Australian Government
Department of Industry, Science, Energy and Resources

Australian Academy of Science

# IMPACT OF COVID-19 ON WOMEN IN THE STEM WORKFORCE

Asia-Pacific

**Acknowledgement of Country**

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Asia-Pacific

# Acknowledgements


## STEERING COMMITTEE

The Australian Academy of Science (the Academy) gratefully acknowledges the leadership and guidance provided by members of the project's Steering Committee who contributed many ideas for the report, provided advice on the research methodology and engaged their local sector.

**Emeritus Professor Cheryl E. Praeger AC FAA** *Chair*, Fellow and former Foreign Secretary, Australian Academy of Science

**Professor Patricio Felmer** University of Chile, Centre for Mathematical Modelling

**Professor Asma Ismail**
President of the Malaysian Academy of Sciences

**Dr Sereana Naepi**
Co-Chair, Early Career Researcher Forum, Royal Society Te ApÐrangi, New Zealand

**Dr Hasnawati Saleh**
Indonesian Young Academy of Sciences and Australia-Indonesia Centre, Indonesia

**Professor Prajval Shastri**
Indian Institute of Astrophysics, India

**Dr Judith Zubieta**
National Autonomous University of Mexico

## CONTRIBUTORS

The Academy gratefully acknowledges the many people working in the science, technology, engineering and mathematics (STEM) workforce across the Asia-Pacific region who provided responses to the survey and those who generously shared their personal stories about the impact COVID-19 has had on their STEM journey.

The Academy acknowledges the financial support that enabled this project provided through the Regional Collaborations Programme (RCP), led by the Australian Government's Department of Industry, Science, Energy and Resources (DISER). The Academy acknowledges the collaboration and support provided by DISER to the project.

The project delivery was led by the Academy and included Louise Moes, Nancy Prichard, Ying-Cheng Chang, Laura Navarro, Allison Hornery and Alix Keyes. Editorial and communication assistance from the Academy communications team and design by GRi.D Communications is gratefully acknowledged.

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# Key discoveries

**1109** RESPONDENTS

**865** WOMEN

## SURVEY AT A GLANCE: WOMEN IN STEM

**FROM 31 ASIA PACIFIC COUNTRIES AND ECONOMIES**

**HAVE POST-GRADUATE QUALIFICATION (80%)**

**WORK AT UNIVERSITY (53%) AND DO RESEARCH (40%)**

**HAVE PERMANENT POSITIONS (49%)**

## The survey results highlighted for women

**The commitment of the women who work in the STEM workforce**

Personal passion for their work (59%) and work fulfillment (46%) are the main reasons why women are likely to remain in STEM

72% reported that their short-term career expectations were to remain in the STEM workforce

**The vulnerabilities experienced by different groups**

Only 56% of women with caring responsibilities had access to flexible work

39% of early career women were on fixed-term contracts and more likely to leave the workforce due to job insecurity

**The need to embed flexibility as part of the road to recovery**

Flexible working arrangements (60%) and flexible measures of work productivity (44%) are the main options to better support women's working conditions

**The different challenges facing the women in the STEM workforce**

50% reported negative mental health impacts in relation to work or home life

30% reported an increase in their workload and

a decrease in productivity

## STORIES AT A GLANCE

**20 STORIES FROM 9 ASIA-PACIFIC COUNTRIES AND ECONOMIES**

## The stories highlighted the experiences of women

**FINDING THE POSITIVE WHEN WORKING FROM HOME**

**BALANCING DOMESTIC AND PROFESSIONAL RESPONSIBILITIES**

**DEALING WITH SHARPER GENDER-BASED INEQUITIES**

**USING ONLINE TECHNOLOGIES TO CONNECT AND WORK**

# Foreword

As Chair of the Steering Committee that oversaw the *Impact of COVID-19 on women in the STEM workforce, Asia-Pacific* project, I had the privilege of working with colleagues around the world with a special interest in women in STEM and gender equity. We met and discussed this project at a time when the world was encountering dramatic challenges due to the sudden outbreak of the COVID-19 pandemic. Its emergence has profoundly affected our lives and day-to-day activities at every level.

Over the years, much work has been done to try to improve gender equity especially in STEM fields. The pandemic is having a detrimental impact on women, and there is a real risk that any progress made pre-pandemic in gender equity in STEM could be jeopardised. The aftershocks could reverberate through the post-pandemic recovery.

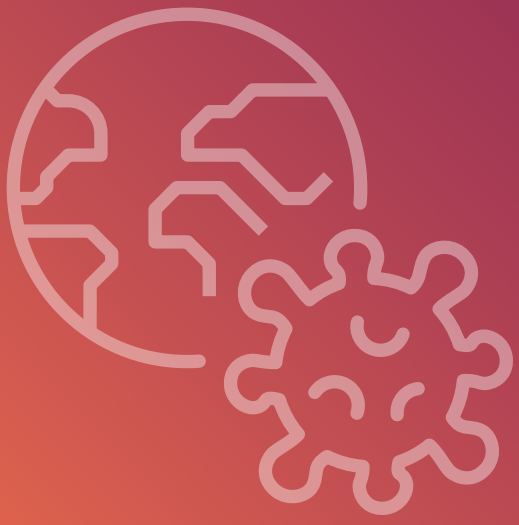
The project is important to help us understand some of the unanticipated impacts that COVID-19 has had on women in STEM, and the potential to exacerbate disparities in the STEM workforce. Knowing about these impacts and learning about some of the solutions found by economies in our region when trying to ameliorate these impacts, will enable us to take action towards the gender equity that our society has long sought to improve.

The project would not have been possible without the generous contributions of many individuals and organisations. I would like to thank and acknowledge the funding and support from the Australian Government's Regional Collaborations Programme of the Department of Industry, Science, Energy and Resources, for this important project. I would like to thank members of the Steering Committee for finding the time to meet virtually, sometimes very early or very late during the day, and providing guidance and wise advice to make this a better project. Of course, thanks go to the more than 1000 colleagues who completed the project survey and the many who generously shared their personal stories. Your contributions have enriched our report.

We also thank other partner organisations and APEC economies for participating in the project. We hope that this collaborative effort will lead us to improve gender equity, support women in STEM across the Asia-Pacific region and build a community of shared values of diversity and inclusion.

**Emeritus Professor Cheryl E. Praeger Chair, Steering Committee,** *Impact of COVID-19 on women in the STEM workforce, Asia-Pacific*

The COVID-19 pandemic has exacerbated pre-existing gender inequity in the STEM workforce across the Asia-Pacific region.



# Executive summary

The Australian Academy of Science, with support from the Australian Government, has produced this snapshot of the dynamic impacts of the COVID-19 pandemic on women in the science, technology, engineering and mathematics (STEM) workforce throughout the Asia-Pacific region. This report captures the lived experiences of women and highlights that important gains in equality may be lost without action.

The main activities of this rapid research project were conducted between December 2020 and June 2021, with a focus on hearing the voices of women in the Asia-Pacific STEM workforce about their firsthand experiences. Activities included **desktop research** of current reports, **a region-wide survey** conducted in March and April 2021, a call for personal stories of people's real-world work life during the pandemic and a **regional online workshop** with 40 participants.

This report is a collaborative project, with contributions from many individuals and organisations across the region. It draws on networks and partnerships available to the Academy and the Australian Government including the Australian Government's overseas diplomatic missions, the Association of Academies and Societies of Sciences in Asia, the APEC Policy Partnership for Science, Technology and Innovation, and the support of partner governments across the region.

The report presents the key findings of this research on the impacts on STEM careers, individual wellbeing and the ways organisations and individuals within the STEM ecosystem could respond to rising challenges brought about by COVID-19.

This mixed-method and collaborative research project, including a survey of over 1000 people in STEM, revealed the **COVID-19 pandemic has exacerbated pre-existing gender inequity in the STEM workforce across the Asia-Pacific region**.

» This has been brought about by changes in lifestyle and the blurring of boundaries between the spheres of work and home, increased domestic and caring responsibilities which have impeded work productivity, precarious and insecure work arrangements, and reduced access to research facilities and workplaces due to lockdown arrangements.

» These conditions have had significant impact on individual wellbeing, as women in STEM respond to social change and balance cultural and familial expectations.

» People from different parts of the Asia-Pacific region shared different perspectives of capacity in their economy to respond to these negative impacts. Regional collaboration, together with supportive workplaces and communities, can minimise gendered impacts of the pandemic on the STEM workforce, now and in the post-pandemic recovery.

Four common themes emerged from the evidence, revealing an interwoven context that women in the STEM workforce were facing.

These themes were:

» impacts on **professionals at work**

» **challenged boundaries** between work and non-work spheres

» **social change and individual wellbeing**

» impacts in **Asia-Pacific and beyond**.

# KEY FINDINGS

## PROFESSIONALS AT WORK

» While different contexts exist between economies, inequity in attracting, retaining and progressing women in STEM career pathways is an ongoing characteristic in the STEM workforce throughout the region. The COVID-19 pandemic and its impacts are likely to deepen pre-existing gender imbalances.

» Structural inequalities and the intersection of multiple barriers faced by women in STEM have been highlighted in the pandemic. In the workplace, inequity in the full participation of individuals in STEM are rarely issues of gender alone, but rather involve a complex set of power relations in which knowledge, social class, socioeconomic status and other elements are intertwined.

» More women than men in the STEM workforce are at early or mid-career stages and are underrepresented at senior levels. Consequently, they are often more likely to be in precarious employment reliant on short-term grant funding and not yet in tenured or management research positions. Job insecurity was further exacerbated during the pandemic, as the stability of employment in the STEM workforce decreased.

» Providing supportive workplaces is crucial to minimise challenges facing women in the STEM workforce during the pandemic. These include flexible working arrangements, flexible measures of work productivity and changing expectations of work value (such as raising the valuation of online teaching in academic performance when reviewing job promotion).

## CHALLENGED BOUNDARIES

» During the pandemic, changes brought about by restrictions such as lockdowns, quarantine and travel bans, produced a new lifestyle of working from home for most people. This challenged conceptual boundaries between the spheres of work and home in the creation of a new 'virtual lifeworld' and presented specific challenges and opportunities for women.

» Online teaching and learning came with a demanding workload, long working hours without switching off, and a lack of social interaction. These activities were mainly conducted by early and mid-career researchers, who are usually disproportionately women.

» Additional domestic responsibilities, such as supervising school learning at home, caused competing priorities as domestic roles and professional roles overlapped. This resulted in negative impacts on productivity for many women, especially in terms of academic output such as journal publications.

## INDIVIDUAL WELLBEING

» Increased activities in the 'virtual lifeworld' dominated the day-to-day routine. While positive impacts included keeping people safe, increased flexibility and the development of new skills, the 'virtual lifeworld' also caused a high level of isolation and anxiety due to the decline in face-to-face interaction.

» Many women also grappled with changing social conditions, and balancing cultural and familial expectations and caring responsibilities with work responsibilities.

## ASIA-PACIFIC AND BEYOND

» People from different parts of the Asia-Pacific region shared different perspectives of capacity in their economy to respond to the identified negative impacts.

» The project identified a collective sense and experience of social phenomena brought about by the pandemic beyond the Asia-Pacific.

» By taking a cross-regional approach to developing a range of solutions, collaboration is key to balancing challenges and opportunities by building on existing initiatives underway through academies and other fora such as the *APEC Women in STEM Principles and Actions*, recommendations outlined in UN Women's *The COVID-19 Outbreak and Gender: Key Advocacy Points from Asia and the Pacific* and the International Science Council's project *A Global Approach to the Gender Gap in Mathematical, Computing, and Natural Sciences: How to Measure It, How to Reduce It?*".

» Efforts to address gender inequity exacerbated by the pandemic could have strong potential to improve the condition of the STEM workforce for all people within it.

# Background and survey demographics

## Women in STEM

It is well documented and becoming more widely accepted that diversity is essential to delivering excellence in STEM, and that diverse and inclusive STEM workforces draw from the widest range of backgrounds, perspectives and experiences thereby maximising innovation and creativity in science for the benefit of humanity[1].

A lack of diversity may indicate that the STEM talent pool is missing critical contributors who are facing barriers to participation, thereby preventing economies from growing capable workforces that rely increasingly on STEM skills and underpin economic growth and global competitiveness.

Over a longer timeframe, as the pandemic restructures the global community, an increased absence of women and other minorities may diminish the quality of scientific endeavour through a lack of diverse analytical perspectives.

Two reports published in May 2020 suggested that there was a need to explore the impacts of COVID-19 on women across the Asia-Pacific region. A report[2] released by the Rapid Research Information Forum (RRIF), led by Australia's Chief Scientist, found that the impacts of the COVID-19 pandemic are expected to disproportionately hinder women's STEM careers and widen disparity between genders in the Australian STEM workforce. The report authors found 'the hard-won gains made by women in STEM are at risk, especially if employers of people with STEM skills do not closely monitor and mitigate the gender impact of their decisions'. Similarly, another report[3] found that women early and mid-career researchers with caring responsibilities were most affected by the pandemic.

## Project scope

This rapid research project sought to understand the impact of COVID-19 on women participating in the STEM workforce, which includes the natural, physical and life sciences, mathematics, engineering, ICT and technology-related disciplines. This project recognised the impacts on women working in different parts of higher education and research, the public and industry sectors, as well as STEM entrepreneurs. As the international science networks mostly accessed by the Academy typically involve other academic institutions, there was a natural focus on the research and higher education cohort within the STEM sector, particularly senior scientists and researchers with postgraduate qualifications. The project recognised that many different occupations require or make beneficial use of STEM skills but may not identify as occupations in the STEM sector.

The project engaged with professionals of all genders working in STEM to capture a holistic view of the issues affecting the workforce and to be inclusive of different perspectives. There was also consideration about the impacts of the COVID-19 pandemic on other marginalised groups, such as indigenous peoples, people living with disability, the LGBTQIA+ (lesbian, gay, bisexual, transgender, gender diverse, intersex, queer, asexual and questioning) community, and people from culturally and linguistically diverse backgrounds. Through this project, we aimed to identify a range of issues to address to improve the environment for the whole STEM workforce in the post-pandemic recovery.

1 The Royal Society, "Overview: Diversity in science", Date accessed on 5 June 2021, https://royalsociety.org/topics-policy/diversity-in-science/topic/

2 E Johnston et al., 2020 "The impact of the COVID-19 pandemic on women in the STEM workforce", *Australian Academy of Science*, 17 May 2020, https://www.science.org.au/covid19/women-stem-workforce

3 Australian Academy of Science, "EMCR Forum resources", https://www.science.org.au/supporting-science/early-and-mid-career-researchers-0/emcrs/emcr-forum-resources

STEM in the Asia-Pacific region, which spans the Americas, Oceania and Asia, is important because of the shared challenges associated with geography and increasingly strong STEM outcomes. By promoting collaboration in the region, the benefits can be amplified.

## Steering Committee

A Steering Committee was formed with representatives from the STEM community across the region to provide guidance for this project.

The Committee met virtually throughout the development of the project and provided many ideas for the report, advice on the research methodology and survey design, and feedback on the report structure. Members also engaged their local networks in the research activities.

The Committee was chaired by Emeritus Professor Cheryl Praeger AC FAA, Academy Fellow, Chair of the Women in Science and Engineering (WISE) Committee that advises AASSA on gender equity in STEM issues, and the 2019 recipient of the Australian Prime Minister's Prize for Science.

Six leading scholars identified through the Academy's international networks were invited to join, with members representing Chile, India, Indonesia, Malaysia, Mexico and New Zealand.


*First Committee meeting*

## Methodology

This project was designed to rapidly capture empirical data in a short three-month period and provide a platform for participants to have their voice heard in describing the impacts on their STEM work lives. Following a desktop review analysing available and known secondary reports, the research methods included:

- a publicly available online survey
- a call for personal stories from the region
- an online interactive stakeholder workshop that presented the preliminary findings and collected feedback from a range of STEM stakeholders on their day-to-day experiences as they relate to the four key themes.

The survey and requests for personal stories were disseminated widely in the region through the Academy and Australian Government's global networks. More detail about the research methodology can be found in the following pages and the survey questions can be found in the Appendix.

## Project pathways: the evidence base

As the global circumstances of the COVID-19 pandemic were dynamic and changing, this project took place in a very short timeframe to capture current and emergent impacts. The main project activities were conducted between December 2020 and June 2021.

