1
Summary of recommendations on gender and STEM in the Regional Gender Agenda

Access: encourage interest in careers	- Women's access to science, technology and innovation, encouraging the interest of girls and young women in these fields (Brasilia Consensus, 2010). - Construction of a new technological, scientific and digital culture for girls and women to bring them closer to new technologies: promote and strengthen the pursuit of scientific and technological careers (Santo Domingo Consensus, 2013).
Access and retention: affirmative measures	- Adopt public policies that include affirmative action to promote the lowering of barriers to access, a better grasp of the use of information and communications technologies (Santo Domingo Consensus, 2013). - Foster the engagement of (diverse) women and girls in vocational training in the sciences (Santo Domingo Consensus, 2013). - Foster equal participation (Montevideo Strategy, 2016). - Promote public policies that include affirmative action measures to foster educational participation, progression and achievement by girls and adolescents (Santiago Commitment, 2020).
Mainstreaming	Science and technology: - Include the gender perspective as a cross-cutting pillar of public policies in information and communications technologies, ensuring full access to and use of these technologies by women and girls (Santo Domingo Consensus, 2013). - Design programmes specifically aimed at closing gender gaps in access, use and skills in science, technology and innovation (Montevideo Strategy, 2016).
Mainstreaming	Education - Provide timely information from the educational system on science and technology training opportunities (Santo Domingo Consensus, 2013). - Adopt legislative and educational measures to eradicate sexist, stereotypical, discriminatory and racist content in media, software and electronic games (Santo Domingo Consensus, 2013).
STEM careers	- Encourage women's labour participation in the fields of science, technology, engineering and mathematics, eliminating occupational segregation and ensuring decent work and wage equality, in particular in emerging sectors, including the digital economy (Santiago Commitment, 2020).

Source: Prepared by the authors, on the basis of Economic Commission for Latin America and the Caribbean (ECLAC), 40 years of the Regional Gender Agenda, (LC/G.2682/Rev.1), Santiago, 2017; Montevideo Strategy for the Implementation of the Regional Gender Agenda within the Sustainable Development Framework by 2030 (LC/ CRM.13/5), Santiago, 2017; and Santiago Commitment (LC/CRM.14/6), Santiago, 2020.

III. Public policies for gender equality in STEM

Public policies on gender and STEM are highly intersectoral: they are linked both to national machineries for the advancement of women —which in many countries of the region constitute a sector within the State— and to institutions in the science and technology and education sectors, which, in several countries, are independent. Such policies also establish dialogue with non-governmental organizations (NGOs), including networks of women researchers, scientists, feminist movements and activists in gender, science and technology issues. This section presents the results of research on the status of national agendas on gender equality in STEM, beginning with national assessments on the subject in certain countries of the region, and followed by recent public policies identified in the research process.

A. National assessments on gender and STEM: what problems do they identify?

A number of countries in the region have published assessments on the status of women in science and technology in recent years, including Argentina in February 2021, Chile in December 2020, Uruguay in February 2020. Using these recent assessments, this section looks at the main identified problems regarding gender inequality in STEM as a way to illustrate the current public debate in the region, particularly in the Southern Cone of Latin America.

In Argentina, "Diagnóstico sobre la situación de las mujeres en ciencia y tecnología" an assessment of the status of women in science and technology published by the Ministry of Science, Technology and Innovation in February 2021, and other documents published by the government, identify the following public problems related to gender and STEM:

- Women researchers are concentrated in the social sciences and medical and health sciences and remain underrepresented in engineering and technology and in the natural and exact sciences (MINCYT, 2021; 2020d).

- Very few women and LGBTI+ persons are in positions of increased responsibility that influence decision-making in science and technology; among jobs higher in the hierarchy, more men hold senior scientific and technological management positions, whereas women occupy only 22% of leadership positions in science and technology organizations (MINCYT,2021).
- Greater participation of women at the university level, including enrolment and graduation levels. In 2019, women represented nearly 60% of the total. However, gaps appear in their choice of discipline of study: women are overrepresented in the social, human and health sciences, while the gap between women and men widens in applied sciences, and especially in engineering (Ministry of Education, 2021).
- Specific barriers to access and completion in the formal education system at all levels for trans people are acknowledged. Although statistics do not yet reflect the inclusion of the transvestite and trans population in the education system, the limited data available, collected in the First Survey on the Trans Population 2012: Transvestites, Transsexuals, Transgender Persons and Transgender Men, conducted by the National Institute of Statistics and Censuses (INDEC) and the National Institute to Combat Discrimination, Xenophobia and Racism (INADI), show high dropout rates due to multiple forms of discrimination and (Ministry of Women, Genders and Diversity, 2021).
- The following problems were identified as of 2019, within the National Science, Technology and Innovation System (SNCTI) of Argentina: disparities in decision-making in higher-up positions; only 14% of management positions in science and technology organizations are held by women; regarding university policy, women hold 64% of positions in academic offices, whereas parity is nearly reached in science and technology offices (43%) (MINCYT, 2020d).

This national assessment clearly identifies the following critical aspects: public policies that are made and executed by men; problems for women in accessing decision-making positions in the organizations within the National Science, Technology and Innovation System; problems for female researchers in accessing the most privileged research positions; horizontal segregation, which reproduces gender stereotypes in science and technology, and evaluation systems as a scaffolding in which men 'select' men (MINCYT, 2020a).

In Chile, in December 2020 the Ministry of Science, Technology, Knowledge and Innovation published the report "Radiografía de género en ciencia, tecnología conocimiento e innovación" (Ministry of Science, Technology, Knowledge and Innovation, 2021). This report indicates that:

- In higher education in 2020, the percentage of women enrolled in comparison to men decreased as the level of study increased from undergraduate, to master's degree, to doctorate. The largest gap between the percentages of women and men enrolled was observed in the basic sciences and technology, both at the undergraduate and master's level. In doctoral programmes, the biggest differences are found in technology and business and administration.
- Among OECD countries, the percentage of all research positions occupied by women in Chile stands at 34%. Furthermore, the position of researcher, which involves leading research and development (R&D) projects, is the one least held by women in Chile.
- At the subnational level, a higher percentage of women in researcher positions are found in the regions of Aysén, Magallanes, and Araucanía compared to elsewhere (41%, 39%, and 37% respectively). Conversely, the lowest participation rate of women in research is seen in the region of Atacama.

- In academic settings such as universities, the presence of women in governing roles is low: as of 2019, 55 deans were men, and only five women. The percentage of full-time positions occupied by women is also lower than it is for men (44% and 56% respectively).
- In research and development projects, 68% of all applicants to the country's largest individual research fund, the National Fund for Scientific and Technological Development (FONDECYT), are men, while 32% are women. This difference persists in the breakdown of funding awarded (women 30% and men 70%).

In Uruguay, the Inter-institutional Roundtable on Women in Science, Innovation and Technology (MIMCIT) published a report entitled "Mujeres en ciencia, innovación y tecnología en Uruguay: un factor clave para avanzar en igualdad de género y desarrollo sostenible" in February 2020 as a participant in the STEM and Gender Advancement (SAGA) project of the United Nations Educational, Science and Cultural Organization (UNESCO). Uruguay was the first pilot country to adhere to this initiative, in 2016. According to the report, national data show that women stray from STEM-oriented learning paths from an early age. Further study is needed, however, of the differential distribution of men and women across fields of knowledge ('horizontal distribution'), given that next to no research exists on this factor compared to other subjects in education analysis and research (MIMCIT, 2020).

The *Encuesta de factores impulsores y barreras*, a survey on barriers to STEM careers in Uruguay conducted by the MIMCIT with female and male researchers[7], highlights the following:

- Care responsibilities affect women's academic careers at different times and stages, putting them at a disadvantage compared to their male peers:
  - Some 33% of male researchers obtained their doctorate degree in three years or less, compared to only 15% of their female counterparts.
  - Forty-one percent of those women researchers interrupted their studies to care for a child or a dependent or for a pregnancy, while only 5% of men interrupted their studies for the same reasons.
  - Care responsibilities were one of the biggest obstacles faced by women as they progressed through their education or career: 46% of female researchers interrupted their studies and/or work for six months or more, compared to 38% of men. Twenty-five percent of female researchers took the break to raise children, care for dependents, or for a pregnancy.
  - Care responsibilities appear as the most common constraint for women (46%) whereas economic constraints such as financing (40%) are more prevalent among men.
  - Forty percent of male researchers and 23% of female researchers work 50 hours or more per week. Thirty-five percent of men with children under the age of six work 50 hours or more, as do only 12% of women in the same situation.
  - Between 40% and 50% of female researchers state that they are primarily responsible for different household tasks, with the largest difference observed in childcare: 41% of women identified as primary caregivers, compared to only 7% of men.

[7] The self-administered, anonymous and voluntary survey was conducted online with men and women who had worked at one point in STEM fields in the National Researchers System (SNI) between 2009 and 2018. It was conducted between 7 December 2018 and 18 March 2019 and responses were obtained from 708 people, the equivalent of around 53% of researchers in that sphere.

- Vertical segregation: participation rates are lower for women than men in every position considered. The largest gaps are seen in director and management positions, obtained by 32% of men but only 15% of women.
  - Thirty-eight percent of male researchers have played a consulting role or taken part in commissions on science, technology and innovation policies in the country, compared to 21% of their female counterparts.
- Harassment: approximately 3 out of 10 female researchers report having experienced harassment in the workplace.

B. What national public policies are recognized?

Given the intersectoral nature of gender and STEM policies, the activities and instruments linked to them are diverse, as they straddle two State sectors: women and gender equality, as well as science, technology and innovation (STI). A regional study conducted by Bello (2020) on women in science, technology and innovation, reviewed more than 200 initiatives (policies, plans, documents and legislation) and identified eight dimensions of analysis of the gender equality agenda. They appear in table 2, divided into five areas of analysis: (1) gender and science, technology and innovation, (2) science, technology and innovation, (3) gender equality, (4) education and (5) civil society.

Table 2
Dimensions for the analysis of gender equality in STI agendas

Scope[a]	Observed dimension
Gender and STI	1. Specific policy on gender equality in STI.
Science, technology and innovation	2. National STI plan, policy or strategy that includes references to gender equality in STEM. 3. National law on STI that includes references to gender equality.
Gender equality	4. National gender equality policy: includes references to STEM. 5. National law on gender equality includes references to STEM.
Education	6. National education policy includes references to gender equality in STEM. 7. National law on education includes references to gender equality in STEM.
Civil society	8. Existence of a national network of women scientists.

Source: Prepared by the authors, on the basis of A. Bello, Women in Science, Technology, Engineering and Mathematics (STEM) in the Latin America and the Caribbean Region, Montevideo, United Nations Entity for Gender Equality and the Empowerment of Women (UN Women), 2020.
[a] The classification by scope of action is prepared by the authors.

Among the dimensions analysed, the first —specific policy on gender and STI— is the most precise, while those that follow are the result of initiatives of various kinds (not necessarily policies, but also plans, programmes, laws and networks). On the basis of the aforementioned dimensions, this report analyses three areas of policy on gender and STEM:

(i) Policies linked to machineries for the advancement of women: public policies or equality plans recently approved in countries in the region that address gender and STEM issues.

(ii) Policies linked to science and technology: public policies (including plans, programmes and legislation) on science and technology that also address gender equality.

(iii) Specific policies on gender and STEM: specific public policies, plans or programmes on gender equality in STEM.

1. Policies linked to machineries for the advancement of women: STEM in gender equality plans

In Latin America, equality plans are "tools used in most of the region's countries. Largely propelled by machineries or mechanisms for the advancement of women, they serve to direct the action of the State and plan and carry out joint work between the different sectors, thus enhancing the institutionalization and mainstreaming of gender" (ECLAC, 2019c). Equality plans are a technical and political planning instrument that have opened up avenues for institutionalizing gender: they set the goal of gender equality, identify priority areas in this field, and propose, design and implement public policies. In addition, they demonstrate the State's commitment to gender equality and establish a pillar around which other policies should function. In recent years, new equality plans have been approved and implemented in several countries that establish new links between gender equality and STEM.

In Argentina, the National Plan for Equality in Diversity 2021-2023 includes science, technology and innovation (STI) as one of its areas of action. As a related strategic objective, it proposes to help reduce the gender-based digital and technological gap, and ensure equal conditions and opportunities, in the access, use and production of information and communications technologies (ICTs) by women and LGBTI+ persons. The plan focuses specifically on achieving equality in diversity in relation to science, technology and innovation and the participation of women and LGBTI+ persons in the national scientific and technological system, as well as in relation to the gender digital divide, a product of gender-based differences in access to and use of ICTs (Ministry of Women, Genders and Diversity, 2021).

In Chile, the fourth National Gender Equality Plan 2018–2030 identifies as one of its advances the development of education policies and programmes specifically geared to giving women access to technology, science and innovation that improves their employability, on the subject of which it is recognized that systematic efforts have been made to minimize gender segregation in the percentage breakdowns of women and men in different disciplines, in the choice of careers, in access to science and the use of technology, and in career paths. The following are identified: affirmative action measures to help women access highly male-dominated scientific careers and standards that take the demands of reproductive life and health into consideration in training processes and career paths (Ministry of Women's Affairs and Gender Equity, 2019).

Parallel to the development of the Chilean equality plan, an assessment highlighted the achievement of equal numbers of women and men accessing different levels of education, albeit with gaps in their performance in the areas of mathematics, science and language. In standardized evaluations, men continue to outperform women in mathematics in the University Selection Tests (PSU). In addition, in 2016, only 17% of first-year women students at Chilean universities were enrolled in engineering and only 22% in sciences, whereas 78% of first-year women students were enrolled in health and social service-related studies and 79% in education. In National Commission for Scientific and Technological Research (CONICYT) competitions, the participation of women in projects and grants rose from 25.65% in 2001 to around 40% from 2009 onwards. Furthermore, around 45% of national PhD and master's grants are awarded to women and around 40% of Becas Chile PhD grants are awarded to women. Disparities exist, however, in FONDECYT-approved projects: 73% of all projects carried out between 2001 and 2005 were led by men and only 27% by women.