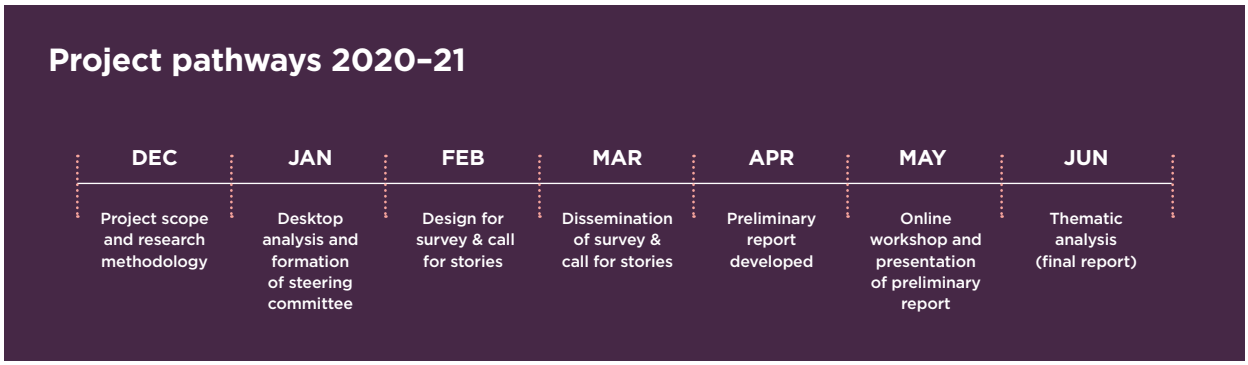



*Figure 1 Project timeline*

## Survey and call for stories: Design and dissemination

The Academy and DISER collaborated to design the survey and call for stories, and the Steering Committee was consulted. The Academy drew on its experiences in documenting and discovering the impact of COVID-19 on researchers and scientists, particularly a survey and report on the impacts of early and mid-career researchers in Australia and a RRIF report on the impact on women in STEM, both released in May 2020.

The survey and the call for personal stories were disseminated widely between 5 March and 12 April 2021. Taking a 'snowball' approach, participants were recruited through global networks such as the Academy newsletters' subscribers and the audiences of social media on Twitter and LinkedIn. Global partner organisations provided strong support, including the Association of Academies and Societies of Sciences in Asia (AASSA), the International Science Council (ISC), the World Academy of Sciences (TWAS), the Global Young Academy (GYA), the InterAcademy Partnership (IAP), the Academia Sinica, Taiwan, among others. DISER also engaged its network in the APEC economies.

## Survey

The survey (at Appendix) comprise 40 questions seeking data on:

- general information, such as demography, educational level, employment and career development
- career development during COVID-19, including uncovering the interactions between personal life, work and society
- the interrelations between work arrangements, career development and domestic life such as caring responsibilities, and the socio-cultural contexts
- wellbeing, including mental health
- women's social status in different socio-cultural contexts.



The survey employed a combination of:

- multiple-choice questions
- multi-select questions
- the option of 'Other (please specify)', so respondents could leave comments or an alternative answer.

## Call for stories

Acknowledging that there are limitations in any survey, and that it cannot fully represent the depth and complexity of the circumstances of life and experience, a call for personal stories was also disseminated to capture information that the survey could not.

A free space was opened for participants to share their perspectives and experiences in their own words. Contributors were not limited in the topics they could write about; however, some directional questions were suggested for inspiration.

The call invited stories on issues of diversity and inclusion. For example, the additional difficulties one may face as a member of marginalised groups were investigated, including ethnic minority status, gender or sexual identity as LGBTQIA+, disability, cultural and linguistic diversity or indigeneity.

Finally, institutional views were also invited, on how organisations or leadership took action to cope with the pandemic.

## Survey results: Demographic data

A region-wide survey was conducted from 5 March to 12 April 2021 as part of the *Impact of COVID-19 on women in the STEM workforce, Asia-Pacific* project. The survey comprised 40 questions designed to gain valuable insights into the experiences and challenges facing women in the region during the pandemic.

A total of 1109 survey responses from 31 Asia-Pacific countries and economies were received.

- 78% (865) of survey respondents identified as women
- 20% (219) as men
- 0.7% (8) as non-binary
- 1.3% (17) did not select a preferred gender.

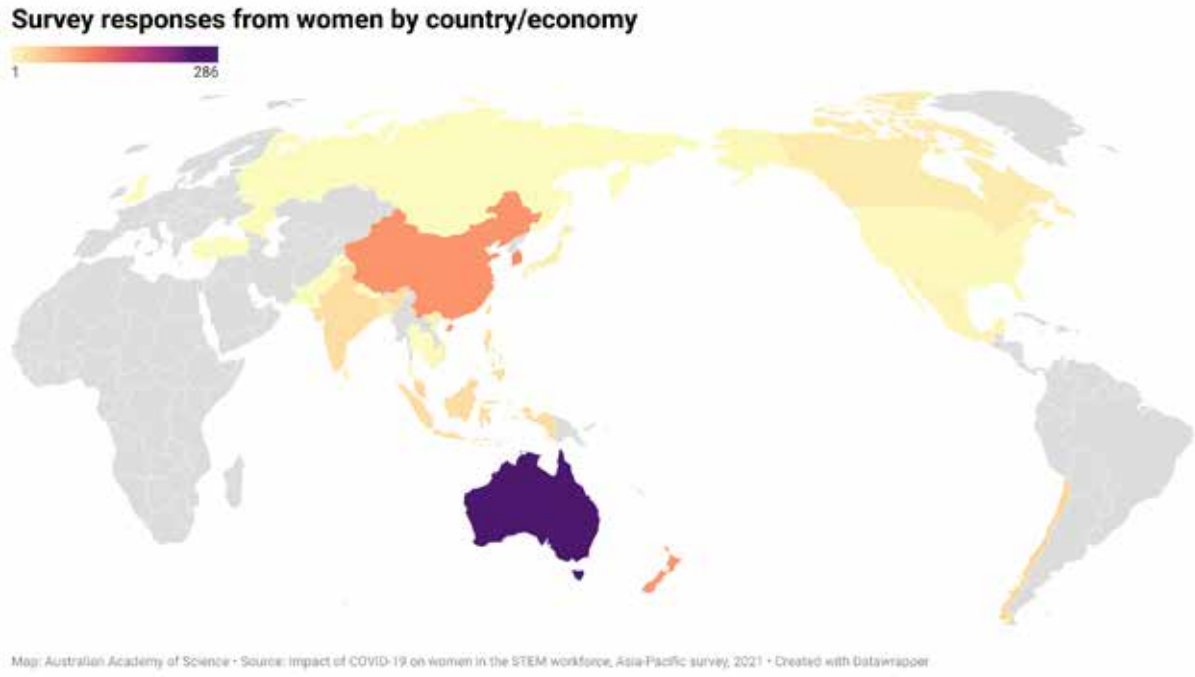
Unless specified, the survey data focuses on the experience and responses from those self-identifying as women. This helps provide a deeper insight into the barriers, challenges and experiences of women in the STEM workforce highlighted in this report. Where relevant, information from participants from other genders is included as part of the analysis particularly where including these statistics provides a valuable comparison point.

The response rate for each of the questions of the survey varied significantly from question to question. To account for these differences, the survey data was analysed based on the whole group of women that engaged in the survey (865), instead of the subgroups who replied to each individual question. Respondents who skipped a question were assigned a value of N/A for that question. Percentages were calculated for responses relative to everyone who engaged in the survey.

## Who participated in the survey?

### LOCATION

865 women from 31 Asia-Pacific countries and economies participated in the survey and below are some of the data findings from the women who participated in the survey.

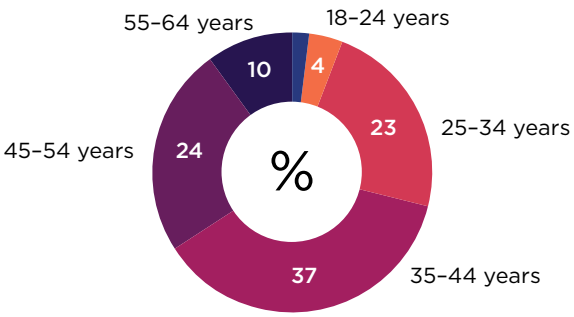



To view an interactive map, please click here: https://datawrapper.dwcdn.net/54MAn/3/

| Country/Economy | Responses |
|---|---|
| Australia | 286 |
| Bangladesh | 15 |
| Brunei | 5 |
| Cambodia | 5 |
| Canada | 15 |
| Chile | 36 |
| China | 90 |
| East Timor | 4 |
| Fiji | 1 |
| Hong Kong S.A.R. | 5 |
| India | 28 |
| Indonesia | 28 |
| Japan | 12 |
| Malaysia | 33 |
| Mexico | 7 |
| Mongolia | 1 |
| Nepal | 3 |
| New Zealand | 88 |
| Pakistan | 3 |
| Russia | 2 |
| Singapore | 4 |
| South Korea | 97 |
| Sri Lanka | 7 |
| Taiwan | 31 |
| Thailand | 2 |
| Philippines | 30 |
| Tonga | 2 |
| Turkey | 1 |
| United Kingdom | 1 |
| United States of America | 4 |
| Vietnam | 9 |
| Did not specify | 10 |

## AGE GROUP

Respondents were mostly under 54 years of age. Women of 35 to 44 years (37%) were the main age group who completed the survey.




## DIVERSITY

| Women who participated in the survey who self-identified as: | |
|---|---|
| Person living with disability | 5% |
| Cultural and linguistically diverse | 11% |
| Member of an indigenous group | 4% |
| Member of the LGBTQIA+ community | 5% |

## EDUCATION

The survey respondents are highly educated. More than 80% of all respondents had attained post-graduate qualification. Almost 60% of women participating have a doctorate/PhD and nearly a quarter have a master degree.

**Doctorate/PhD (58%)**
Master degree (22%)
Bachelor degree (13%)

## FIELDS OF RESEARCH

A wide range of disciplines was represented in the survey. Women in chemistry were the biggest group (13%), followed by women in physics and mathematics (12%), and biology (11%).

**Chemistry (13%)**
Mathematics and Physics (12%)
Biology (11%)
Engineering (10%)
Medical sciences (9%)

## What is their employment situation?

The representation of career stages was quite well spread in the survey. Early career women were more likely to work under fixed-term contracts (39%), while mid-career and women with established careers mostly work in permanent or ongoing positions. 30% of women identified as mid-career (10-20 years in the workforce). Almost 50% of the respondents are in permanent or ongoing positions.

### CAREER STAGE BY YEARS IN THE WORKFORCE


### TYPE OF APPOINTMENT

There was a high response from those working at a university (53%) and working in government and government-related research (36%). A significant proportion of women selected research and development as their main role at work (40%).

Casual or temporary (5%)
Fixed term contract (24%)
**Permanent/Ongoing (49%)**
Unemployed (2%)
Other type (20%)

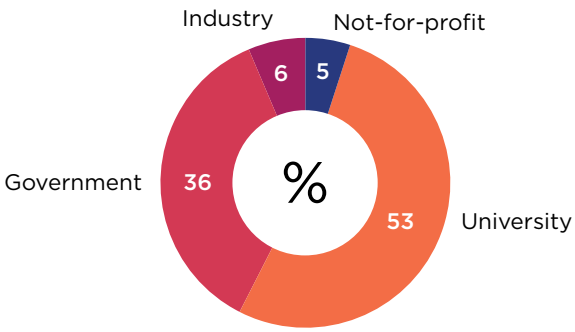
### TYPE OF APPOINTMENT BY CAREER STAGE

**EARLY CAREER**
Casual or temporary (14%)
Fixed term contract (39%)
**Permanent/Ongoing (32%)**

**MID CAREER**
Casual or temporary (3%)
Fixed term contract (23%)
**Permanent/Ongoing (62%)**

**ESTABLISHED CAREER**
Casual or temporary (1%)
Fixed term contract (19%)
**Permanent/Ongoing (69%)**

## MAIN CAREER ENGAGEMENT




## MAIN ROLE AT WORK

**40%** WORK IN RESEARCH AND DEVELOPMENT

**19%** WORK IN TEACHING OR TRAINING

**9%** WORK IN MANAGEMENT

**6%** WORK IN ANALYSIS AND TESTING

## INSTITUTIONAL SUPPORT

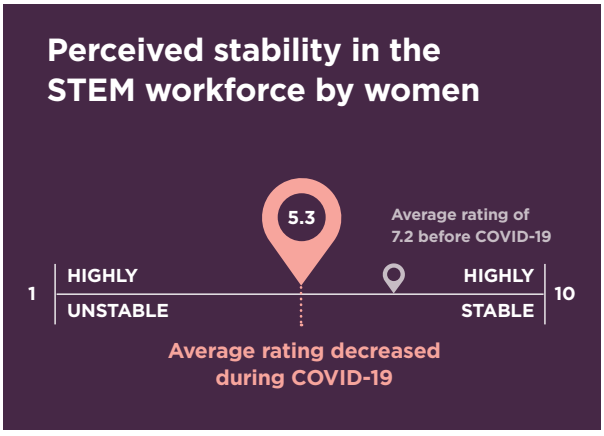
Broadly, the institutional support available to both men and women was similar. There was a difference in career advancement opportunities–such as promotions and secondment.

**Institutional support available at their current place of employment**

| | Women | Men |
|---|---|---|
| Paid leave (e.g. maternity leave, sick leave, annual leave) | 69% | 70% |
| Equal opportunity policy (e.g. gender equality, anti-discrimination, diversity policy) | 62% | 72% |
| Career and professional development (e.g. training opportunities) | 62% | 67% |
| Career advancement opportunities (e.g. promotions) | 50% | 64% |
| Social welfare | 47% | 53% |
| Health insurance | 30% | 34% |

## How did they perceive their career development during the COVID-19 pandemic?

Respondents were asked to rank stability in the STEM workforce using a scale from 1 to 10. On average, this is how women perceived stability in the workforce before and during the pandemic:




Men ranked stability in the STEM workforce as a 7.7 before COVID-19, and as a 5.8 during COVID-19.

| These are the top 3 career expectations in the short term | |
|---|---|
| **Be in the same or similar role** | **43%** |
| Job promotion | 14% |
| Change careers and open to possibilities outside STEM fields | 12% |

The survey highlights the commitment and passion of the women that are part of the STEM workforce.

**56%** **OF WOMEN REPORTED A HIGH OR VERY HIGH LIKELIHOOD TO STAY IN STEM***

*COMPARED TO 65% OF MEN

## Main reasons why women are likely to remain in STEM

**59%**
**PERSONAL PASSION FOR THEIR WORK**

**46%**
**WORK FULFILLMENT**

**29%**
**CAREER ADVANCEMENT**

**24%**
**GOOD INCOME**

Men reported very similar reasons why they are likely to remain in STEM. However, 35% of men listed good income was one of their main reasons.

48% of women who listed lack of opportunities as one of the reasons why they would leave the STEM workforce are on permanent or ongoing appointment. This could relate to reduced opportunities available as women progress in their STEM careers. This issue has been highlighted in strategies to address gender equity in STEM, such as the *Australian Women in STEM Decadal Plan*.

51% of women who listed job security as a reason to leave the STEM workforce are on casual and fixed-term contracts.

32% of women with caring responsibilities listed family responsibilities as a reason to leave the STEM workforce.

## Top 5 possible reasons why women in STEM would leave their careers in STEM

**36%**
**LACK OF OPPORTUNITIES**

**25%**
**JOB INSECURITY**

**22%**
**FAMILY RESPONSIBILITIES**

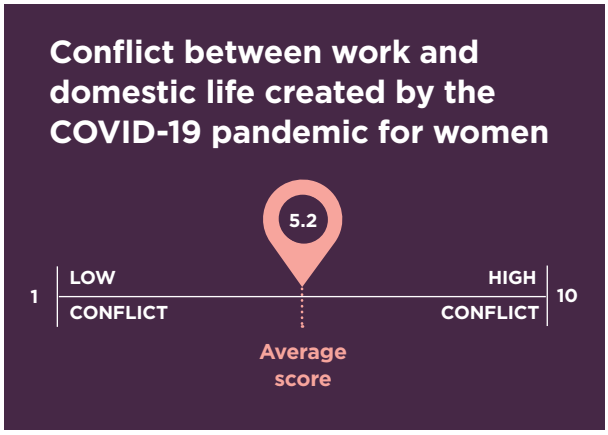
**21%**
**MENTAL HEALTH**

**15%**
**CHANGE OF CAREER INTEREST**

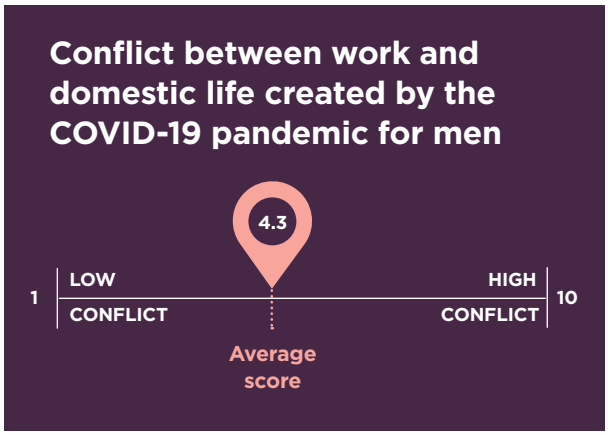
Men also reported lack of opportunities (30%) as the main reason why they would leave STEM, followed by change of career interest (19%) and job insecurity (17%).

## Domestic and personal life

Respondents were asked to rank the level of conflict between work and domestic life created because of the pandemic from 1 to 10. This is how women rated that conflict:




Men rated their work and domestic life conflict one point lower than women:




### DOMESTIC ISSUES

**63%** OF WOMEN REPORTED SPENDING MORE TIME AT HOME AS A RESULT OF THE PANDEMIC

**61%** OF MEN REPORTED SPENDING MORE TIME AT HOME AS A RESULT OF THE PANDEMIC

| Top 3 issues experienced by women when spending more time at home are: | |
|---|---|
| **Increased housework** | **36%** |
| Additional caring responsibilities | 33% |
| Relationship challenges of any kind | 13% |

| Top 3 issues experienced by men when spending more time at home are: | |
|---|---|
| **Increased housework** | **29%** |
| Additional caring responsibilities | 28% |
| Relationship challenges of any kind | 17% |

30 women and 6 men reported incidents of domestic violence as a result of the pandemic.

## Health and wellbeing

The survey explored the impacts of the pandemic on the health and mental wellbeing of women. 44% reported a neutral influence of the pandemic in their physical health, while 56% of women considered that the pandemic negatively impacted their anxiety or mental health in relation to their work or home life. This could be a result of the stress generated by changes to work–home dynamics.

### Top 3 concerns about home life in response to the COVID-19 pandemic for women

46%

**WORK-LIFE BALANCE DIFFICULTIES**

32%

**CONFLICT OF WORK/FAMILY RESPONSIBILITIES**

28%

**CHANGES TO RELATIONSHIPS WITH PARTNER/FAMILY MEMBERS/CHILDREN**

Men were more likely to report neutral impacts both for their physical health (42%) and their anxiety levels (41%).

Men reported similar concerns to the changes to their work–life balance (45%) in response to the pandemic, but they were less concerned about the conflict between work and family responsibilities (21%) and changes to relationships (18%).

## What were the changes to their work circumstances?

When asked how negatively or positively their job was affected due to the COVID-19 pandemic, women rated these impacts as a 4.4 out of 10 on average, while men rated the impact as a 4.6 out of 10.

### Impacts of the COVID-19 pandemic for jobs for women


Women who experienced restrictions to accessing the workplace and who were working from home were more likely to report increased workloads and reduced productivity (average of 46%). Of the 33% of women who reported increased workload due to the pandemic, 65% are on permanent contracts and 40% are mid-career.

### The top 3 changes to income and workload for women in STEM as a result of the pandemic

33%

**INCREASED WORKLOAD**

30%

**DECREASED PRODUCTIVITY**

12%

**DECREASED INCOME**

Men reported the following changes to their income as a result of the pandemic: 31% increased workload, 27% decreased productivity and 11% decreased income. It is important to highlight that 12% reported an increase of their productivity (compared to 10% of women).

# Story contributions

A total of **20 stories** were received, submitted by 17 people, from 9 economies including Australia, Bangladesh, Chile, Colombia, India, Pakistan, Peru, Singapore and Canada.

Unlike the survey, which was anonymous, the call for stories offered contributors the opportunity to include their names and affiliation in this project, or to remain anonymous. Their full stories are included in the Appendix.

The stories provided deeply personal accounts of women's careers in STEM before and during the pandemic. Women from throughout Asia, the Pacific and the Americas contributed their voices to the study and reported strikingly similar experiences in navigating their way through their careers and the pandemic.

The overwhelmingly central theme emerging from the stories was the difficulty women in particular face in balancing professional and domestic responsibilities as a result of the COVID-19 pandemic. Many of these women live in social and cultural situations in which it is typically the woman's role to take care of domestic and caring responsibilities. The closure of schools and the necessity of home schooling of children was especially problematic for women who had to take on the role of teacher in addition to those of mother and STEM professional.

With most women working from home due to lockdowns, the conflation of domestic and professional roles presented several problems common to most story contributors.

**The common themes across many of the stories included:**

- balancing domestic and professional responsibilities
- an increase in working hours
- the positives in working from home
- uptake in ICT use and application to connect and work.

Overall, they experienced an expansion of 'working hours' as their usual office hours were interlaced with hours attending to domestic duties such as childcare and care of older people, supervising schooling at home and various other household duties. While some found this beneficial and appreciated the increased flexibility and control over their work routines, others found meeting performance goals in their professional life difficult.

Some noted that this difficulty had the undesirable effect of slowing their career progress. This latter point is of particular importance where male STEM workers can continue to work relatively unburdened by domestic duties. Thus, the pandemic has exacerbated existing gender imbalances.

While making note of the inequalities, and the difficulties they faced pre-pandemic, most of the story contributors maintained a positive outlook and managed to draw positives from the challenging contexts in which they found themselves.

# Online workshop

An online workshop was held on 4 May 2021 to engage with over 40 STEM professionals from across the world, including Malaysia, Indonesia, Mexico, Colombia, Taiwan, India, Chile, New Zealand, Canada, France, Nepal, Pakistan, Russia, South Africa, and the United States.

Influential advocates, such as Australia's Women in STEM Ambassador, Professor Lisa Harvey-Smith, participated in this event. Other partner organisations were represented by senior officials including AASSA, ISC, TWAS, GYA, the Asia Foundation and Academia Sinica, Taiwan. There were also representatives of APEC economies and story contributors who joined the workshop.

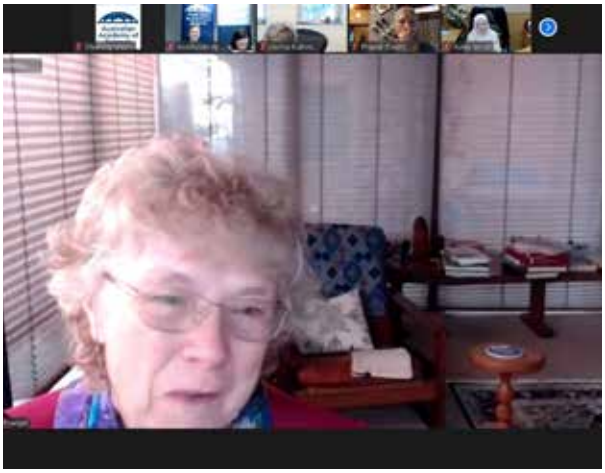
Professor Cheryl Praeger welcomed participants and opened the event on behalf of the project Steering Committee. Steph Gorecki Natik, General Manager of International and Astronomy Branch, DISER, also provided comments on the importance of this project through the lens of the Australian Government's Regional Collaborations Programme.

> "In 2019, the APEC forum endorsed the APEC Women in STEM Principles and Actions committed to increasing women and girls' participation. [...] They reinforced that women and girls' participation and leadership in STEM and the APEC region requires engagement and action from all pillars of the STEM ecosystem: governments, the private sector, academia and civil society."

The preliminary findings from the survey and stories received by the Academy were shared in this workshop.

Participants were also invited to provide feedback through break-out group discussions based on each of the four themes in the thematic framework, with discussion hosts then presenting their key findings from the break-out group discussions.

*Some of the online workshop participants*



*Professor Cheryl Praeger*


*Steph Gorecki Natik, General Manager*

The data revealed four themes that reflected the impacts of COVID-19 on women in STEM in the Asia-Pacific region. These are **professionals at work, challenged boundaries, social change and individual wellbeing**, and **Asia-Pacific and beyond**. These interrelated themes explore the challenges and impacts that STEM professionals have encountered as a result of the pandemic.

# Professionals at work

**Women in STEM have less secure employment at senior levels and are more susceptible to job loss due to the pandemic.**

**COVID-19 has exacerbated existing gender inequity and disparities in STEM, including productivity impacts and barriers to women progressing in their STEM career.**

**The reluctant departure of women from STEM careers due to social and economic changes is likely to have significant impacts for economies, societies and future scientific endeavours post the pandemic.**

## Framing this theme

The **Professionals at work** theme explores the various dynamics in play within the professional working contexts of women in STEM, and the ways inwhich these dynamics have been impacted by the pandemic. This includes issues such as workforce representation, job security, work arrangements and workloads, opportunities for advancement, collaboration, and professional relationships.

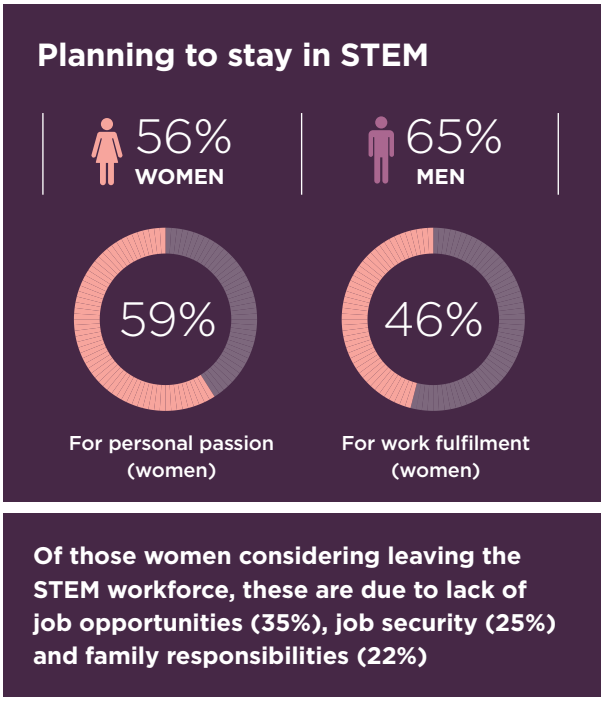



*Figure 2 Changes in the professional life of women in STEM*

> "[My] workload has increased hugely due to having to create content for online teaching, lack of any postgrad demonstrators due to university funding cuts and also having to cover the workload of academic staff who were made redundant through university cuts."
>
> Survey respondent

## Research insights

### IMPACT ON THE SECURITY OF WORK

According to the APEC Women and the Economy Dashboard 2017, women's representation among STEM graduates in the region is well below 50% and graduates from Engineering, Manufacturing and Construction was as low as 15% in some APEC economies[4]. In Australia, considered an advanced economy, only 13% of STEM-qualified occupations were undertaken by women in 2020[5].

As well as being disproportionately underrepresented in the STEM workforce in general, women are more likely to be in roles that are less senior and less secure. Among STEM women who are employed in the university workforce, 47% are casual workers[6]. Their male counterparts, on the other hand, hold more senior and permanent roles; many are 'bosses' occupying decision-making positions. In the area of biomedical science, according to *EpiMonitor*, women scientists are not only paid less on average, but they are also "promoted less, and less likely to receive grant funding, and are more likely to leave their careers than men"[7].

In Australia, levels of enrolment and participation of international students has encountered a dramatic downturn due to travel bans and border closures. This shortfall of international student fees is having a flow-on effect on university research budgets[8]. In fact, many higher education institutions in the region are facing financial difficulty and budget cuts.

These cuts have a direct impact on the hiring of research personnel and as a result could have the potential to slow research activities at universities[9]. In this circumstance, unsurprisingly, those who are in junior, part-time or non-permanent roles in the organisational hierarchy are more likely to be the first to lose their employment. In Australia alone it was estimated at least 7000 research-related academic staff would lose their jobs due to financial constraints in the higher education sector brought about by the pandemic[10].

A recent study[11] by the US National Academies of Sciences, Engineering and Medicine (NASEM) found shutdowns and social distancing measures aimed at combating the pandemic have disproportionately harmed the careers and wellbeing of US female academic researchers.

The survey of more than 700 respondents found that the pandemic had negatively affected female scientists' work–life balance, productivity and mental health, and during lockdowns, women tended to bear the brunt of family responsibilities, with 28% reporting an increased workload, and 25% reporting decreased productivity.

Issues surrounding decreased research productivity have more than just short-term impacts. In an environment in which research outputs stands "as a proxy for scientific merit"[12] and so is considered of greater value than teaching in a higher education context[13], any downturn in research outputs will have significant negative long-term career prospects.

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4 The APEC Women and The Economy Dashboard 2017 https://www.apec.org/publications/2017/09/the-apec-women-and-the-economy-dashboard-2017

5 Department of Industry, Science, Energy and Resources, "STEM-qualified occupations", https://www.industry.gov.au/data-and-publications/stem-equity-monitor/stem-qualified-occupations#stemqualified-occupations

6 E Johnston et al., 2020 "The impact of the COVID19 pandemic on women in the STEM workforce", Australian Academy of Science, 17 May 2020, https://www.science.org.au/covid19/women-stem-workforce

7 J Michelson, 2020, "Women In STEM Careers Could Lose During Covid-19—4 Steps to Help", *Forbes*, 22 July 2020, https://www.forbes.com/sites/joanmichelson2/2020/07/22/women-in-stem-careers-could-lose-during-covid-19---4-steps-to-help/?sh=4728bc1f3fef

8 N Zhou, 2020, "Australian universities to cut hundreds of courses as funding crisis deepens", The Guardian, 30 Sep 2020.https://www.theguardian.com/australia-news/2020/sep/30/australian-universities-to-cut-hundreds-of-courses-as-funding-crisis-deepens

9 J Radecki & RC Schonfeld, 2020, "The impacts of COVID-19 on the Research Enterprise: A landscape Review", 26 October 2020, *ITHAKA S+R*. https://apo.org.au/sites/default/files/resource-files/2020-10/apo-nid309096.pdf

10 F Larkins et al., 2020 "Impact of the pandemic on Australia's research workforce", *Australian Academy of Science,* 8 May 2020, https://www.science.org.au/covid19/research-workforce

11 National Academies of Science, Engineering, and Medicine, 2021, The Impact of Covid-19 on the *Careers of Women in Academic Science, Engineering, and Medicine*. Washington, DC: The National Academies Press. https://www.nap.edu/catalog/26061/the-impact-of-covid-19-on-the-careers-of-women-in-academic-sciences-engineering-and-medicine

12 E Gibney, 2017, "Teaching load could put female scientists at career disadvantage", *Nature*, 13 April 2017, https://www.nature.com/articles/nature.2017.21839#citeas

13 CY Chen, 2015, "A Study Showing Research has been valued over teaching in higher education", Journal of the Scholarship of Teaching and Learning, June 2015, Vol. 15, No. 3, pp 15-32. https://files.eric.ed.gov/fulltext/EJ1064434.pdf

Prior to the pandemic, women were already facing this situation due to higher "teaching and non-research-related administrative"[14] load than their male colleagues. Now, as women take on further impediments to their research outputs such as domestic chores, home schooling and caring responsibilities, they are more likely to experience a consequent downturn in their research output. As such, decreases in women's research productivity because of the pandemic are compounding the capacity for women to produce high levels of research outputs and will have an even greater damaging effect on their long-term career performance.

## UNEQUAL BURDEN

Arriving in a pre-existing context of gender disparity, COVID-19 impacts have also come with the "immediate threat"[15] of widening these disparities in STEM fields. Women were found to be more economically and socially vulnerable as a result of the COVID-19 pandemic. The capability of women to "absorb economic shocks is therefore less than that of men" as a UN policy brief published in April 2020 found, as well as noting the pandemic is "deepening pre-existing inequalities, exposing vulnerabilities in social, political and economic systems"[16].

The survey results show that respondents have a perceived decrease of their job security in the STEM workforce. Before COVID-19, the stability of the STEM workforce was positively scored by women at 7.2 on the scale of 1 to 10. This has come down to 5.3 during COVID-19, indicating a reduction in job security and stability. 43% of women respondents thought they would remain in the same or a similar role.

Despite facing the uncertainty of the pandemic, 56% of women respondents expressed a high or very high likelihood to stay in STEM (compared to 65% of men). The average weighted score showed a score of 8. In particular, 40% of respondents even provided the highest level of likelihood indicating that they would stay in STEM, with a score of 10.

However gender-based perceptions of the support STEM professionals experience hints at the underlying unequal support and pressure women face. The survey findings infer that men felt higher levels of support available by the current place of employment on every facet compared to women. Notably men and women differed significantly on equal opportunity policies (62% for women and 72% for men) and career advancement (50% for women and 64% for men) impacting their perceived benefits of staying in the STEM field.