A number of instruments are identified as operational components that contribute to the success of the plan. One such instrument is the Education for Gender Equality Plan, geared towards fostering equality and the comprehensive development of men and women in the education system; establishing mechanisms and skills within the Ministry of Education; and fostering proposals on how to mainstream gender in education reform. Among stated goals are proposals for gender-related criteria and content in instruments included in the Access to Higher Education Programme (PACE), the associated indicator of which is the number of identified measures that increase the number of women in science, technology and mathematics careers (Ministry of Women's Affairs and Gender Equity, 2019).

In Costa Rica, the National Policy on Gender Equality and Equity (2018–2030) adopts the conceptual approach of the Montevideo Strategy to the structural challenges of gender inequality. In challenge 3 on socioeconomic inequality, it outlines that despite a higher level of academic achievement, women in professional and non-professional fields still occupy traditionally female positions, which are paid less and are not found in the most dynamic sector of the economy (National Institute for Women (INAMU), 2018). Among the problems it identifies is that of career segregation at different levels of education: in technical schools, for every 100 men there are 94.2 women, most of whom work in services, where, for every 100 men, there are 156 women; at the university level, in 2015 most women graduated with degrees in education, health sciences and social sciences, while fewer women than men graduated from basic sciences or engineering programmes, and only 30.9% of all graduates in what are known as "traditionally male" fields are women.

In axis 3 on the distribution of wealth in the national policy, two expected outcomes are related to STEM: (16) more women with access and skilled in the use of information and communications technologies (ICT) and open data management for the development of their educational, professional, political and productive endeavours, in all regions and areas; and (17) more women with access to both public and private technical, technological and scientific education and to cutting-edge research for sustainable development.

In Mexico, the National Programme for Equality between Women and Men 2020–2024 (PROIGUALDAD) identifies a significant underrepresentation of women in highly profitable professional fields, such as information and communications technologies, engineering and mathematics, as well as a significant educational gap among women over 30 (INMUJERES, 2020). Table 3 identifies STEM-related measures in PROIGUALDAD 2020–2024.

Table 3
Mexico: STEM-related measures in PROIGUALDAD 2020–2024

Priority objective	Priority strategy	Fundamental measure (STEM-related)
1. Advance economic autonomy for women to close historical inequality gaps.	1.2 Encourage the elimination of sexist attitudes and behaviours to enable the full and equal participation of women in economic activities.	1.2.4 Conduct creative workshops for girls and adolescent girls, focused on science, technology, engineering, mathematics and robotics, that encourage entrepreneurship and their future inclusion in the labour market.
	1.3 Facilitate women's entry into the labour market, against a backdrop of equality, non-discrimination, and decent and dignified work.	1.3.6 Foster measures to encourage the inclusion and promotion of women in the public energy, science, technology, communications and transport sectors.
		1.3.8 Foster strategic measures to help women access the energy, technology, engineering, communications and transportation sectors and enhance their employability.
5. Ensure the equal participation of women in decision-making processes in political, social, community and private spheres.	5.2 Foster cultural change in Mexican society to recognize the political capacities and decision-making autonomy of women.	5.2.1 Support efforts to ensure that ongoing social media measures advance the political participation and rights of women, girls and adolescents, in a culturally and territorially relevant approach that includes the use of new technologies, community radio and public media.

Source: Prepared by the authors, on the basis of National Women's Institute (INMUJERES), *Programa Nacional para la Igualdad entre Mujeres y Hombres 2020-2024*, Mexico City, December 2020.

In Peru, the National Gender Equality Policy was approved in 2019 under the Ministry of Women and Vulnerable Populations. The policy identifies inequality in access, control and use of information and communications technologies (ICTs), noting a digital divide in the country visible not only in the smaller number of women who use ICTs, but also in the persistence of gender-specific structural inequalities that act as barriers to their access and use (Ministry of Women and Vulnerable Populations, 2019). This policy includes a priority objective 4, Guarantee the exercise of women's economic and social rights, which points to the need to increase the participation of women in traditionally male-dominated careers, and to guarantee equal access, continuation and success of men and women pursuing vocational degrees in technology, higher degrees in technology, teaching or the arts, and university degrees.

In the Dominican Republic, the National Plan on Gender Equality and Equity identifies the underrepresentation of women in all areas of ICT, including in careers in science, technology, mathematics and engineering, as well as the labour market. According to national data, women occupy only 36.8% of all jobs generated in this sector. The plan specifically proposes that the digital agenda of science and technology and that of gender equality work hand in hand, based on the recognition of equal access to the digital technologies so vital in accessing employment opportunities (Ministry for Women's Affairs, 2020).

Among its priorities are the design, planning, development and rigorous evaluation of ICTs with a focus on gender equality, as well as encouraging reform of the General Education Act and the Higher Education, Science and Technology Act to ensure gender mainstreaming as a guiding principle of Dominican education at all levels. In addition, among the lines of action on the theme "education for equality", the teacher training component calls for the implementation of awareness programmes and campaigns in the media and at schools, aimed at encouraging women to study for STEM careers and become involved in the sciences; and for efforts on the part of universities to attract women to careers in technology.

A summary of the links between gender and STEM in the equality plans is presented in table 4 below.

Table 4
STEM in recently approved equality plans

Country	Equality plan	References to STEM
Argentina	National Plan for Equality in Diversity 2018–2030	Areas of action: Science, Technology and Innovation (STI) Strategic objective: help close the gender-based digital and technological divide in the access, use and development of ICTs by women and LGBTI+ persons.
Chile	Fourth National Gender Equality Plan 2018–2030	Progress: affirmative measures geared towards bringing women into highly male-dominated scientific careers. Education sector goals: strengthen efforts to help women stay in science, technology and mathematics careers.
Costa Rica	National policy for Effective Equality between Women and Men	Axis 3 expected outcomes: (16) More women with access and skilled in the use of information and communications technologies (ICT) and open data management for the development of their educational, professional, political and productive endeavours, in all regions and areas. (17) More women with access to both public and private technical, technological and scientific education and to cutting-edge research for sustainable development.
Dominican Republic	National Plan on Gender Equality and Equity 2018–2030	Priorities: The design, planning, development and rigorous evaluation of ICTs with a focus on gender equality; encouragement of reform of the General Education Act and the Higher Education, Science and Technology Act to ensure gender mainstreaming as a guiding principle of Dominican education at all levels.

Mexico	National Programme for Equality between Women and Men 2020–2024 (PROIGUALDAD)	Priority strategy: Support women in entering the labour market. Measures: Foster measures to encourage women to stay and be promoted in the public energy, science, technology, communications and transportation sectors. Foster strategic measures to help women access the energy, technology, engineering, communications and transportation sectors and enhance their employability.
Peru	National Gender Equality Policy 2019	Objective: increase the participation of women in traditionally male-dominated careers, and guarantee equal access, continuation and success of men and women pursuing vocational degrees in technology, higher degrees in technology, teaching or the arts, and university degrees.

Source: Prepared by the authors, on the basis of official information from the respective countries.

2. The science and technology sector: gender equality and science and technology policies

In addition to policies linked to machineries for the advancement of women are those focused on the science and technology sector. Such policies can include gender equality as part of a gender mainstreaming strategy in this sector. Measures taken in this sector in certain countries later lead to specific policies on gender and STEM.