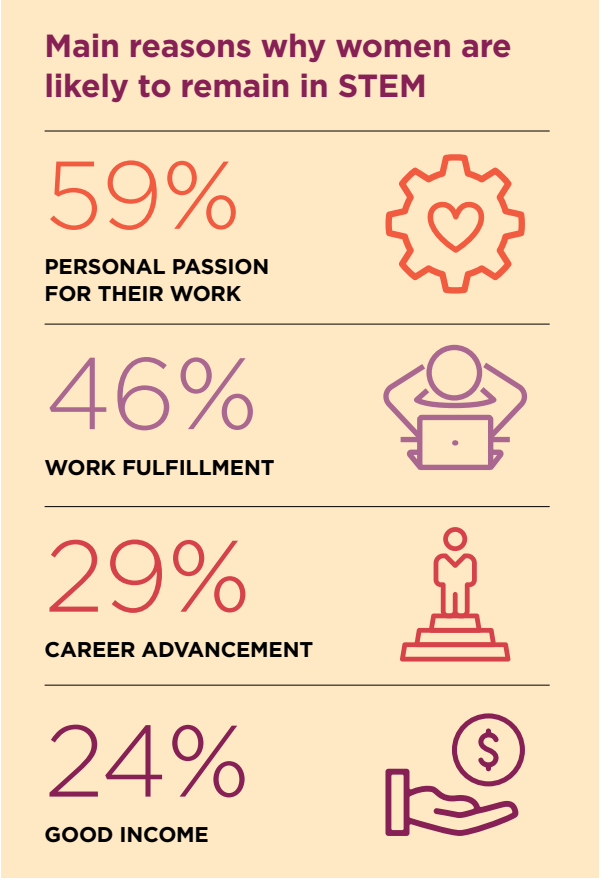


*Figure 3 Main reasons why women are likely to remain in the STEM workforce.*

14 E Gibney, 2017, "Teaching load could put female scientists at career disadvantage", *Nature*, 13 April 2017, https://www.nature.com/articles/nature.2017.21839#citeas

15 E Johnson et al., 2020 "The impact of the COVID19 pandemic on women in the STEM workforce", Australian Academy of Science, 17 May 2020, https://www.science.org.au/covid19/women-stem-workforce

16 United Nations, "Policy Brief: the Impact of COVID-19 on women", https://www.un.org/sexualviolenceinconflict/wp-content/uploads/2020/06/report/policy-brief-the-impact-of-covid-19-on-women/policy-brief-the-impact-of-covid-19-on-women-en-1.pdf

Key reasons for staying in STEM for all respondents included personal passion (59%) and work fulfillment (46%) (Figure 3).

Respondents noted that if one day they had to leave STEM, it was believed that lack of job opportunities (36%) and the problem of job insecurity (25%) were likely to be motivating factors (Figure 4). This issue of workplace instability was a particularly strong concern for Australian respondents: both job insecurity (53%) and a lack of job opportunities (46%) are higher than the average.

51% of those who cited job insecurity as a reason to leave STEM are on casual or fixed-term contracts, while 48% of women who listed lack of opportunities as a reason to leave the STEM workforce are on permanent and/or ongoing appointment. 32% of women with caring responsibilities listed family responsibilities as a reason they would leave the STEM workforce.

An interesting inference from the survey results is that women may leave STEM due to biases and lack of opportunities to progress, which existed well before the pandemic, pointing to existing barriers to progression and retention for women in STEM.

Most people perceived that their work performance had been affected by the pandemic, with the weighted average score of 4.4 out of 10 (Figure 5). 60% saw the impact as mostly negative. Many comments on this issue were provided in the survey.

> **"Too demanding, overwork, heavy stress, too competitive"**
>
> **"Lacking support from leaders and management"**
>
> **"I am concerned that my area of research will not be supported given the new priorities of dealing with the COVID pandemic"**

The survey and workshop revealed heavy workloads, poor leadership, competing social interests, and exclusionary cultures or behaviour such as racism contributed to their negative experience in STEM workplaces.

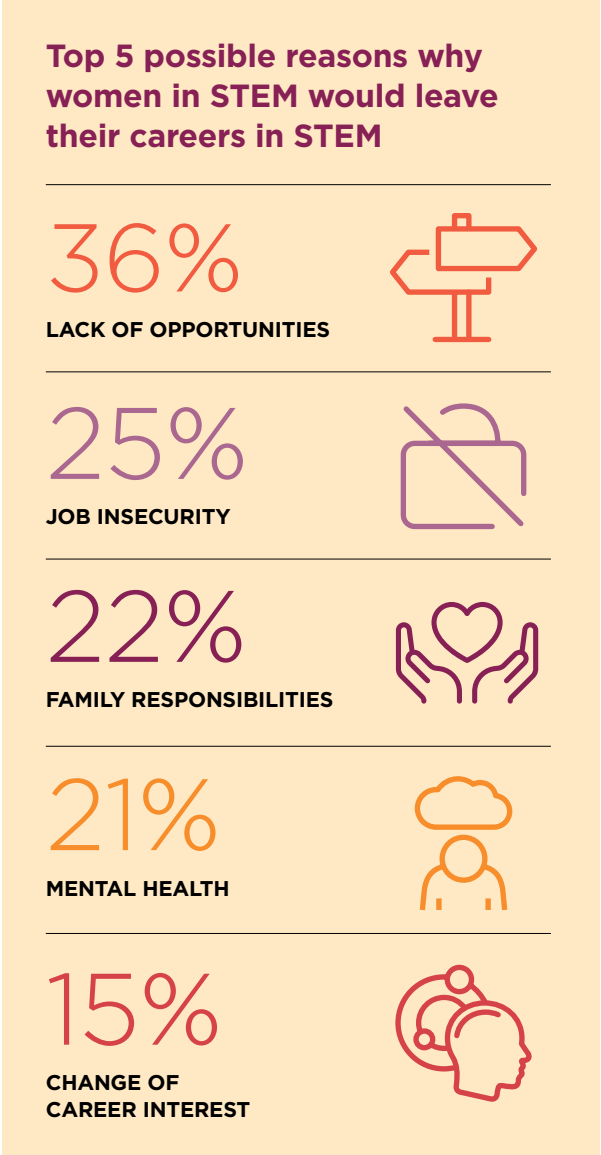


*Figure 4 Main reasons why women in the Asia-Pacific region would leave their careers in STEM.*

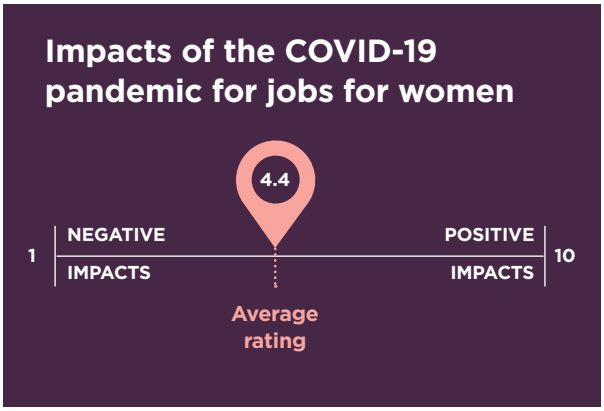


*Figure 5 Perceived impacts by women in the STEM workforce of the COVID-19 pandemic for the work.*

## GENDER BIAS AND DISCRIMINATION

Among Australian respondents, valuable reflections were provided with more detail regarding gender bias and discrimination in general.

> **"[Discrimination is] only a concern for people (women) experiencing [it]—leadership is not particularly concerned"**

> **"All of these (gender bias and discrimination) are issues, but the workplace was not concerned and has no report or action plan"**

> **"I'm not aware of any of the above, but I am conscious I might be unconsciously biased (as male)"**

Sometimes gender bias is accompanied with other biases such as race, religion, and cultural or linguistic discrimination. In these more complicated circumstances, bias can happen within the same gender. These intersectionalities create even more adversity during a shock like the COVID-19 pandemic.

> **"Racism towards Indigenous women and women of color from white people, including white women too"**

In some workplaces, discrimination occurred more often than normal in social settings. For example, one respondent reached out for help due to the high levels of discrimination in the hospital she works in.

> **"A strong bias exists against women having children, and discrimination when applying for jobs or taking leave. As a junior doctor I constantly experienced sexual harassment from many other staff—doctors, nurses, technicians etc."**

Regarding how gender equality is affected by the COVID-19 pandemic, almost half of the survey respondents perceived that the pandemic has created challenges for women (45%). "It worsens gender inequality" was also highly agreed upon (32%).

Nevertheless, some respondents see that the pandemic is "creating opportunities for men to better balance work–life commitments" (26%). This view is supported by all genders, not only men.

## IMPROVING CONDITIONS FOR WOMEN IN STEM

Potential solutions were identified to underpin improved working conditions and workplace cultures for women in STEM fields.

Approximately 60% of all survey respondents suggested flexible working arrangements, 44% referred to flexible measures of work productivity (e.g. publication records) and 38% supported collaborative work possibilities and professional social networks as key solutions.

| **Which options will better support women's working conditions in the STEM fields in your country/economy to cope with the COVID-19 pandemic?** | |
|---|---|
| Flexible working arrangements (e.g. work hours or workspace) | 60% |
| Flexible measures of work productivity (e.g. publication records) | 44% |
| Collaborative work possibilities and professional social networks | 38% |
| Formal guidelines for institutions/ employers in considering the impacts of the COVID-19 pandemic on work | 37% |
| Personal financial support (e.g. research grants) | 34% |
| Financial support for research organisations/institutions | 33% |
| Financial support for industry (including private business) | 17% |

*Mechanisms to support women's working conditions in STEM*

Other than the potential solutions above, we received many comments from respondents hoping to inform organisations and policies affecting workplace culture and organisation. These are explored in the concluding chapter of this report.

## AN ENDURING COMMITMENT TO STEM PROFESSIONS

**Despite facing uncertainty, 56% of women said they are likely to stay in the STEM workforce (compared to 65% of men)**

There is a clear commitment from many survey respondents to continue with a career in STEM, despite the persistent challenges that have been identified.

Some of the story contributors illustrated how they entered their chosen STEM fields. In general, role models like parents, grandparents and teachers at school played a key role in developing their interest. Natalia Indira Vargas-Cuentas from Peru, for example, was particularly encouraged by her father, who taught her to fix electrical appliances in the house when she was a little girl.

*Natalia Indira Vargas-Cuentas*

In a story from India, Dr Sandeep Kaur-Ghumaan's parents suffered hardship, and without having the opportunity to go to school themselves, her parents supported the children to pursue education. Sandeep thus learnt science through school and role models in society. This led her to her career as a professor in her area.

These journeys of becoming STEM professionals are inspiring. It is also important to reflect on the the current situation now that they have entered the STEM workforce.

*Dr Andrea Cristina Paula-Lima*

Dr Andrea Cristina Paula-Lima from Chile was always a top student. She received a scholarship for her PhD, and fellowship as a postdoc. However, after entering her career, she had difficulty receiving her first grant and is now still struggling to run her lab. In her society, 70% of the grants are given to men. She does not have the same opportunities as men do. "I am just not seen as good enough to compete with those talented men," she said. During the pandemic she has spent most of her time helping with her children's homework.

Another story is similar. Despite both men and women being equal in the education system, one story contributor's workplace has been "taken over by male colleagues". She and her female colleagues are frontline educators who care about the next generation's education. By contrast, their male managers know little about higher education. "They care more about personal achievement and prestige instead," she observed.

These examples show that gender hierarchies still exist today. The corresponding power relations, however, seem to persist even in more senior levels of the workplace where women face gender-based inequality throughout their career.

## A COLLECTIVE RESPONSE TO THE EFFECTS OF THE PANDEMIC

During the regional workshop, the discussion on this theme raised several astute observations about the immediate and long-term effects of the pandemic.

Not only focusing on women now working in STEM, the group also emphasised some strategies aimed at tackling the problems faced by early and mid-career researchers such as job security.

With the cyclical nature of research grants and funding, and significant financial losses in the research and higher education sectors, job insecurity is already a major problem and will only be exacerbated due to COVID-19.

The group also observed that the problems faced by STEM professionals in different areas of the world are similar. The extent to which people and economies have the capability to respond to the pandemic will depend on the interventions and solutions that they implement. Hence, sharing information about successes and failures could expedite the collective recovery from the pandemic. As suggested during the workshop, ongoing collaboration and learning from people in different parts of the world are a path to identifying and developing solutions to the shared problems across the region.

The group also outlined a few initiatives that might have a positive impact on professionals at work. In a case in New Zealand, for example, fellowships or sponsorships were introduced aimed at addressing the different needs of diverse groups, including women[17]. Also, flexible measures of performance and work output were proposed as a possibility aimed at redressing imbalances in diversity.

Finally, the workshop also heard a call to ensure that, in order for organisations to meet the targets set, policies aimed at alleviating problems must be closely monitored and readjusted. This will enable organisations and sectors to understand what is working and what is not, and to reset the priorities as needed.

17 Graduate Women New Zealand, "Scholarships", https://gwnz.org.nz/scholarships/


*Workshop break-out group discussion led by Anna-Maria Arabia (Chief Executive, Australian Academy of Science)*

# How can the STEM ecosystem respond?

Individuals, organisations, communities and governments can each play a part in supporting STEM professionals, and the retention and progression of women in the STEM workforce.

The following actions have been identified by project participants as some of the ways to support professionals at work:

- Acknowledge that disparity and inequity of opportunity between genders existed before the pandemic.
- Develop baseline measures to understand diversity and inclusion within organisations and evaluate actions to see how progress is being made.
- Strongly support and lead organisational diversity, inclusion and equity frameworks across all levels.
- Retain and enhance existing diversity and inclusion strategies, including targets and quotas where they exist, and take intersectional approaches, not just those focused on gender.
- Develop flexible and inclusive workplace cultures.
- Consult regularly with employees on what's working and find out what support they need.
- Explore the role of specific interventions, like scholarships, that can address the needs of diverse groups.
- Support measures that increase the visibility of women in STEM and STEM pathways.
- Recognise that publications alone are not an effective measure of productivity and success in STEM, and use more flexible measures such as teaching, mentoring and collaboration opportunities.

# Challenged boundaries

**COVID-19 restrictions, such as lockdowns, quarantine and travel bans, have blurred the boundaries between work and home causing a wide range of impacts including widespread adoption of working from home.**

**Many women have experienced a substantial increase in caring responsibilities and domestic duties (33% of women and 28% of men according to the survey).**

**The overlapping of home and work spheres has had significant impacts on productivity and the capacity to produce research, as women in STEM face competing priorities.**

## Framing this theme

The **Challenged boundaries** theme explores the evolving interactions between work life and home life, where the pandemic has accelerated the experience of a new style of online or 'virtual lifeworld'. The key issues emerging from this exploration revolve around the challenges faced in navigating competing priorities and expectations, and the flow-on effects on productivity and performance.

### Top 3 concerns about home life in response to the COVID-19 pandemic

46%

**WORK-LIFE BALANCE DIFFICULTIES**

32%

**CONFLICT OF WORK/FAMILY RESPONSIBILITIES**

28%

**CHANGES TO RELATIONSHIPS WITH PARTNER/FAMILY MEMBERS/CHILDREN**

*Figure 6 Top three concerns about home life in response to the COVID-19 pandemic*

> **"While flexible working time arrangements largely make it more convenient for women to fit in their caring workload, it also allows them to be overworked as there are now greater expectations to attend work meetings late into the night."**
>
> Survey respondent

## Top 5 work circumstances affected by restrictions introduced in response to the COVID-19 pandemic for women

56%

**SWITCHED TO WORKING FROM HOME**

56%

**EXPERIENCED TRAVEL RESTRICTIONS**

51%

**EXPERIENCED RESTRICTIONS TO ACCESS THEIR WORKPLACE**

35%

**EXPERIENCED REGIONAL LOCKDOWNS**

33%

**ADOPTED NEW PROTECTIVE ITEMS AND EQUIPMENT AT WORK**

*Figure 7 Top five circumstances affected by COVID-19 restrictions*

# Research insights

### BLURRED WORK–LIFE BOUNDARIES HAVE BECOME WORSE THROUGH COVID-19

With the advent of technology and greater connectedness to work through devices, the separation between work and personal lives has become increasingly blurred in recent years. The impacts of COVID-19 and the widespread shift to work from home arrangements have caused the boundary between work and home to become even less distinct.

These impacts are felt as people adapt to manage their work responsibilities and personal lives and wellbeing, while parents and carers juggle work commitments with family responsibilities as well.

Even before the pandemic, women in many Asia-Pacific regions were doing three times more unpaid care and domestic work than men at the global level[18].

The issue of maintaining a work–life balance was indicated as the main area of concern with 46% indicating this in the survey responses (Figure 6). This number was higher for women with caring responsibilities (61%).

Some people also experienced a positive change in their work–life balance, as reflected by their comments:

> **"More time to spend with family ... it was great"**

> **"Flexible working is a real option for everybody and can be a way to balance work and home commitments, particularly by reducing travel time"**

> **"More time at home, less travel, better work-life balance"**

On the other hand, however, many respondents found it difficult to adapt to a blurred work–life boundary.

> **"Less time for myself, work longer hours, tired more often"**

51% of survey respondents had caring responsibilities and reported higher concerns about their work–life balance and managing work/family responsibilities (Figure 9).