In Argentina, an assessment of the situation of women in science and technology published in February 2020 identified that public policy action to mainstream gender in the National Science, Technology and Innovation System (SNCTI) is still emerging in the country (MINCYT, 2021). This was followed by the development of the National Programme for Gender Equality in Science, Technology and Innovation that will be reviewed in the section on specific policies. This assessment identified 45 instruments, including protocols, programmes and observatories against gender-based violence; family leave and improvements to the childcare system; and the development of specific resources for training. Specifically, the Argentina Innovadora 2020 plan for science, technology and innovation, and its strategic guidelines for the period 2012–2015, established certain links between gender, science and technology, particularly in the increase of women in research careers. Along with this plan, a project was launched to amend Act 25467 on science, technology and innovation (STI), which incorporates gender mainstreaming in research and gender parity in the attribution of certain positions within the STI system.

In Chile, a process was developed in 2016 to update and redefine the Institutional Policy on Gender Equity in Science and Technology, created in 2013 with the aim of fostering greater gender equity in the national STI system using an internal participatory process. This resulted in the Institutional Gender Policy 2017–2025 of the National Commission for Scientific and Technological Research (CONICYT), which establishes three lines of work: (i) fostering and reinforcing gender equality in the development of scientific and technological activity; (ii) enhancing the visibility of scientific and technological development in the country from the perspective of gender equality; (iii) establishing a culture of gender equity and diversity in the management of CONICYT human and financial resources. In 2017, this institution spearheaded the organization of the Gender Summit 12, the first Latin American summit on science and technology focused on gender, held at ECLAC. This policy is part of the CONICYT general gender equity system, composed of an assessment of the main barriers, gaps and gender inequities in the world of science and technology, the aforementioned policy, the annual action plan, a monitoring and follow-up system, an organizational framework (technical team) and a dissemination and awareness strategy.

In Colombia, the +Women +Science +Equity Programme was developed in 2021 by the Ministry of Science, Technology and Innovation with the support of the Office of the Vice-President of the Republic via the Presidential Council for Women's Equality in partnership with the Organization of Ibero-American States for Education, Science and Culture. The goal of the programme is to stimulate interest among young women in scientific careers and help them build life projects through connections, empowerment and leadership in order to help them access the National Science, Technology and Innovation System (SNCTI). The programme will be developed in two phases: (1) encouraging, strengthening and drafting projects, and (2) project development and mentoring, which will include national and international internships.

In Mexico, a law on science and technology passed in 2002 was modified in 2013 to include article 2: paragraph VIII to foster the inclusion of gender mainstreaming with a cross-cutting vision in science, technology and innovation, as well as gender parity throughout the national science, technology and innovation system.

In Uruguay, an Inter-institutional Roundtable on Women in Science, Innovation and Technology has been held since 2016 to conduct inter-institutional, comprehensive work for the construction of a public policy model that identifies and tackles determining factors in the educational paths and professional segregation of women in Uruguay. In 2017, a study was carried out to identify STI policies and instruments in Uruguay and provide inputs for a better understanding of gender barriers in this sphere, as well as proposals for overcoming them. Findings showed that policies that linked gender and STI translate into specific, fragmented measures, sometimes with criteria that vary for the same issue. Furthermore, they are often supported by personal measures, without being formally incorporated into institutions (MIMCIT, 2020).

3. Specific policies on gender and STEM

There are also specific policies on gender and STEM that have been approved in recent years in three countries in the region. These policies are eminently intersectoral in nature and are notable for having come into effect in recent years (including the last two years in the context of the COVID-19 pandemic). The three policies are as follows:

- Argentina, 2020: National Programme for Gender Equality in Science, Technology and Innovation.
- Chile, 2021: National Gender Equality Policy for Science, Technology, Knowledge and Innovation, and its action plan "50/50 by 2030".
- Costa Rica, 2018: National Policy for Equality between Women and Men in Training, Employment and the Enjoyment of the Products of Science, Technology, Telecommunications and Innovation 2018–2027.

In Argentina, the National Programme for Gender Equality in Science, Technology and Innovation, created in 2020 by the Ministry of Science, Technology and Innovation, defines among its objectives: (i) to make STI institutions conducive environments for women and LGTBI+ persons to perform and progress on an equal basis and free from violence, (ii) to include gender analysis in the content of R&D policies, programmes and projects from the design phase, (iii) to foster equality for women and the LGTBI+ population in access to high-ranking positions, (iv) to coordinate action with different public and private agencies, and (v) to cooperate with other organizations in the development of studies, research and knowledge transfer.

This programme seeks to work throughout the National Science, Technology and Innovation System (SNCTI) —not only in the related ministry— in the following roles (MINCYT, 2021): (i) to assist SNCTI agencies in the preparation and design of public science and technology policies that are gender sensitive, (ii) to assist in the monitoring of policies and practices, through the gathering and analysis of data, and in follow-up to action on gender issues in science and technology, (iii) to evaluate results and impacts of policies and action on gender equality, and to encourage studies and assessment reports on the status of women and the LGTBI+ population in the SNCTI, and (iv) to develop proposals and recommendations for improving the status of women and the LGBTI+ population, and of analysis indicators; training for gender mainstreaming in research projects, (v) to foster gender mainstreamed communications in science, encouraging activities that improve the visibility of the work of women and the LGTBI+ population, and generating interest in careers in the sciences; advising SNCTI organizations and institutions on the subject, and fostering inclusive and non-sexist language. A selection of the principal lines of work developed between 2020 and 2021 are shown in table 5.

Table 5
Argentina, 2020: national programme for gender equality in science, technology and innovation, lines of work 2020–2021

Lines of work	Objective
Gender and science action bank	Publicize gender mainstreamed instruments and measures for science and technology (S&T) in SNCTI institutions.
Technical reports on scientific and technological skills	Analyse, disseminate and provide information on SNCTI gender-related capacities with regard to public agenda items. These are based on a consolidated thematic thesaurus of people, R&D projects and S&T products related to specific topics in the databases. To date, two technical reports are in development: one on gender-based violence and another on care responsibilities.
Gender mainstreaming in science	Inclusion of gender and sex analysis in the design of research, development and innovation projects, as a criteria of quality and relevance in evaluations and financing, and in the dissemination of results. It involves two types of measures: cycles of round table discussions and working groups.
Assistance in gender mainstreaming into STI policy instruments	Establish recommendations, initially for two wide-reaching instruments: the “Investigador/a de La Nación Argentina” award and the “Concurso Nacional de Innovaciones – INNOVAR” competition.
MINCYT internal working group on gender mainstreamed communication on science and technology	Define common criteria for the production of gender and diversity mainstreamed articles and publications.
Coordination with cross-cutting policies	A national plan against gender-based violence established by the Ministry of Women, Genders and Diversity; application of the Micaela Act to train high-level MINCYT authorities and S&T agencies under its purview.

Source: Prepared by the authors, on the basis of Ministry of Science, Technology and Innovation, *Programa Nacional para la Igualdad de Géneros en Ciencia, Tecnología e Innovación. Resumen Ejecutivo*, 2020.

Of note among the aforementioned lines of work are the technical reports on scientific-technological capacities developed using analyses of National Science, Technology and Innovation System (SNCTI) databases. The report on gender violence presents information on national capacities in research and development (R&D) on the subject, along the following two axes:

- **Human resources in science and technology**: curricular information in the databases indicated 187 people with systematic R&D activities focused on problems related to gender violence, but this was the central theme of their research for only a small portion of them.
- **Scientific and technological production and R&D financing**: the National Register of Products (RENAPROD) indicated that most scientific production linked to the subject consists of articles in journals (47.6%), followed by chapters in books and books. The analysis concludes by pointing out that scientific production on gender violence would appear more to be the product of individual efforts by young or middle-aged women in the early stages of their careers, whose academic training is basically in the social sciences, and who do so alone, with little involvement in professional networks or institutional coordination, and who experience difficulties in obtaining adequate funding (MINCYT, 2020b).

Gender violence is therefore an area of research with emerging capabilities and little institutional presence, given little priority on the agenda of financing Argentina's scientific and technological system (MINCYT, 2020b).

The report on national capacities in research and development (R&D) on the subject of care addresses the same axes of analysis, noting that in the SNCTI, some two hundred people have produced scientific studies on the subject, the vast majority of them women, predominantly based in the Autonomous City of Buenos Aires and the Province of Buenos Aires. Also reported is a predominance of small groups of two or three people working together, and the existence of inter-institutional links with the University of Buenos Aires and the National Council of Scientific and Technical Research (CONICET) as central nodes (MINCYT, 2020c).

In Chile, the National Gender Equality Policy for Science, Technology, Knowledge and Innovation was approved in 2021, along with its "50/50 by 2030" Action Plan, which also includes a 2020–2022 action plan. Both the policy and the plan are led by the Ministry of Science, Technology, Knowledge and Innovation with the active participation of the Ministry of Women's Affairs and Gender Equity, the Undersecretariat of Higher Education and the Undersecretariat of Telecommunications. The approved policy aims to decisively move forward in the removal of barriers that prevent the full participation and development of women in science, technology, knowledge and innovation, in order to bring greater diversity and creativity to research and development activities, to increase available talent and, ultimately, establish a fair and robust system of science, academics and technology that incorporates equal opportunities, rights and treatment of women in all its dimensions (Ministry of Science, Technology, Knowledge and Innovation, 2021). The policy development process included:

- The creation of a council for gender equality in science and technology, chaired by the Undersecretary of Science, Technology, Knowledge and Innovation, composed of more than 10 specialists in different areas of knowledge. Its objective is to advise the Ministry of Science, Technology, Knowledge and Innovation in the design, implementation and monitoring of the National Gender Equality Policy for Science, Technology, Knowledge and Innovation and its action plan.
- The compilation of international policies and plans for gender equality in science, technology, knowledge and innovation, including experiences from 29 countries.
- A panel discussion with 135 girls, young women and adolescents, and 200 researchers, from around the country.
- The creation of an inter-ministerial committee on gender equality in science, technology, knowledge and innovation, for the purpose of implementing and monitoring the Policy and its Action Plan, and stating its commitments at the international level at the United Nations Generation Equality Forum[8], with the support of the Ministry of Science, Technology, Knowledge and Innovation, the Ministry of Women's Affairs and Gender Equity, the Ministry of Foreign Affairs and the Undersecretariat of Telecommunications.
- The launch of a public consultation for the National Gender Equality Policy for Science, Technology, Knowledge and Innovation, in which 1,550 people took part nationwide, aimed at gathering a wide range of opinions on how to achieve gender equality in the science, technology, knowledge and innovation system.

The areas of action and objectives of this policy are detailed in table 6.

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[8] The Generation Equality Forum is a global meeting for gender equality, convened by UN-Women and co-chaired by the Governments of Mexico and France, with the leadership and participation of civil society, developed in both countries in 2021.

Table 6
Chile: areas of action and objectives of the national gender equality policy for science, technology, knowledge and innovation, and its action plan "50/50 by 2030"

Area of action	Policy objectives
1. Inclusive, protected childhood experiences, empowered with future-ready skills	To encourage curiosity, scientific exploration and critical thinking skills in children from an early age, encouraging them to question themselves and the world around them in order to build skills for the future. Care must be taken to ensure that all girls and boys can unlock their full potential regardless of biology or physical characteristics, and that these learning experiences in science, technology, knowledge and innovation seek to eradicate the gender stereotypes prevalent in our cultural canons. Achieving this cultural change requires working with the entire learning environment of boys and girls; educators, families, and society at large.
2. Inclusive, transformative and accountable science, technology, knowledge and innovation systems	To build a more diverse and inclusive national science, technology, knowledge and innovation system that ensures access, development and leadership for women in all social organizations involved in the creation, dissemination and application of knowledge.
3. A State committed to data, tools and policies to achieve gender equality in science, technology, knowledge and innovation	Decisive progress towards gender equality in science, technology, knowledge and innovation is only possible by strengthening research, development and innovation institutions in their ability to design, monitor and evaluate gender policies.
4. Science, technology, knowledge and innovation to address the impacts of the gender gap in our society	Science, technology, knowledge and innovation are fundamental tools for understanding our environment and building solutions to the challenges we face. This is why, in order to fully understand complex phenomena and develop potential solutions, consideration must be given to the particularities of gender when designing, measuring, analysing and applying knowledge. Science, technology, knowledge and innovation are powerful tools for understanding and resolving gender gaps, as well as for mitigating the most significant effects that gender has on our society.

Source: Prepared by the authors, on the basis of Ministry of Science, Technology, Knowledge and Innovation (2021), Política Nacional de Igualdad de Género para la Ciencia, Tecnología, Conocimiento e Innovación, y su plan de acción "50/50 para el 2030", Santiago.

In Costa Rica, the National Policy for Equality between Women and Men in the Training, Employment and Enjoyment of the Products of Science, Technology, Telecommunications and Innovation 2018–2027 (PICTTI), led by the Ministry of Science, Technology and Telecommunications (MICITT), highlights existing gender gaps in education, employment and the enjoyment of the products of science, technology, telecommunications and innovation, which holds women back from obtaining jobs in the most dynamic private and public sectors in the country.

One of the policy's objectives is to encourage equal participation of women and men in terms of attracting them to the different fields of science, technology and innovation and their retention, training, skills development, quality employment and research therein, so that all can benefit from scientific and technological progress (MICITT, 2018). The areas of action and objectives of this policy are detailed in table 7.

This plan was drafted by the Ministry of Science, Technology and Telecommunications as the governing body of this sector, with the support of the National Institute for Women, the coordinating body of the National Policy on Gender Equality and Equity, which contains the commitments of the government of Costa Rica to guarantee the full exercise of women's human rights.