18 P Burtt & N Shewandas, 2020, "Women and equality: The post-COVID challenge in the Asia Pacific", *Griffith University*, 10 August 2020, https://blogs.griffith.edu.au/asiainsights/women-and-equality-the-post-covid-challenge-in-the-asia-pacific/

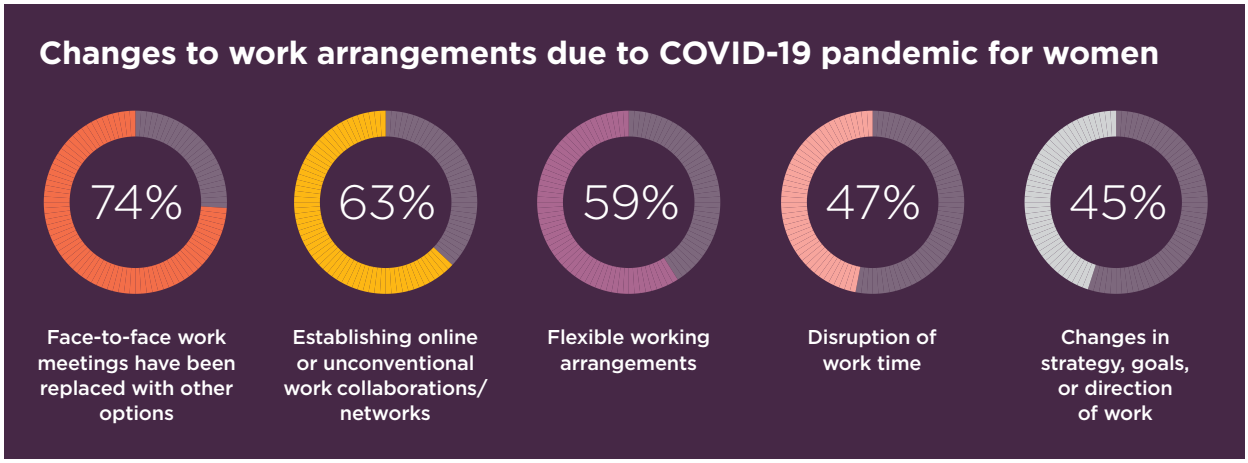


*Figure 8 Top five changes to work arrangements due to COVID-19 restrictions.*

## COVID-19 HAS INCREASED WORKLOADS FOR MANY STEM WORKERS

Heavy workloads have become a collective experience shared among many STEM professionals. Restrictions and social distancing have meant that online activity has brought people closer in a virtual way. This has become a 'new normal' in day-to-day life. Almost every story that was submitted in some way touched on an increased reliance on online activities for work and home life. However, online communication and online teaching should be distinguished as two different types of activity bringing specific opportunities and challenges for women in the STEM academic workforce.

Most people in the STEM workforce are familiar with online communication in the workplace, but its increased reliance became a challenge as well as an opportunity, in the context of the pandemic. A few stories reflected a positive view, such as saving a significant amount of commute time. "We were wasting a lot of carbon before", Jaana Dielenberg from Australia said.

For those who needed to conduct online teaching, however, it was a different story. Senior lecturer Dr Han Zhe from Singapore described how she struggled to learn new skills, develop materials, deliver the content, and conduct student assessment, when she suddenly needed to transition fully to online teaching.

Workshop group discussion also explored the issue of online teaching, with a particular emphasis on quality. While teaching online, it can be difficult to know if students are listening, or are even present for the class, if they have their cameras turned off. This might have further downstream consequences in terms of skills and expertise of students and impact their ability to find a job following graduation.

*"... now my teaching load has expanded to 50% of my work hours. I am not assessed on my teaching for my KPIs or promotion. Nor am I trained in teaching—I'm working in the dark; I am not the best person for this job and I'm unable to do my research that I have grants for. But I saw a lot of my teaching colleagues let go, which baffles me—they are expert educators, I am making it up as I go along"*

**" My workload skyrocketed"**

**"Massive increase in workload following redundancy round"**

**" My workload has increased three-fold"**

*Working from home has many advantages, including for pets. Photo courtesy of Jaana Dielenberg*

## WORKING FROM HOME INCREASED CARING RESPONSIBILITIES FOR WOMEN IN STEM

As shown in Figure 7, most women who responded to the survey experienced restrictions. Working from home (56%), travel restrictions (56%), and restrictions to workplace access (51%) were the most commonly shared experiences.

The movement towards more flexible work arrangements brought about by changed working arrangements during the pandemic may be a positive for men and women to maintain a work–life balance.

The closure of schools and day-care centres brought a substantial increase in caring duties for working women who are also mothers. This is also similar for families that include people who are unwell or living with a disability who require care.[19]

In many economies, especially in Asia, women are regarded as the main performer of domestic roles conducting childcare, housework, and care of older people. In many households women and men juggle their roles as working parents.

But policies that make it easier to transition to a part-time job or take leave may actually be weakening women's position in the labour market and their lifetime earnings potential, therefore widening gender gaps in pay.

This highlights the need for equal policies for women and men regarding flexible work arrangements.

## DECREASING PRODUCTIVITY FOR WOMEN COMPARED TO MEN DUE TO THE COVID-19 PANDEMIC

As the survey results indicate, face-to-face interaction decreased, whereas online work collaboration, changes in work strategies and flexible working arrangements were of great concern (Figure 8).

It has also been observed that there is a large decline of productivity and research engagement. For example, fewer articles were submitted for publication by female researchers in March and April 2020 compared to the preceding two months and in March and April 2019.

According to a medical preprint site, medRxiv, female first-author submissions appeared to have a sudden drop from 36% in December 2019 to 20% in April 2020, coinciding with the pandemic. Female scientists in general have encountered a sudden drop in terms of their academic engagement and research output compared to their male peers, in early analysis[20].

**"Different time zones [for virtual events] extended one's working hours".**

## ACTIONS THAT CAN SUPPORT WOMEN'S PARTICIPATION IN STEM

The workshop group discussing this theme developed important ideas surrounding the disjuncture between how work was carried out pre-pandemic and now. The group outlined some ways to respond, starting with the recommendation that funding agencies and governing institutions must move beyond tokenistic statements in addressing issues faced by women.

For example, as women and early and mid-career researchers often also have responsibilities as carers, especially of young children of school age, there is a greater challenge to manage and balance work and caring responsibilities.

It's important that leaders recognise these circumstances and involve people across all parts of an organisation's hierarchy in making decisions about positive and equitable changes to workplace culture and conditions. This suggestion indicates the potential of changing and challenging institutions to reformulate work and management practices during and beyond the pandemic. Essentially, by instituting equitable changes higher in the hierarchy, there is a greater chance these changes will flow throughout an organisation.

In the survey responses, almost 70% of women indicated they had paid leave available to them by their employer, while only 62% said they had equal opportunity policy, career and professional development. Only half indicated they had career advancement opportunities.

19 L Ruppaner & J Meekes, 2021, "Flexible work arrangements help women, but only if they are also offered to men", *The Conversation*, 8 March 2021,https://theconversation.com/flexible-work-arrangements-help-women-but-only-if-they-are-also-offered-to-men-155882

20 G Viglione, 2020, 'Are women publishing less during the pandemic? Here's what the data say", *Nature*, 20 May 2020, https://www.nature.com/articles/d41586-020-01294-9

## SOCIETAL CONDITIONS AND INDIVIDUAL EXPECTATIONS AROUND CARING RESPONSIBILITIES

For those with caring responsibilities, especially with children of school age, and family members with illness (including mental illness) to look after, the situation was even harder to deal with during the pandemic. A significant majority of women with caring responsibilities (71%) were working from home because of the pandemic, but only 56% of women with caring responsibilities had access to formalised flexible work arrangements with their employer. This highlights the discrepancies in the support mechanisms that women in STEM workplaces have access to.

**"Home schooling while working from home was particularly challenging".**

62% of women with caring responsibilities reported additional caring load because of the pandemic. This could be attributed to their strong involvement in online schooling and their opportunities to access the flexible working arrangements they need to manage these new responsibilities. Men who participated in the survey reported similar challenges: 48% of men indicated they have caring responsibilities of some kind, and of that group, 56% reported additional caring load due to the pandemic.

### Women in the STEM workplace with caring responsibilities

**51% of the women who participated in the survey identified they have some kind of caring responsibility. Of those:**

75%
**CARE FOR SCHOOL-AGED CHILDREN**

32%
**CARE FOR ELDERLY RELATIVES**

63%
**ARE ON PERMANENT/ ONGOING POSITIONS**

62%
**REPORTED ADDITIONAL CARING RESPONSIBILITIES AS A RESULT OF THE PANDEMIC**

61%
**ARE CONCERNED ABOUT THEIR WORK-LIFE BALANCE**
Compared to 46% of all women

71%
**WERE WORKING FROM HOME AS A RESULT OF THE PANDEMIC**
Compared to 56% of all women

56%
**OF WOMEN WITH CARING RESPONSIBILITIES ABLE TO WORK FLEXIBLY**

76%
**SAID FLEXIBLE WORKING ARRANGEMENTS WOULD SUPPORT WOMEN'S WORKING CONDITIONS IN STEM**

*Figure 9 Impacts of COVID-19 for women with caring responsibilities.*

## CHALLENGED BOUNDARIES


*The workshop breakout group discussion was led by Professor Prajval Shastri*

# How can the STEM ecosystem respond?

Individuals, organisations, communities and governments can each play a part in supporting women in STEM to navigate challenged work-life boundaries which may have been exacerbated by the pandemic.

The following actions have been identified by project participants as some of the ways to retain women in the STEM workforce:

- Deepen understanding and awareness of the impact of increased online engagement on work and personal lives.
- Ensure digital accessibility and support is available to all.
- Involve people across all parts of an organisation's hierarchy in making decisions about positive and equitable changes to workplace culture and conditions.
- Normalise flexible work practices by making them available to all genders.
- Provide accessible and affordable quality childcare and early learning support.
- Provide adequate paid parental leave, for all parents, regardless of gender.
- Support the development of new skills and capability in online teaching and collaboration.

# Social change and individual wellbeing

**Mental health has been impacted by isolation due to lockdowns, constantly managing competing priorities, increased workloads, and lack of opportunities to switch off. Accessible, available and affordable mental health services and supports are critical now, and beyond the pandemic.**

**Individuals' opportunities to feel a part of their community and access their support networks have been affected.**

**Women with caring responsibilities and those who reduced their working hours have been particularly affected by the pandemic.**

## Framing this theme

The **Social change and individual wellbeing** theme explores the nexus between the wider social changes emerging from the pandemic and the deeply personal impact that these changes are causing for women working in STEM.

> "Lack of down-time [has been a challenge]. My partner and I are constantly working, as 'flexible' has come to mean 'always on'. As a result, we are both close to burnout."
>
> Survey respondent

## Research insights

### MENTAL HEALTH CONSIDERATIONS IN AN UNCERTAIN WORLD

Against this backdrop of uncertainty, insecurity and change of working context, the survey showed that 56% of women said the pandemic negatively influenced their anxiety or mental health in relation to their work or home life.

COVID-19 is creating a situation where women in STEM fields might be more marginalised. Going beyond its impact on individuals, greater levels of social change have also occurred. The individual's experience of and interaction with their world is increasingly virtual. It encompasses a wide range of day-to-day activities, including distance education, telehealth, online entertainment, digital and-contactless services and so on. Traditional face-to-face activities such as classroom teaching have been transformed into online education[21].

Partially because women in STEM are generally less senior in organisational hierarchies, it is mainly women who "led the early adoption of online study, spending more time developing materials and resources, and taking on extra hours, to make up for the loss of casual staff, as well as performing mentoring and caring roles at a time of particular stress"[22].

### SAFETY AT HOME

Along with heightening economic and mental health pressures, and restrictions on movement, many women are not only vulnerable at work but also vulnerable at home with family and domestic violence being real and challenging issues facing them.

In Malaysia, its crisis hotline, Talian Kashi, has received a 57% increase in calls from vulnerable women since the lockdown, in which domestic violence was one of the main issues raised.

Similarly, in Indonesia, legal service organisations received a threefold increase in the number of reported domestic violence cases two weeks after work from home and stay at home orders were imposed[23]. In Australia, the number of victims of family and domestic violence related sexual assault increased by 13% in 2020[24].

It is not insignificant that 30 women and 6 men respondents disclosed they had concerns for their safety at home due to the conditions created by the pandemic, together with individual comments in the responses.

### CHALLENGING EXPECTATIONS AROUND WOMEN'S ROLES IN SOCIETY

The workshop group discussing this theme raised valuable points regarding how women are working at the intersection of gender roles and work.

In many of the sociocultural contexts they noted, there is the additional burden of social expectations around women's caring roles for children and families in general. Home schooling, for example, has indicated a shift in women's role from that of carers to educators. This kind of extra responsibility must be accommodated in any initiative aimed at addressing issues faced by women. Society should continue to educate men and boys to take household responsibilities.

The group also discussed positive impacts on the ways in which work in STEM has developed because of the pandemic. For example, it was noted that there were now more opportunities to invite a diverse array of seminar speakers. Also, opportunities for professional development have arisen with new techniques and through various digital tools. At the same time, however, these commitments and activities are highly demanding.

An important point raised by the group relates to the problem of isolation, along with the increasing phenomenon of suicide. Its negative impact on our society and individuals is profound if the issue is neglected. The group recommended the urgent development of flexible measures to suit the needs of different individuals.

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21 J Radecki & RC Schonfeld, 2020, "The impacts of COVID-19 on the Research Enterprise: A landscape Review", 26 October 2020, *ITHAKA S+R*. https://apo.org.au/sites/default/files/resource-files/2020-10/apo-nid309096.pdf

22 E Johnston et al., 2020 "The impact of the COVID19 pandemic on women in the STEM workforce", Australian Academy of Science, 17 May 2020, https://www.science.org.au/covid19/women-stem-workforce

23 N Setianto, 2020, "The disproportionate effect of COVID-19 on South-East Asian Women: Case studies from Malaysia and Indonesia", *Australian Institute of International Affairs*, 06 May 2020, https://www.internationalaffairs.org.au/australianoutlook/the-disproportionate-effect-of-covid-19-on-southeast-asian-women-case-studies-from-malaysia-and-indonesia/

24 Australian Bureau of Statistics, 2021, "Family and domestic violence sexual assault up 13%", Media release, https://www.abs.gov.au/media-centre/media-releases/family-and-domestic-violence-sexual-assault-13

## SOCIAL ISOLATION AND FAMILY IMPACT

The separation from close family members living in other countries has been challenging. This has been a collective experience for migrant people in particular.

Within families, one of the story contributors, Ershad Jan Chowdhury of Bangladesh, caught the COVID-19 virus but thankfully recovered well. However, he lost many relatives and friends to the virus and experienced a hard time in his country.

As Ershad observed, the economic crisis impacted both individuals and society. To survive, people have no choice but to go out and try to find work to buy food, even when they are at risk of death. While the virus can be transmitted to anyone, it can affect people differently depending on the social-economic status of the population and access to resources in their economy.

In another story, the impact of death was shared by Meghmala Sheshrao Waghmode from India. She describes that in her society, life and death rites and rituals are significant parts of life—from birth, weddings and funerals—as they contain deep personal meaning.

During the pandemic, however, dead bodies were buried under surveillance by the authorities, sometimes even without significant family members present.

Meghmala did not elaborate further. Nevertheless, she provided her observation that "this is the time where we need to follow science and not the tradition".

These stories demonstrate how the pandemic has challenged social and cultural norms.