Table 7
Costa Rica: areas of action and objectives of the national policy for equality between women and men in the training, employment and enjoyment of the products of science, technology, telecommunications and innovation 2018–2027

Areas of action	Specific objectives
1. Attracting women to science, technology and innovation	Help improve women's participation in science and technology, from early childhood and throughout life.
2. Training and retaining women in careers in science, technology and innovation	Encourage the enrolment of women in technical and professional degrees in science and technology and the successful completion of their studies.
3. Fostering women's research and employment in science, technology and innovation	Facilitate the creation of networks of competent stakeholders to establish and implement mechanisms to eradicate gender inequalities in the distribution of financing, as well as in the hiring, remuneration and career processes involved in science and technology jobs in the public and private sectors.
4. Fostering social ownership of science with a gender perspective	Stimulate the social uptake of science and technology by supporting gender mainstreamed scientific and technological projects and research in all areas of human development, with an active role played by women in approaching and solving problems based on different sociocultural contexts.
5. Sustainability and follow-up	Create a monitoring and evaluation system coordinated by the bodies established to enable implementation of the Policy plan.

Source: Prepared by the authors, on the basis of Ministry of Science, Technology and Innovation (MICITT), *Política nacional para la igualdad entre mujeres y hombres en la formación, el empleo y el disfrute de los productos de la ciencia, la tecnología, las telecomunicaciones y la innovación 2018-2027*, San José, 2018.

IV. Specific policies on gender and STEM: analysis

A. Analysis framework for policies on gender and STEM

As seen above, analysis of policies and initiatives on gender equality in STEM involves two usually disconnected spheres: policies on gender equality and women's autonomy, and policies on science and technology (or science, technology and innovation). The terms used for both vary from country to country; they have been developed relatively recently; and are usually analysed separately.

Both areas are complex, not only in terms of the issues they address, but in the policy process itself. For example, research on science, technology and innovation policy, a specific field, should address this complexity in terms of the number of stakeholders involved, the different levels of intervention, policy fields, and interactions between them and between different policy instruments (Bortagaray, 2016). The same applies to policies on gender equality and women's autonomy, which also involve complex factors, such as the recognition of gender inequalities as a public problem, social demands, and the wide range of stakeholders and policy instruments involved.

As a framework for analysis, and with the particularity of this intersection of policies in mind, we look at three main areas based on a review of the literature: the types of policies or strategies on gender equality and women's autonomy (ECLAC, 2019c; Astelarra, 2004; Alonso, 2010), gender mainstreaming experiences in science and technology (Bonder, 2004; UNESCO, 2017) and gender and STEM policies in other contexts (Caprile and others, 2012; Müller and others, 2011, Castaño and others, 2010).

The first area analysed are policies on gender equality and women's autonomy. These can be defined as "policies aimed explicitly at improving the living standards of women and at guaranteeing human rights" (ECLAC, 2019c). These policies adopt various types of strategies. A review of gender policies in the European Union and Latin America conducted by Astelarra (2004) points out that various types of gender policies have been implemented which are adapted to the different political frameworks and differences between political systems and traditions in each country. These policies take different approaches to addressing inequalities and have primarily relied on three types of strategy until now: equal opportunity, positive or affirmative action and gender mainstreaming.

While each strategy approaches gender inequalities differently, they reflect progress and complementarity. According to Astelarra (2004), equal opportunity aims to guarantee women access to a public sphere from which they were previously excluded. Affirmative action, which implies taking a step further, acts as a mechanism to correct the initial disadvantage at which women found themselves, whereas mainstreaming implies taking a gender-based approach to all public action. Alonso (2010) also establishes three main types of policies based on a review of the literature: equal treatment, specific measures and mainstreaming, all of which strive for equality, but adopt different strategies to do so (Squires, 2005; Verloo, 2001; Rees, 1998, cited in Alonso, 2010). Gender policies are reported to have taken a variety of orientations to account for the strategies mentioned above "since public policies began to tackle the problems arising from gender inequality, they have shifted from an approach of resolving issues specific to women, to one directed at equality and achievement of the full exercise of human rights" (ECLAC, 2019c).

In regard to the second area analysed —gender mainstreaming in science and technology specifically— Bonder (2004) points out that while there is no consensus on the subject, specialists agree that these strategies are far from being implemented due to the following obstacles, among others:

- Disparities between what is said in international organization documents, the policies proposed in each country, and what is actually done.
- The reiteration of recommendations and initiatives that are disconnected from the realities observed in science and technology in each country.
- Proposals based on an idealized model of 'top-down' mainstreaming that disregard the realities of individual institutions; the degree to which decision makers are aware of the problem and to which the scientific community is amenable and willing to change.
- The limited production of studies, indicators and policy assessments on which to base lessons and define best practices.

Similarly, Wajcman (2004) points out that "the equal opportunities strategy has had limited success precisely because it fails to challenge the sexual division of labour in the wider society". In the case of technology, this "is not simply a question of acquiring skills, because these skills are embedded in a culture of masculinity that is largely coterminous with the culture of technology" (p. 15).

The third area analysed looks at policies that specifically link gender and STEM. McNally (2020) analyses the STEM gender gap in post-secondary education and finds that policy responses vary depending on the level of education involved and the location. In Europe, a meta-analysis of gender equality policies on science and research was conducted, covering the period between 1980 and 2008, which summarized trends observed (until then) in the research literature, including the impact of higher education, the restructuring of gender equality in science and research, and measures for the advancement of women in scientific careers. It identified three key challenges: (1) the inclusion of gender policy assessment in theories of social change; (2) gender in policy innovation and (3) a re-examination of power and political struggle (Caprile and others, 2012; Müller and others, 2011; Castaño and others, 2010).

Caprile and others (2012) observe an important conceptual distinction between the different approaches, strategies and instruments found in gender equality policy in Europe. A report by Rees (2002) on national policies on women in science in Europe makes a distinction between positive (or affirmative) action measures and gender mainstreaming, pointing out that this distinction is not clear in the literature, as both types of measures are increasingly used in combination and are complementary. Notably, it was found that:

- Definitions of gender mainstreaming vary, as does, and to a considerable degree, practice.
- Affirmative action covers a wide range of initiatives in higher education, public institutions, private organizations, and the labour market, to provide more opportunities for women to overcome gender inequalities.

Caprile and others (2012) point out that in most countries, and at various institutional levels, both strategies (affirmative action and gender mainstreaming) overlap and have been adopted simultaneously. While both appear to mutually reinforce one other and foster policy success, several authors underscore the particular role played by affirmative action in contextualizing gender equity or equality, compared to mainstreaming. Müller and others (2011) compare "positive measure-based" and "gender mainstreaming" approaches and notes that the literature addresses three subject areas: (1) progress in scientific careers through professional training and skills building, stipends and fellowships, networking and mentoring, and measures for better work-life balance; (2) science, management and reform, including the role of new legislators, frameworks, institutional structures, committees and observatories, quotas or new steering instruments such as incentives and targets; and (3) the gender dimension in research and higher education, including gender, pedagogy and curriculum, exclusive education, institutionalization of gender studies, and the evaluation of gender in research.

One notable initiative in this area has been the STEM and Gender Advancement Project (SAGA), created by UNESCO in 2015 and the basis of the SAGA Survey of Gender Equality in Science, Technology and Innovation (STI) Policies and Instruments, designed to collect information about how gender equality is addressed in: national and subnational policies and plans; legal and institutional frameworks; and the operational policy instruments, plans, initiatives and measures implemented by national research institutions and universities (UNESCO, 2017). It is used to analyse all aspects of gender equality to identify gaps in policy combinations and assist policymakers in establishing, implementing, monitoring and evaluating gender equality in policy, based on seven areas targeted by policy objectives: social norms and stereotypes, primary and secondary education, higher education, career advancement, research on content, practices and agendas, policy formulation processes; entrepreneurship and innovation.

These three areas are used below to analyse experiences and examples of policies in the region that are presented above.

B. What does recent experience in the region show?

Concerning the types of policies on gender equality and women's autonomy, the classification proposed by Astelarra (2004) and Alonso (2010) reveals a predominance of policies and actions in the region aimed at addressing the underrepresentation of women in STEM as a key agenda item and via affirmative measures and gender mainstreaming initiatives in the science and technology sectors. In some cases, this gives rise to specific policies on gender and STEM. To a lesser extent, measures for equal opportunity and treatment are linked to legislative measures or legal reform. This is the case in Mexico and Argentina, which have sought to mainstream gender into national laws on science and technology.

In Chile, equality plans include affirmative measures and objectives to encourage the access of women to highly male-dominated careers in science and to keep more women in careers in science, technology and mathematics. In Mexico, measures exist that encourage the inclusion and promotion of women in the public energy, science, technology, communications and transportation sectors, as well as strategic measures to help women access the energy, technology, engineering, communications and transportation sectors and enhance their employability. In Peru, policy seeks to increase the participation of women in traditionally male-dominated careers, and guarantee equal access, continuation and success of men and women pursuing vocational degrees in technology, higher degrees in technology, teaching or the arts, and university degrees. In addition to a primary focus on the underrepresentation of women in STEM, countries such as Argentina are making progress in recognizing gender diversity, including women and LGBTIQ+ persons.

Concerning gender mainstreaming in science and technology, several initiatives are noted, including national assessments to identity gender inequalities in each country's science and technology sector, which can lead to the development of gender equality measures such as sector-specific policies that take gender into consideration. In Argentina, for example, certain links were established between gender, science and technology —particularly in the increase of participation of women in research careers— in an assessment carried out in 2021 on the status of women in science and technology, and in the Argentina Innovadora 2020 plan for science, technology and innovation, and its strategic guidelines for the period 2012–2015. In Chile, gender mainstreaming in science and technology is a component of the Institutional Policy on Gender Equity in Science and Technology of the National Commission for Scientific and Technological Research (CONICYT), and in Uruguay, in the coordinated efforts of the Inter-institutional Roundtable on Women in Science, Innovation and Technology. As pointed out by Bonder (2004), a lack of assessment of gender and STEM policies and other types of initiatives are a persistent shortcoming.

Experience in specific gender and STEM policies in the region are the most significant in terms of their scope and purpose. As mentioned above, most came into effect in recent years, including the last two years of the pandemic. In Argentina, the National Programme for Gender Equality in Science, Technology and Innovation extends the notion of gender to the LGBTIQ+ population. It also links science and technology to other gender equality issues such as violence and care and looks at how they come into play in human resources and scientific production.

Chile approved the most recent policy: the National Gender Equality Policy for Science, Technology, Knowledge and Innovation, and its action plan "50/50 by 2030", notable for the participatory process underpinning its creation and cross-sector coordination between different ministries: the Ministry of Science, Technology, Knowledge and Innovation, with the active support of the Ministry of Women's Affairs and Gender Equity; the Undersecretariat of Higher Education, and the Undersecretariat of Telecommunications. This particular policy also identifies the underrepresentation of women in science, technology, knowledge and innovation as the main problem, and focuses largely on exploring how women are excluded or underrepresented.

In Costa Rica, the National Policy for Equality between Women and Men in the Training, Employment and Enjoyment of the Products of Science, Technology and Innovation (PICTTI), approved in 2018 prior to the pandemic, also focuses attention on the underrepresentation of women. Its main areas of action include the social uptake of gender mainstreamed science and the creation of a monitoring and evaluation system to ensure the sustainability and follow-up of policy. It is also the result of cross-sector coordination between the Ministry of Science, Technology and Telecommunications and the National Institute for Women, the coordinating body of the National Policy on Gender Equality and Equity.

Concerning the analysis of gender and STEM policies, findings in other contexts and examples indicate that affirmative measures are taken in conjunction with gender mainstreaming measures. In STEM sectors in particular, both types of measures are used in combination and are complementary, as pointed out by Rees (2002). In European science contexts, they overlap or are adopted simultaneously. A focus on traditional and academic education (primary, secondary and university) is observed, with almost no mention of vocational training. In addition, the problem is viewed as being the exclusion of women rather than androcentric biases in the sciences, leading to measures geared at improving women's access, rather than generating change or reform in the actual STEM fields themselves.

V. Concluding remarks

A. The importance of STEM in a transformative recovery with gender equality

The COVID-19 pandemic has had both positive and negative effects on connections between gender and STEM. On the one hand, evidence shows that the pandemic made countries turn to science; demonstrated the value of digital technologies in an emergency; and energized knowledge production systems. On the other, it presents the risk of exacerbating social inequalities (UNESCO, 2021b).

Working conditions faced by women in the region are particularly complex. The economic and social effects of the pandemic are expected to have a substantial impact on women's autonomy, with a decline in their employment equal to an 18-year setback (ECLAC, 2021). As for the labour participation and employment conditions of women in STEM fields, where they have been a minority until now, there is a risk of deepening gender inequalities. It bears asking whether science and technology are incorporating diverse perspectives, including women in solutions to the pandemic and its consequences, and whether the proposed solutions are useful or beneficial to women.

Initial studies show that the pandemic has disproportionately affected women researchers, even if they have been at the forefront of managing the crisis (UNESCO, 2021b). Women working in STEM fields, even in small numbers, face the same cross-cutting gender-related obstacles and barriers that jeopardize the careers of women in all sectors: excessive domestic and care responsibilities that hinder both on-site and remote work; job insecurity and instability; unemployment; and temporary or permanent decreases in income. Also at play is an overload of paid work by women employed in sectors overburdened by the pandemic and lockdowns: healthcare in a context of intensive use of health services, the adaptation of educational systems to remote learning methods powered by technology, a decrease in scientific and technological production by women, and domestic and care work within the home.

On the other hand, a paradox arises: large percentages of women work in sectors that are key in managing the pandemic, such as intensive health care, a sector in which 73.2% of employees are women, and the adaptation of education systems (70.4% of jobs in the education sector are occupied by women). At the same time, digitalization is playing an increasingly larger role in practically all activities of life (ECLAC, 2020b), where women are excluded to a higher degree. For Wacjman, Young and Fitzmaurice (2020), the rise and widespread dissemination of digital technologies shapes gender (in)equality in the educational sphere in a multiplicity of ways and not only in terms of access to technology, but also in terms of "deficits" in learning and skills. Women in low- and middle-income countries in particular lack the necessary techno-social capabilities to compete in a global online environment.

Science, technology, engineering and mathematics are among the sectors that drive sustainable development and represent opportunities for women's economic autonomy. They include: the energy transition, non-conventional renewable energies, sustainable mobility and urban space, the digital revolution for sustainability, the health-care manufacturing industry, the circular economy, the sustainable recovery of tourism and the care economy (ECLAC, 2020b). All these areas require professional skills and training in STEM fields, which should be encouraged as a way to achieve substantive equality as an outcome of measures for gender equality and women's autonomy.