**"Mental health impacts—disconnected from family, friends and regular activities."**

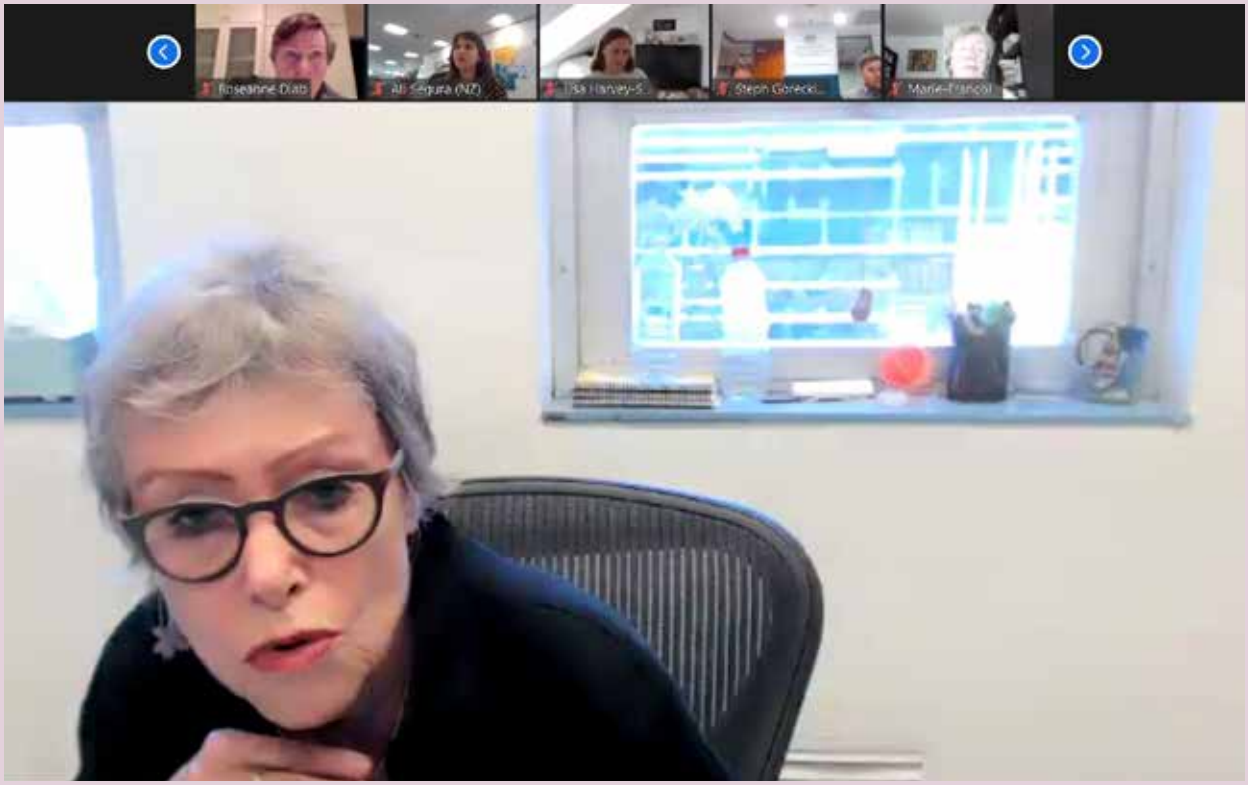
**"Living alone—nobody to see or talk to regularly."**

**"Worrying about family overseas"**

*" I still remember... when lockdowns were going on, many poor didn't have any jobs; they were begging door to door. We heard their touching appeals almost all day from morning to night. We tried to help people within our capacity by providing money to the people who used to work around us, also distributed some money or food in the community from our family, however, those were just a drop in the ocean of needy people. So, at times people broke the law and came out of the lockdown situation. They started running business, work and life became normal with all the risks of being affected by corona and subsequent deaths."*

Ershad Jan Chowdhury, Bangladesh

*Mr Ershad Jan Chowdhury and family*



*The workshop breakout group was led by Professor Halina Rubinsztein-Dunlop*

## How can the STEM ecosystem respond?

Individuals, organisations, communities and governments can each play a part in supporting individual wellbeing in a time of significant social change which has been brought about by the pandemic.

The following actions have been identified by project participants as some of the ways to support individual wellbeing:

- Acknowledge that individual health and wellbeing are priorities and there is a need for support.
- Ensure access to mental health support and actively seek to understand the gaps.
- Take flexible approaches to better respond to individual circumstances and support their mental health.
- Explore and develop collaborative work possibilities to build networks to reduce isolation.
- Establish and support professional social networks.
- Offer flexibility and extension where possible for grant applications and research deliverables within grants, that recognise the specific impact of the pandemic on women in STEM.

# Asia-Pacific and beyond

**This is a global pandemic which has led to the rise of common social changes across all economies and as such global solutions will be required.**

**People from different parts of the Asia-Pacific region shared different perspectives of capacity in their economy to respond to negative impacts, for example disparities between access to digital technologies, will impede equal recovery across the region.**

**Regional strategies, frameworks and collaboration are needed to find solutions to health, social and economic challenges now and in the post-pandemic recovery, including addressing marginalisation and disadvantage facing women.**

## Framing this theme

The **Asia-Pacific and beyond** theme applies regional and global lenses to the issues identified by the research. There are common social changes and challenges that extend to all populations due to the global pandemic and there is disparity between places to respond, so a corresponding need for regional opportunities to respond and collaborate is critical.

> "Women in every part of the world are sharing similar problems... [we have] a real desire to see how we can help each other by sharing some of the solutions that might be adopted in one country... can be implemented in another."
>
> Workshop discussion

## Research insights

### A REGIONAL PERSPECTIVE ON STEM WORKFORCE PARTICIPATION

In STEM fields, the gender disparity across the workforce in the Asia-Pacific is prominent. As statistics show, in East Asia and the Pacific, less than a quarter (23.4%) of the STEM workforce are women. The number falls even lower in South and West Asia, where women represent only 18.5%[25]. In most Asia-Pacific economies, again, women are mainly part-time and casual workers[26].

During the pandemic, more women (53%) have seen their work hours reduced than men (31%), said a UN report *Unlocking the lockdown*. In South Asia, it is also estimated that approximately 25%–56% of women have lost their jobs[27].

The Asia Foundation[28] noted that the COVID-19 pandemic will exacerbate pre-existing unequal power relations in society.

For a long time in the Asia-Pacific region, "gender stereotypes and social pressures have been two key obstacles hindering female representation in the workforce"[29]. Women's domestic roles are seen as more important than their career development.

The COVID-19 pandemic, therefore, could "reverse the limited progress that has been made on gender equality and women's rights", said UN Secretary-General António Guterres[30].

42% of survey responses said the pandemic has worsened gender inequity at an individual level.

There are varying views on whether women felt they were marginalised or disadvantaged in their society in general (Figure 10).

In India, more respondents agreed that women have a marginalised social status. With the averaged weight score at 7.19, Indian women responded at a level of 7.62 score, whereas Indian men showed 6.36.

Interestingly, Australian respondents have a higher agreement that women are more disadvantaged. It is not only Australian women who rated this issue highly at 6.37, but also Australian men at a 5.68 level of agreement. Women's social status in Australia was perceived to be more disadvantaged than the regional average.

In Japan, the average rating was 6.4, while in Mexico it was 7.4. In both countries men and women reported similar levels of perceived marginalisation of women. In Indonesia, men perceived the margnialisation of women as much lower (2.6) than women (4.2).

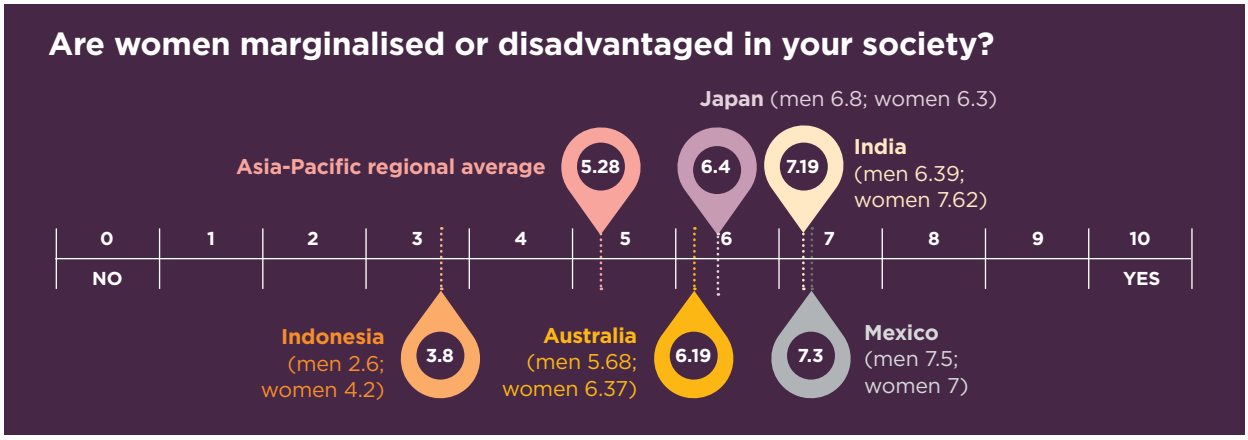



*Figure 10 Perceptions of marginalisation of women in selected Asia-Pacific economies*

25 L Ugwuegbula, 2020, "STEM Gender Bias Cripples Asia-Pacific Regions", 14 February 2020, https://thediplomat.com/2020/02/stem-gender-bias-cripples-asia-pacific-region/

26 P Burtt & N Shewandas, 2020, "Women and equality: The post-COVID challenge in the Asia Pacific", *Griffith University*, 10 August 2020, https://blogs.griffith.edu.au/asiainsights/women-and-equality-the-post-covid-challenge-in-the-asia-pacific/

27 *Ibid*.

28 E Pennington et al., 2020, "Funding the Frontline: Rapid Response to the Gendered Impacts of Covid-19 in Asia", *The Asia Foundation*, 29 April 2020. https://asiafoundation.org/2020/04/29/funding-the-frontline-rapid-response-to-the-gendered-impacts-of-covid-19-in-asia/

29 P Burtt & N Shewandas, 2020, "W omen and equality: The post-COVID challenge in the Asia Pacific", *Griffith University*, 10 August 2020, https://blogs.griffith.edu.au/asiainsights/women-and-equality-the-post-covid-challenge-in-the-asia-pacific/

30 T Burki, 2020, "The indirect impact of COVID-19 on women", *The Lancet*, Vol 20, August 2020, https://www.thelancet.com/journals/laninf/article/PIIS1473-3099(20)30568-5/fulltext

## DIGITAL AND SOCIAL INFRASTRUCTURE, AND EQUALITY OF ACCESS

As the stories submitted to this project showed, there are different levels of social and economic infrastructure between economies and, in turn, the capacity of each to cope with the pandemic. Meghmala Sheshrao Waghmode, from India, encountered financial difficulty arising from a reduction of salary due to lockdowns. She then started online teaching. In her observation she notes, "online education was possible only for the students with the facilities of internet and electronic devices. Due to a lack of these facilities, many students in my country could not avail themselves of online education." Given 63% of women survey respondents pivoted to online engagement for their work, online access is critical for ongoing engagement during the pandemic (refer to Figure 7).

By contrast, even prior to the pandemic, Jaana Dielenberg from Australia had been mainly working remotely. This work capacity has been enabled by high levels of infrastructure development such as stable internet, and she lives in a state of reasonable wellbeing having access to good electronic devices and with the financial ability to pay the bills beyond the level of her basic needs.

While the pandemic has highlighted an urgency for online connectivity, lack of access to digital services and infrastructure could exacerbate inequalities between economies in the region in the recovery period.

The United Nations identified that nearly 52% of the Asia-Pacific region's 4.3 billion people as being 'offline' as such, are denied access to such many of the technological innovations used to contain the pandemic and mitigate its impact (such as scaled-up testing, contract tracing and mapping)[31].

The capacity to recover from the pandemic's economic and social consequences will also be impeded in economies with limited digital connectiveness.

The UN Women report *The COVID-19 Outbreak and Gender: Key Advocacy Points from Asia and the Pacific* highlights how the pandemic has further limited access to women's health services as resources are diverted to address COVID-19, as well as ways pandemics reduce women's economic activities. It outlines ten specific strategies that economies can take[32].

The capacity of communities and individuals to adapt to the greater reliance on online education differs between economies. "Education… is the pillar of the nation", noted Sheshrao Waghmode, reflecting on the observation that as education shapes a society in the long term, the success of online education is dependent on the extent to which a society is ready to adapt and have access to the digital technologies and connections required. Different levels of social infrastructure eventually will enlarge the socioeconomic gap between the poor and the rich at the global level, where online education is involved. Access to education, either online or otherwise, will shape the regional recovery and understanding these disparities will be important for the Asia-Pacific as a region, and as individual economies.

## A GLOBAL CRISIS NEEDING GLOBAL SOLUTIONS

In another story, issues of travel bans and international border closures were highlighted. Today, as people have stopped travelling for most occasions (such as work, education, family reunions and vacations), international voluntary work has also come to a halt. Dr Eva Cheng from Australia described her engagement with a volunteer team *Feto Enginhera (Women in Engineering in Timor-Leste*) in 2019. The pandemic has unfortunately ceased her voluntary activities. She drew observations from the situation with her deep reflection: "What we learnt from COVID-19 is how inequality compounds to widen gaps in access to basic services, education and opportunity".

The workshop group discussion on this theme raised the point that some economies have a high proportion of highly skilled workers who are now returning home due to international border closures, increasing opportunities for

31 United Nations, "Bridging Asia-Pacific 'digital divide' vital to realize tech benefits", August 2020, https://news.un.org/en/story/2020/08/1070502

32 UN Women, *"The COVID-19 Outbreak and Gender: Key Advocacy Points from Asia and the Pacific"*, https://asiapacific.unwomen.org/-/media/field%20office%20eseasia/docs/publications/2020/03/ap-giha-wg-advocacy.pdf?la=en&vs=2145

*Dr Eva Cheng with volunteer team Feto Enginhera (Women in Engineering in Timor-Leste)*

entrepreneurial development. As workshop participants noted, people with high qualifications, such as PhDs, are returning to a situation where there are limited STEM jobs available domestically, and it is hoped they may take this opportunity to turn their expertise to developing their own business. In doing so, this might enable some lower-level graduates the opportunity for jobs rather than being drawn into the 'gig economy' in areas not related to their fields of study.

The pandemic represents a global crisis that will require **global solutions** to meet the existing and arising social and economic challenges.

Recent data from the OECD demonstrate economic recovery is likely to remain uneven and dependent on the effectiveness of vaccination programs and public health policies, with some economies recovering much faster than others[33]. For example, South Korea and the United States are reaching pre-pandemic per capita income levels after about 18 months, while Mexico could take between between three and five years.

Regional solutions to the distribution of vaccines, sharing medical knowledge and equipment, and our consideration of approaches to improving the STEM workforce offer opportunities to build a stronger Asia-Pacific region. Gender-inclusive policy settings, particularly in the STEM and innovation areas, are key to creating the conditions needed for a sustainable economic recovery from the pandemic that benefits all of society[34].

Beyond the economic recovery, global efforts to advance gender equity are more critical than ever. Efforts through the Generation Equality Forum[35]—a civil society-centred, global gathering for gender equality, convened by UN Women and co-hosted by the governments of Mexico and France—has the aim of securing a set of concrete, ambitious and transformative commitments to achieve immediate and irreversible progress towards gender equality.

The Forum will seek to highlight that, despite the commitments to global gender equality made in the *UN Beijing Declaration of 1995*[36], not a single country in the world has achieved gender equality. The Forum acknowledges that women's rights are at risk of rolling back further because of the COVID-19 crisis— due in part to heightened poverty and risks of gender-based violence.

Efforts by all UN member states to progress the 17 *Sustainable Development Goals* (SDGs) and 169 targets, including Goal 5 which seeks to 'achieve gender equality and empower all women and girls', must also remain a priority to achieve the targets by 2030[37].

The seventh edition of UNESCO's *Science Report 2021* reiterates the importance of the progress towards these goals—dedicating an entire chapter of the report to gender inequities in STEM[38].

*School outreach capacity-building workshop. Feto Enginhera*

33 OECD, 2021, "OECD -Global prospects are improving but performance diverse strongly across countries", *OECD*, Date accessed on 05 June 2021, https://oecd.org/economic-outlook on 05 June 2021, https://oecd.org/economic-outlook

34 OECD, 2021, "Towards gender-inclusive recovery", 19 May 2021, https://www.oecd.org/coronavirus/policy-responses/towards-gender-inclusive-recovery-ab597807/

35 The Generation Equality Forum, 2021, Date accessed on 5 June 2021, https://forum.generationequality.org/

36 United Nations Entity for Gender Equality and the Empowerment of Women (UN Women), 2015, "Beijing Declaration and Platform for Action, Beijing +5 Political Declaration and Outcome", Date accessed on 5 June 2021, https://www.unwomen.org/en/digital-library/publications/2015/01/beijing-declaration

37 United Nations, "Transforming our world: the 2030 Agenda for Sustainable Development", https://sdgs.un.org/2030agenda

38 UNESCO, "Science Report 2021", https://www.unesco.org/reports/science/2021/en

## GLOBAL ISSUES, REGIONAL RESPONSE: WHAT CAN ASIA-PACIFIC DO AS A REGION IN THE WORLD?

### Regional strategies and frameworks

Beyond addressing immediate health and economic challenges, efforts to increase women's participation in STEM in the Asia-Pacific region are underway, recognising how this can accelerate innovation and economic growth in the region.

This includes the 2019 launch of the *APEC Women in STEM Principles and Actions*[39] (the Principles and Actions), a set of suggested principles and actions for encouraging women's participation in STEM. The Principles and Actions recognise the many barriers inhibiting women's ability to participate as innovators in the knowledge economy and compete on a global scale.

The private sector, academia and civil society institutions within the APEC region are encouraged to voluntarily adopt the principles and actions to support the advancement of women and girls in STEM fields.

The Principles and Actions include three focus priorities:

» Acknowledging women's critical role in the economy and the importance of their inclusion to developing innovations and technology, especially those used by women.

  - Actions that can support this principle include providing lifelong education, training and mentoring for women and girls in STEM; support for women-led businesses; and raising public awareness on the value of promoting women in STEM.

» Advocating for amplifying and showcasing the accomplishments of a diverse group of women in STEM as well as for increasing women's participation.

  - Supportive actions can include examining the gender disparity in leadership positions and collecting and sharing sex-disaggregated data related to STEM education and careers.

» Identifying and addressing the social, cultural and economic barriers facing women and girls in STEM.

  - Important actions include creating an enabling environment through interventions that are not limited to removing legal and regulatory barriers.

The opportunity of the Principles and Actions as a mechanism to identify and share best practices that commenced during the APEC Women in STEM Initiative launched in 2019, must be enhanced and continued. Leading science bodies are well placed to collate and curate best practices.

Between 2017 and 2019, the ISC led a project to develop *A Global Approach to the Gender Gap in Mathematical, Computing, and Natural Sciences: How to Measure It, How to Reduce It?*[40] with eleven scientific partner organisations.

The final report and published book reports on ways the project investigated the gender gap in STEM disciplines from different angles, globally and across disciplines, through a global survey of scientists with more than 32,000 responses; an investigation of the effect of gender in millions of scientific publications; and the compilation of best-practice initiatives that address the gender gap in mathematical, computing, and natural sciences at various levels.

The ISC project concludes that the gender gap is very real in science and mathematics, and presents methodologies, insights, and tools that have been developed throughout the project, as well as a set of recommendations for different audiences: instructors and parents; educational institutions; scientific unions; and other organisations responsible for science policy.

Further, ISC survey respondents highlighted that formal guidelines for institutions and employers in considering the impacts of COVID-19 on work would be helpful.

Common guidelines for organisations in the Asia-Pacific region could be developed to support the myriad of STEM organisations grappling with these challenges.

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39 Asia-Pacific Economic Cooperation (APEC) Secretariat, 2019, "APEC Economies Agree on Principles and Actions to Support Women in Science, Technology, Engineering, and Mathematics", *Asia-Pacific Economic Cooperation*, 15 Oct 2019, https://www.apec.org/Press/News-Releases/2019/1015_PPSTI

40 International Science Council, 2020 "A Global Approach to the Gender Gap in Mathematical, Computing, and Natural Sciences: How to Measure It, How to Reduce It?" https://gender-gap-in-science.org/work-packages/task-1/

The Australian Academy of Science currently leads a domestic strategy to maintain support for Australia's *Women in STEM Decadal Plan*[41] (a ten-year strategy to increase the participation of women and girls in STEM) by creating a network of STEM organisations who are champions of the plan[42] as well as creating a community to share best practice in gender equity activities. This approach could be applied in a similar way in the Asia-Pacific region, by inviting economies or STEM organisations to respond to and engage with the APEC Principles and Actions, creating regional networks and collaborations in gender equity.

The Athena Swan Charter[43] is a framework used to support and transform gender equality within higher education and research (HER) sectors. Established in 2005 to encourage and recognise commitment to advancing the careers of women in STEM, the Charter is now being used across the globe to address gender equality more broadly, and not just barriers to progression that affect women. Some economies have piloted the rollout of Athena Swan in their HER sectors, such as Australia, through the *Science in Gender Equity* (SAGE)[44] initiative.

**Draw on landmark national strategies that address gender equity in STEM**

A number of economies in the region have developed national strategies with a range of associated actions that seek to improve the participation of women and girls in STEM, including:

» in the United States through the 2020 National Academies of Sciences, Engineering, and Medicine (NASEM), *Promising Practices for Addressing the Underrepresentation of Women in Science, Engineering, and Medicine* which reviews the current state of knowledge of factors that drive underrepresentation of women in STEMM and provides an overview of existing research on policies, practices, programs, and interventions for improving recruitment, retention, and advancement of women in these fields.[45]

» in Australia, through the *Women in STEM Decadal Plan*, which outlines a ten-year strategy to address gender inequity in the Australian STEM system through six opportunity areas. The *Australian Government's Advancing Women in STEM strategy* responds to the decadal plan and aims to increase gender equity in STEM education and careers. The strategy envisions a society that provides equal opportunity for people of all genders to learn, work and engage in STEM.

» To achieve this vision, the government is leading and supporting action in 3 areas:

  - enabling STEM potential through education
  - supporting women in STEM careers
  - making women in STEM visible.

These national strategies may be helpful to inform further work across individual economies or within the region as a whole.

**Collaboration and professional social networks**

Survey respondents highlighted collaborative work possibilities and professional social networks could provide an important source of support, community and opportunities.

In collaboration with AASSA and IAP, the Australian Academy of Science is currently developing STEM Women Asia, an online searchable platform featuring women working and engaging in STEM in the Asia region. **STEM Women Asia** aims to increase the visibility of women in all areas of STEM and provide a valuable resource for promoting gender equity in STEM, by showcasing the breadth of scientific talent in the region. The platform will be launched in 2021 and will eventually enable thousands of women from a range of STEM disciplines to be offered exciting opportunities to progress their careers and personal capabilities.

This initiative presents an immediate, tangible support mechanism for women in STEM to connect and collaborate within individual countries, as well as across the region.

41 Australian Academy of Science, 2019, *Women in STEM Decadal Plan*. https://www.science.org.au/files/userfiles/support/reports-and-plans/2019/gender-diversity-stem/women-in-STEM-decadal-plan-final.pdf

42 Australian Academy of Science, "Women in STEM Decadal Plan Champions", Date accessed on 5 June 2021, https://www.stemwomen.org.au/champions

43 AdvanceHE, "Athena Swan Charter", https://www.advance-he.ac.uk/equality-charters/athena-swan-charter

44 Science in Australia Gender Equity, https://www.sciencegenderequity.org.au/

45 National Academies of Science, Engineering, and Medicine, 2020, *Promising Practices for Addressing the Underrepresentation of Women in Science, Engineering, and Medicine: Opening Doors*. Washington, DC: The National Academies Press. https://www.nap.edu/catalog/26061/the-impact-of-covid-19-on-the-careers-of-women-in-academic-sciences-engineering-and-medicine

*Workshop breakout group discussion led by Professor Asma Ismail*

## How can the STEM ecosystem respond?

This project has revealed both common and unique impacts of the global pandemic across different economies. Regional and global collaboration across economies by governments, organisations, communities and individuals has the power to bring about solutions that minimise the gendered impacts of the pandemic on the STEM workforce.

The following actions have been identified by project participants as examples of regional and global collaboration:

- Drive ongoing commitment and action to advance the APEC Women in STEM Principles and Actions.
- Recommit as economies and communities to the UN Beijing Declaration 1995 and SDGs and track progress on gender equity aspired to in these frameworks.
- Create opportunities to share best practice among economies in the region, including consideration of the International Science Council's initiative to address the gender gap in science and mathematics.
- Leverage existing domestic strategies that address gender equity in STEM and use them as a blueprint to extend their reach throughout the region.

# A call to action

**"The bottom line is, if anything happens that has a negative impact on academia, it's going to have an outsized impact on women. The one possible silver lining is that the pandemic is bringing these issues into focus."**

**Sherry Marts, career coach and consultant, Washington DC[46]**

Through a range of empirical evidence, this rapid research report has discovered some of the key current and emerging impacts of COVID-19 on women in the STEM workforce in the Asia-Pacific region.

While the pandemic may have exacerbated gender inequity in STEM, it will hopefully highlight these issues, many pre-existing, so that policymakers and others can take steps to address them. Some of these actions are outlined below. A list of issues identified through this project for further research is provided later in this section.

This report highlights that gender-based inequity continues to be a problem across the STEM workforce in the region in the eyes of many STEM stakeholders. Specific issues raised include attitudes to gender bias, the way women interact with their colleagues, and their colleagues with them, and issues with exclusive workplace and organisational cultures. Statistically, women are underrepresented in STEM and in STEM leadership, and when they are in STEM they are overrepresented in more junior roles and have more precarious working arrangements than men.

Prior to the COVID-19 pandemic, women in STEM fields were often already in more vulnerable positions. With the progress of the pandemic, economic crises have arisen and job insecurity has further increased. Given that women are often in more junior roles such as early career researcher, they have borne the brunt of a host of uncertainties such as a reduction in working hours and income, as well as job losses. At the same time, they are more likely to be responsible for caring roles and increases in domestic responsibilities, hindering productivity and capacity to work even online as they manage increasing workloads, deadlines, and the need to juggle work and household responsibilities. This all combines to jeopardise their continued participation in the STEM workforce, now and beyond the pandemic, with significant potential impacts to societies, economies and the future of science.

46 S Reardon, 2021, "Pandemic measures disproportionately harm women's careers", *Nature*, 29 March 2021, https://www.nature.com/articles/d41586-021-00854-x

# What you and your STEM ecosytem can do:

## To support professionals at work

- ☑ Acknowledge that disparity and inequity of opportunity between genders existed before the pandemic.
- ☑ Develop baseline measures to understand diversity and inclusion within organisations and evaluate actions to see how progress is being made.
- ☑ Strongly support and lead organisational diversity, inclusion and equity frameworks across all levels.
- ☑ Retain and enhance existing diversity and inclusion strategies, including targets and quotas where they exist, and take intersectional approaches, not just those focused on gender.
- ☑ Develop flexible and inclusive workplace cultures.
- ☑ Consult regularly with employees on what's working and find out what support they need.
- ☑ Explore the role of specific interventions, like scholarships, that can address the needs of diverse groups.
- ☑ Support measures that increase the visibility of women in STEM and STEM pathways.
- ☑ Recognise that publications alone are not an effective measure of productivity and success in STEM, and use more flexible measures such as teaching, mentoring and collaboration opportunities.

## To manage challenged boundaries

- ☑ Deepen understanding and awareness of the impact of increased online engagement on work and personal lives.
- ☑ Ensure digital accessibility and support is available to all.
- ☑ Involve people across all parts of an organisation's hierarchy in making decisions about positive and equitable changes to workplace culture and conditions.
- ☑ Normalise flexible work practices by making them available to all genders.
- ☑ Provide accessible and affordable quality childcare and early learning support.
- ☑ Provide adequate paid parental leave, for all parents, regardless of gender.
- ☑ Support the development of new skills and capability in online teaching and collaboration.

## To support individual wellbeing during social change

- ☑ Acknowledge that individual health and wellbeing are priorities and there is a need for support.
- ☑ Ensure access to mental health support and actively seek to understand the gaps.
- ☑ Take flexible approaches to better respond to individual circumstances and support their mental health.
- ☑ Explore and develop collaborative work possibilities to build networks to reduce isolation.
- ☑ Establish and support professional social networks.
- ☑ Offer flexibility and extension where possible for grant applications and research deliverables within grants, that recognise the specific impact of the pandemic on women in STEM.

## Across Asia-Pacific and beyond

- ☑ Drive ongoing commitment and action to advance the APEC Women in STEM Principles and Actions.
- ☑ Recommit as economies and communities to the UN Beijing Declaration 1995 and SDGs and track progress on gender equity aspired to in these frameworks.
- ☑ Create opportunities to share best practice among economies in the region, including consideration of the International Science Council's initiative to address the gender gap in science and mathematics.
- ☑ Leverage existing domestic strategies that address gender equity in STEM and use them as a blueprint to extend their reach throughout the region.

## Areas of further investigation

### ETHNOGRAPHIC DEPTH

Despite having received many good personal stories, a greater number of stories would provide a better picture of insiders' views. This qualitative data allowed us to look at specific and individual impacts. To understand the deeper underlying reasons behind peoples' choices and behaviour, there is a need for more fine-grained qualitative investigation to understand questions like why fewer girls follow STEM pathways compared to boys, as well as the crucial personal decisions different people make in grappling with the pandemic.

### FOCUS ON ENTREPRENEURS

The pandemic has created a severe challenge for STEM professionals in all areas including entrepreneurs. The circumstances they encountered were different from those who were employed in the workforce. How entrepreneurs overcame the financial crisis and maintained (or failed to maintain) their business, including the difficulties of retaining staff during lockdowns, would need to be explored further. In addition, the movement of STEM researchers into entrepreneurship and the gig economy due to a lack of job opportunities in STEM could be further explored to consider the impacts on economies, innovation systems and individuals. Further, the role and effectiveness of targeted development initiatives like Australian Government and other programs to advance women's economic empowerment, that includes supporting women in the market economy, could be further considered.

### GIRLS' EDUCATION

From the outset of this project, it has been understood that it is important to improve girls' education in STEM fields. However, due to the short timeframe of this project, it was not possible to incorporate girls' education in the project scope.

Research has found that, by the year 2030, almost 80% of jobs in Southeast Asia will require basic digital literacy and applied ICT skills[47]. Attainment of these skills will directly affect one's capacity to earn money. It therefore becomes an urgent need to provide these skills to vulnerable girls with the progress of the pandemic. This will also be more difficult if women are not represented widely in STEM as they have been forced to exit due to economic and/or social constraints, and there are limited role models and visibility of career pathways in STEM available to girls. The linkage between women in the STEM workforce and girls' education is the next step through which this report could inform policy relating to the STEM workforce.

### SCIENCE INCORPORATES SOCIAL SCIENCE

There have been new developments in cross-disciplinary collaboration in recent years, due to its cutting-edge potential in moving research beyond the confines of traditional engagement within the same discipline. However, science and social science have rarely bridged this divide. With the progress of the pandemic, however, social changes challenge old patterns, principles and even ethics that have shaped academic work for a long time. Research innovation should develop some non-conventional approaches to enable creative insights to understand and address rising social and economic challenges and harness opportunities.

47 S Reardon, 2021, "Pandemic measures disproportionately harm women's careers", Nature, 29 March 2021, https://www.nature.com/articles/d41586-021-00854-x

## IMPACT ON MEDICINE FRONTLINE WORKERS AND THEIR FAMILIES

Surveys and personal stories contained a strong message that people who worked in health settings such as hospitals had encountered a great deal of hardship during the pandemic.

Not only from the overwhelming workload, but discrimination within society had also arisen as people treated them as though they carried the virus everywhere. Medical practitioners and researchers in health settings experience workplace conditions and culture which is distinct from workplaces such as universities. A specific project focusing on the fields of medicine would be necessary to understand how these professionals have lived and worked through this critical time of pandemic.

## MENTAL WELLBEING

This project only partially touched on issues of mental wellbeing. Despite finding that mental health is an important issue of concern to many of the respondents, it was not possible to delve into the scale of the problem or possible solutions. Contributing factors such as social isolation and cultural norms were highlighted as key issues in which a multi-pronged research project could provide additional understanding and identify potential areas for further action. As one of our story contributors demonstrates, people from diverse backgrounds at all levels of STEM, from students to professionals, are struggling with mental wellbeing because of the pandemic, as are people from all walks of life, underlining the need for community-wide responses.

# Appendix

# Appendix: Personal stories

*Stories have been minimally edited by the Australian Academy of Science to improve clarity*

## Story from Dr Andrea Cristina Paula-Lima (Chile)

**Associate Professor, Universidad de Chile, Chile (Cell Biology)**

*Dr Andrea Cristina Paula-Lima*

I would like to share my experience to reflect how COVID-19 has impacted women in science. My story is neither the most successful nor the saddest reality. Still, I believe this story will illustrate that career advancement in the sciences is not necessarily based on meritocracy and to think that it is will not overcome women's obstacles to survive in academia. So here it goes:

My name is Andréa Paula-Lima; I am a Brazilian native living and working in Chile since 2007. Since my childhood, I was one of the top students in my class; what this means is that my academic skills were far superior to most of the men I had to interact with at that time.

Accordingly, I was selected to study through my high school years in a very prestigious institution where I obtained the title of Biotechnology Technician by the age of seventeen. Then I was ranked 4th to enter one of the best universities in Brazil (UFRJ) on course to a career in pharmaceutical science. In the first year of university, I joined a scientific laboratory where I was rapidly in charge of my own research line. I finished my undergraduate studies with two papers published in ISI journals. Then, I was ranked first in the PhD Competition, which allowed me to count on a fellowship to conclude my PhD thesis. With three ISI articles published as first author and a two-year-old daughter, I had a grand finale of my postgraduate studies.

Convinced that I wanted to pursue a career as a researcher, I moved to Santiago de Chile to start a new life adventure. Together with my daughter and furnished with a suitcase filled with the most important things that I could carry, we arrived alone in this country. In Chile, I also have had fantastic opportunities to develop my career. After publishing essential papers as a postdoctoral fellow, and having my second child, I obtained a position as Assistant Professor at the University of Chile, just three years after arriving in this country. I also had no difficulties getting my first grant project and starting my independent career in a new laboratory. I have had no problems obtaining students. We have been publishing constantly and I have won several prizes in recognition of my successful career.

After all that I have said, you must probably ask why I have been so explicit with my success. Despite my whole life of effort and talent, of being professionally equal or better than most of the men I have interacted with, I do not have the same opportunities. Let me be more explicit: today, despite all the good things I previously described about myself and my career, I am now struggling to sustain my lab and my students, while the most competitive grant in Chile is given to men in 70% of cases. This is still more serious if we consider that the government expenses in scientific research correspond to less than 0.4% of Chile's gross domestic product.