In addition to the connection between gender and STEM, this implies adding a third link: sustainable development and public policies. For Bortagaray (2016), public policies in these areas must be underpinned by their objectives and seek to coordinate development trajectories based on science, technology and innovation that are also environmentally and socially sustainable. To this can be added gender equality and women's autonomy, implying a need to incorporate an explicit focus in science, technology and innovation policy that moves beyond improving competitiveness and instead towards comprehensive, sustainable and socially inclusive development processes (Bortagaray and Gras, 2013, cited in Bortagaray, 2016).

The links are evident, given that knowledge and skills in science, mathematics, engineering and technology (STEM) are relevant, not just to those who work in STEM-related fields, but in "understanding our daily lives, ranging from our day-to-day health and our communication with others, to our knowledge of climate change and sustainable living" (IBE-UNESCO, 2017). In the context of the pandemic and the consequences and opportunities it creates, there is an urgent need to "bridge the development divide, so that women and girls everywhere might benefit from technological developments" (United Nations, 2019). This extends to other STEM fields that will drive the post-pandemic recovery.

B. Why are public policies on gender and STEM needed?

As reviewed throughout this document, STEM fields are key in addressing the digital revolution and accelerated technological change, now exacerbated and complicated by the COVID-19 pandemic, but they must be examined from a critical, feminist and gender perspective so as to transform patterns of inequality historically present in science and technology, which far from being neutral, reproduce and sustain various forms of inequality and exclusion. Herein lies the transformative potential of STEM.

The problem of women's underrepresentation STEM fields is the tip of the iceberg: a cluster of structural problems and inequalities that must be analysed in perspective and addressed by policies that accommodate these complexities. In the current context, achieving women's autonomy and rights requires a comprehensive and transformative approach to public policy (ECLAC, 2019a). This is especially true of public policies on gender and STEM. Greater gender equality and economic autonomy for women in Latin America is possible by transforming the fields of science and technology, not only to improve women's access to them, but to transform science and technology into spaces that enable greater equality and greater respect for the rights and dignity of all people.

Resolving the structural challenges of gender inequality therefore involves addressing not only its effects (underrepresentation or low participation of women, gender stereotypes, biased career choices), but also —and above all— its causes (sexual or gendered division of labour, the social organization of care and the concentration of power). The androcentric and patriarchal models that have shaped modern science and are perpetuated in educational and professional environments in the sciences, technology, engineering and mathematics. Thus, connecting gender equality to STEM involves identifying the gender inequalities expressed therein and outlining policy proposals that can substantially transform these inequalities with help from STEM fields. However, trends in the public policy agenda reflect partial approaches to gender issues in STEM based on proposals for one-dimensional, women-centred solutions that do not necessarily address gender relations or masculinities, and that only provide limited visibility to other people facing discrimination on the basis of gender, such as the LGBTIQ+ population (only policies in Argentina do so).

As Wacjman, Young and Fitzmaurice (2020) point out, despite the variety of initiatives implemented since the Beijing Declaration and Platform for Action, a lack of coherent policy persists, both in the field of technology and STEM in general. Though the gender digital divide is a major issue on public agendas, technology alone cannot address the systemic problems that it causes, given that "gender inequality stems from multiple intersecting economic, social, political and cultural barriers, and remedies must be grounded in evidence about which barriers are in play across different contexts" (p. 22).

The challenge for countries in the region in the current context of the pandemic is therefore to develop comprehensive STEM policies for achieving women's autonomy and rights in changing economic scenarios (ECLAC, 2019a). These public policies must include a variety of strategies and combine affirmative action and measures with legislative reform and measures for equal opportunities and the mainstreaming of gender in STEM-related sectors, both in education and the professions. Bringing long-standing feminist theory on science and technology to international policy recommendations could provide the countries of the region with a key resource to nurture the public policy process.

In light of this report, the following are a few recommendations as to how public policies can contribute to gender equality and women's autonomy in STEM in Latin America:

- Encourage specific assessments on gender and STEM, given that multiple forms of gender inequality and discrimination exist in these fields. This requires the collection of specific related data; such information is not always available at the country level, and it is essential that information systems in science and technology consider statistics, indicators and gender analysis.
- Broaden the scope of STEM in education, including vocational training, which tends to go unnoticed in STEM fields and skills as well as in analysis of gender inequalities. It is also important to strengthen connections between policies and employment in STEM fields, as well as women's economic autonomy.
- Encourage participatory processes in the development, implementation and assessment of public policies on gender and STEM to ensure a fundamental link with civil society, women's and feminist organizations focused on STEM.
- Develop systematic assessments of gender and STEM policies to analyse whether such policies help reduce gender inequalities, especially in relation to the structural challenges identified in the Montevideo Strategy.
- Advance intersectoral working bodies and coordination to drive the development of gender and STEM policies (which are eminently intersectoral in nature) with ongoing coordination of the machineries for the advancement of women with the science and technology sector, the education sector, and the production sector, among others.

- Facilitate the convergence of development objectives to overcome policy fragmentation: gender equality and women's autonomy, scientific and technological development and sustainable development are not mutually exclusive. To the contrary, they must be addressed together in a coordinated manner.
- Foster comprehensive policies that are based on a combination of strategies and a multidimensional approach to gender inequalities in STEM as complex public problems. This implies combining affirmative measures, using gender mainstreaming as a strategy, and action for regulatory change, in line with the goal of gender equality, substantive equality and women's economic autonomy, as well as advancing in the design of new strategies for policies aimed at gender equality and women's autonomy.
- Encourage two-way mainstreaming processes: gender mainstreaming in science and technology policies, as well as mainstreaming of the STEM approach in gender policies —on education and employment in particular— and especially in a changing economic context tested by the COVID-19 pandemic and accelerated technological change.

Lastly, there is a need to expand upon the public debate on gender inequalities in STEM, which is a topic addressed extensively and on an increasing basis in the public agenda in the region. Certain questions arise in conclusion that are useful for further reflection: is it enough to encourage greater access for women to the sciences, technology, engineering and mathematics if they are then confronted with a profoundly unequal work environment? Are women responsible for their underrepresentation in STEM (e.g. in relation to their interests, career goals and capabilities) or is change needed in the disciplines, organizations and companies that generate and use science and technology? Could STEM fields help structurally overcome gender inequalities in society by generating knowledge? How does the social organization of care shape scientific and technological production by men? This list is not exhaustive; other key issues remain which require further analysis and policy development.

A deeper approach to public problems and gender inequalities in STEM is possible with a better understanding of these problems —one that looks beyond access and participation to other forms of gender-based exclusion and discrimination (LGBTIQ+ peoples, for example or based on ethnic or racial status) and analyses how scientific and technological organizations reflect a generalized social order that includes both women and men, and how the production of knowledge itself plays a role in perpetuating and sustaining relations of power and domination to the disadvantage of women and other groups who experience inequality. A profound change in the sciences and technology could be a favourable way to structurally address gender inequalities in Latin America. If policies do not move decisively in that direction, the current context of the pandemic can be either an opportunity or a risk.

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