COVID is showing how scientists are relevant to society. Despite this fact, I have not obtained a Fondecyt grant for three consecutive years because my application has not been evaluated as good enough to receive funding, despite the fact that I have been invited to present my work at the most prestigious international meeting in my area; moreover, my CV is not considered good enough to compete with all these talented men. To make things worse, during the pandemic I have been spending far more time on housework than my husband. But take it easy! Before accusing my husband of sexism, you should know that he is a medical doctor about to have a serious burnout after a year of hard work with the pandemic situation. Is he guilty? Does he like to see his wife in this unfair housework situation? Probably not. But this is my actual situation,

which will indubitably impact my productivity in the following years and increase the already established gender gap. So, I sincerely would like to ask you, who are reading this narrative: Should I struggle to move my lab forward, or should I just give up this lost battle to wash the dishes? What is the place you would like to see me occupying after all? Do you think it is worthwhile to keep swimming against the tide? Should I continue to swallow my frustrations to get my students ahead anyway? Or do you believe instead that the best thing I can do is to spend my time with my children's homework? Questions like these, which are of concern to women and especially in crisis situations, have made several of them give up their professional ambitions. Doubts of this type have held back women's progress in the most diverse areas in human history. So I can assure you that nothing will stop me from resisting, despite it all.

## Story from Dr Anna Duwenig (Canada/Australia)

**Postdoctoral Fellow, University of Wollongong, Australia (School of Mathematics and Applied Statistics)**

Before the COVID-19 pandemic started, I had planned to move to Australia in April 2020, a month after defending my PhD thesis at the University of Victoria (UVic) in BC, Canada, to commence a 3.5 year fixed-term position as an Academic Research Fellow at the University of Wollongong (UOW) in NSW, Australia. As the Australian government closed the borders for non-citizens in late March 2020, I was unable to follow through with that plan and instead remained in Canada. With the help of my supervisor at UOW, I was allowed to start working remotely in April 2020. My position consists of 40% teaching, 40% research, and 20% governance.

Some context:

» A very similar story is true for my partner, who defended his PhD a month after me, commenced his postdoctoral position at a European university remotely in May 2020, and is to this day living in Victoria BC.

» I am working in pure mathematics in the field of Operator Algebras, which is 'infamous' for having only a small number of women; see https://arxiv.org/abs/1509.07824 . I know of multiple women in the field who have suffered some sort of harassment at work.

» Since August 2020, I have been a Board Member and Junior Mentor of the Operator Algebras Mentor Network (https://oamentornetwork.wordpress.com/) whose goal it is to retain women researchers, especially early-career, in the field of operator algebras.

*Beach in Wollongong, Australia*

*Beach on Vancouver Island, Canada.*

A brief overview of how the **pandemic has negatively impacted** my life:

» The Mathematics department at UVic generously gave my partner and me an office to share. As we are not allowed to use it simultaneously because of COVID-Health Policies and as we are "encouraged to work from private residences", I effectively **work from home** 90% of the time. Our apartment has no dedicated office, so I have been working from our living room with a non-ergonomic setup, leading to some mild physical problems.

» The **time difference** between my time zone (Pacific time) and my employer's time zone (Australian Eastern Time) ranges between 17 and 19h. Consequently, I sometimes work on Sundays and often late in the evening.

» Both home office and time difference blur the lines between 'work time' and 'free time', which has had a negative impact on my **work-life balance**.

» While I am generally comfortable navigating **technology**, it was difficult to quickly adjust most of my work habits to the remote conditions. For example, before the end of 2020, I had never taught a subject online before, let alone coordinate one. I had to relearn how to deliver content and enable participation from students, and I had to teach myself how to properly record and edit videos. This meant a steep increase in workload to keep up with the personal standards of teaching I had for myself in regular times.

» The **lack of day-to-day interaction**, both with students and with colleagues, has had an impact on my mental health that I did not anticipate. Fortunately, I had visited UOW in the past, so I already knew some people in the department that I was comfortable reaching out to when necessary. Nonetheless, I feel disconnected from what is going on at the university and am more overwhelmed than normal by seemingly routine tasks, often because of a lack of feedback that I would naturally get in face-to-face situations.

» As I am a **German citizen**, I am in Canada only as a visitor. At times, I am distressed about my status here; I have applied for a second visitor-record in January 2021, but I am not expecting to receive a decision until August 2021. Should the Canadian government decline my application, I would have to suddenly move back to Germany.

» Conversely, **emigrating to Australia** during my fixed-term position is expected of me when it becomes possible, so I also have to make plans to move to the exact other end of the world. In late May 2021, my first request for a travel exemption was declined by the Australian government.

The above impacts are mostly framed negatively, but there have also been some **positive impacts**.

» **My partner and I** were supposed to move to (very literally) opposing ends of the world for several years—instead, we had the opportunity to spend another whole year living together (and maybe beyond that).

» The region we live in was not hit hard by COVID-19. Our **personal day-to-day life** was not changed too much by restrictions, which I know is very different for many people in the world. We have been able to follow our regular fitness routine and see friends, albeit only outdoors.

» Due to my hard work in the past year, I have received a lot of **positive recognition** from my supervisor and colleagues at UOW, who appreciate that my situation is difficult. I am convinced that I have proven myself to be reliable even in difficult situations.

» My **supervisor** at UOW has been fantastic and invaluable. In our weekly 30-minute virtual meetings, he helps me navigate my situation, defuses any worries I might have, and generally gives me support. He has been very understanding of any difficulties I have had and has repeatedly extended a helping hand. If it were not for his constant efforts, I am certain the remote working situation would not have been bearable.

» Many **conferences and seminars** in my field of research were moved online. Especially before my teaching started in 2020, I used these to network with more people than I regularly would have by starting email conversations with experts whose talks I attended. I have also been given the opportunity to deliver several virtual talks in remote locations.

All things considered, I have been extremely fortunate, even if the 'negative impact' list might read as if I am not aware of that.

## Story from Professor Azra Khanum (Pakistan)

**Ex-Dean, Faculty of Sciences/visiting Faculty, PMAS-Arid Agriculture University, Rawalpindi, Pakistan**

In the early 1960s when I was in middle school, I was taking general science as one of my subjects. The way my science teacher started explaining science significantly enhanced my enthusiasm for the subject. It was in 9th grade when students were allowed to choose their subjects, so I opted for science but was told that I didn't have any choice at our school unfortunately, so I had to go for arts, the only choice. I did not become discouraged with this fact at all and around 8-10 students approached the school administration to try to change this. I must admit it was because of the guidance and favourable action of the school administration that the Education Department allowed our School to open Science for us too. This was my humble start with passion and love for science.

Thereafter, I never looked back and moved forward with my sheer interest, passion and commitment in Biological Sciences. I wanted to become a doctor but could not because of some unavoidable circumstances. I did my masters in chemistry with a heavy heart since no other opportunities were available at that time except getting a master degree in chemistry, botany or zoology. Though I never thought to become a teacher, however, an opportunity arose which allowed me to switch over from chemistry to biochemistry/molecular biology and my intuition guided me to grab it—the reason being that this subject was closer to what I had wanted to study. Thus, it was indeed a new opening which led me to develop my career and groom myself as a university science teacher and a scientist. Hats off to my parents, teachers and mentors to whom I will always be in debt.

Although I retired as a biochemistry professor and dean, Faculty of Sciences from Arid Agriculture University Rawalpindi, Pakistan in 2009 but one way or other, I am still active and my commitment and passion for teaching and research has not been lessened. Besides academia, I am also involved with national and international science organizations for enhancement of female participation in STEM. In this journey, I felt greatly blessed and cherished at one unforgettable moment when I lost my husband. I have no children either and I was totally lost but in few days, I found my strength and spirit back as students from all over the world provided me such an eternal impression that they are all with me like the Great Wall of China. I feel extremely proud to have this great profession which links us all.

Now comes another turning point in my life. The routine activities, in general, were going satisfactorily in all educational institutes including my university till the whole world, including Pakistan, was knocked out by COVID-19 in early February 2020 and the later global emergency was declared by the WHO. In line with the worldwide response, the Pakistan Government also closed down all educational institutions to curtail the spread of COVID-19 along with other measures like complete lockdown on 13th March 2020. As a result millions of teachers and students have been left in total chaos.

Since the higher-education sector in Pakistan is comprised of both public and private sector, universities are recognized by a government body, the Higher Education Commission, Pakistan (HEC). Thus, all universities were asked by HEC to start preparing their systems to be able to offer effective online teaching as a substitute for regular classes to ensure that education is not being affected during the COVID-19 pandemic. Universities, in general, were not prepared to take this assignment. Despite the fact HEC initiated and sponsored many projects in [since] 2011 such as eLearning, a digital library program, the Pakistan Education & Research Network (PERN), the Pakistan Research Repository (PRR) and a Campus Management System, they were not prepared. Because of the acquisition of this new technology in a short span of time, students and teachers both have faced several challenges as it was largely unfamiliar and untested in Pakistan.

*Tamgha-i-Imtiaz, a civil award bestowed to Prof. Dr. Azra Khanum in recognition of her outstanding services in the field of Science (Biotechnology) by Government of Pakistan, 2009.*

***Formal induction of Prof. Dr. Azra Khanum as Fellow, Pakistan Academy of Sciences, Pakistan, (2005) by Prof. Dr. Atta ur Rahman, President, Pakistan Academy of Sciences.***

*A glimpse of Biotechnology Laboratory, Department of Biochemistry, PMAS-Arid Agriculture Rawalpindi, Pakistan*

I also found myself scrambling and very much stressed with the realization of my shortcomings, and the million-dollar question now is, how I am going to cope with the present unwanted situation at this stage of my life; meaning in age group of 70 plus. However, this situation proved to be a blessing in disguise for me like millions of others. The first thing I did was get an upgrade on my desktop computer, laptop and smart phone with the required software and internet facilities for smooth running. In the meantime, the HEC and universities initiated training courses with provisions for mature age people teaching how to use e-learning sites such as Zoom, Google classroom, Microsoft teams etc. and WhatsApp. Gaining knowledge and acquiring experience provided me ample confidence and endurance to take online interactive classes from undergraduate to doctoral levels effectively and efficiently where you are not face to face. Thus I was facilitated for personalized learning for a variety of needs through high-tech and low-tech services.

Besides taking online classes, there was another obstacle for many to take care of student's online assessment and examinations in place of conventional ones. Based on HEC provided guidelines, I was compelled to learn different approaches for assessment. For example, one was an open book exam with the specified time period for submission of 2 to 24 hrs. I had to learn techniques to specifically design exam papers to minimize cheating and plagiarism. Others included oral exams, class presentations and assignments. However, the most difficult and cumbersome part of assessment was online paper checking. Going through the papers up and down and trying to keep the parity/uniformity in marking was a gigantic task indeed. Thereafter, online discussion on marked papers followed. On top of these, there was a need to take care of all those students who were joining online from far flung areas having connectivity problems since almost all activities were transformed to a digital format. In the digital world a two-hour lesson takes up to four to six hours of documenting and preparation. Furthermore, I have to be in touch with my students 24/7 to minimize a sense of isolation and to help them solve problems whatever and whenever encountered. That means our lives are engulfed by smart phone, laptop and desktop devices. One can imagine how much stress we all are facing, and education is just one of the aspects of the COVID-19 pandemic's impact on our lives.


*11th AASSA Regional Workshop on Gender Issues in Science Research and Education. Association of Academies and Societies of Sciences in Asia (AASSA) and Korean Academy of Science and Technology (KAST). Seoul, Korea, 2015.*

*Launch of Sri Lanka National Chapter OWSD 29th March 2018*

At this stage, if anyone asked me to rate my online experience during this duration, I will rate it semester wise as of spring 2020 a nightmare, fall 2020 as improved one and spring 2021 as a much better one. I am looking forward to coming out of this pandemic soon and starting our regular teaching and research with conventional as well as modern technologies we learnt during this most challenging period of our life. In fact that is how life drives with old-new experience and old-new beginnings without concern for what age group are you in. You know old is gold too.

## Story from Mr Ershad Jan Chowdhury (Bangladesh)

**Senior Supply Chain Professional and Researcher, Alumni, University of Melbourne/ Alumni Australia Award, Bangladesh (Humanitarian Operation)**

### COVID-19 Pandemic in My Simple Life

It was March 19 2020, when I last attended my regular office. On 20th I felt the symptoms of COVID-19 and was asked to go for a test. I was worried, because, even if I would be negative, I might be infected during COVID testing as many other possible positives would be around. The next day, when I reached the testing centre, I found as expected a crowd without physical distancing. However, fortunately everyone tested on that day at that centre was found negative. Countrywide lockdowns started soon after my recovery of illness in late March and since then I have been working mostly from home.

At the beginning of March 2020, we shifted house from Pallabi to Lalmatia suburb to avoid heavy traffic while travelling to and from my sons' school. But within one week of the move all educational institutions had closed their in-person learning platform. So my children had to take online classes from mid-March 2020.

We have been keeping ourselves confined at home for one year. We are spending record time on screens due to our official tasks, meetings, social interactions or entertainment...and thereby have developed problems like irritation and eye pain, changes in spectacles and headaches. Within this online year my elder child completed his IAL and started his bachelor degree; the youngest passed AS IAL and is still studying online for their IAL final. We lost many known faces, friends and relatives during this period and are still anxiously waiting to hear more sad news. This is really a horrific situation around us. We don't know what is the reality. Some people say COVID-19 will never go, some say this is nothing but a flu, others say 2022 will be crucial, some suggest to stay at home, some others encourage us to go out and mix with people. We are not sure whom to follow, and we can't trust anyone now, not even the WHO or the Government. Every day there is a feeling, am I infected? Will I survive? Will I be able to see all around me are fine and in good health?

I can still remember, during the COVID-19 first wave, when lockdowns were going on, many poor didn't have any jobs; they were begging door to door. We heard their touching appeals almost all day from morning to night. We tried to help people within our means by providing money to the people who used to work around us, we also distributed some money or food in the community from our family, however, that was just a drop in the ocean of needy people. So, at times people broke the law and came out of lockdown. They started running business, working and life became normal with all the risks of being affected by COVID-19, and subsequent deaths.

*Mr Ershad Jan Chowdhury and family*

But we were not like those people, so we are still working from home and going out only for essential needs. So, what we are getting by that cautiousness? Two times I tested as COVID-19 negative, was vaccinated and still quite healthy and fine. What have we lost? Social entertainment like movies at the Cineplex, enjoying theme parks, beaches, the company of friends, relatives, or sports or events, etc. Life is dead, isn't it? Actually, it's not. I am really enjoying my confinement and working from home. Every day I used to lose 4 hours on the street while I was working at the office physically. After returning from the office, I was too tired to do any other thing than to rest. Kids were tired from the journey to school and used to lose significant time like 4 to 5 hours on the road. My spouse had a boring lonely life at home. From morning to evening she had to spend her time alone working by herself. But now, she has three more strong hands to assist her; so, she became a powerful CEO! I can save time and give more output to the office as well as at home. Children are able to spend more time on both study and what else I don't know exactly, probably videos, games, etc. Sometimes all of us can watch a movie together at home; and of course, we can now take all meals together, that's a great gift of COVID-19 confinement! I want corona to go at once, but I like this online life, at least it gave us more family time than we ever had before. When Corona leaves, I will miss my family for sure.

## Story from Dr Eva Cheng (Australia)

**Director, Women in Engineering and IT, University of Technology Sydney, Australia (Engineering)**

**[Story 1]: My journey collaborating with Feto Enginhera (Women in Engineering in Timor-Leste) since 2019 and through COVID-19**

The seeds for my journey as a volunteer with the Feto Enginhera (Women in Engineering) team in Timor-Leste were sown in July 2018. Joining a 2-week Engineers Without Borders (EWB) study tour with university students transformed my life in two ways: first, the people, culture and environment of Timor struck a home chord; and, I met the inspirational team of women engineers in Feto Enginhera (FE). Sister souls, indeed!

I have been actively involved in women in engineering advocacy since my days as a PhD student. Now an academic and Director of a Women in Engineering and IT unit at an Australian university, when the Australian Volunteer Program role for a Gender and Strategy mentor working both remote and with in-country assignments with the FE team in Timor-Leste, it was the perfect volunteer opportunity for where I was at!

We started with videoconference catch-up calls with the FE team from August 2019. This built the connection and rapport for my 5-week assignment in Dili to hit the ground running working with FE in Jan-Feb 2020. Five weeks was definitely not enough time in-country, but with semester-based university calendars calling, this short time in Dili cemented our ongoing collaboration.

Less than one month after coming back to Australia, the COVID-19 pandemic escalated in the region: lockdowns commenced, AVP volunteers were repatriated, and uncertainty became our new way of being for 2020.

Our shared values and visions for gender equity, combined with an already established practice of videoconference catch-up calls, meant that our collaboration continued as COVID-19 lockdowns and travel bans appeared. My original intention was to return to Timor at the end of 2020 for a few months to work with FE again. So, at the time, this recommencement of videoconference catch-ups felt like a natural ebb and flow between remote and in-person collaboration.

*Photos of in-country visit (Jan–Feb 2020)—continuing collaboration during COVID-19 has been online.*

FE's journey to transition from an EWB program into an independent local non-profit association inspired local momentum for more collaboration from Australia. Sharing FE's vision and work at a few EWB and industry events organically formed a remote volunteer team from different parts of Australia. Since forming in August 2020, our informal fortnightly online catch-ups continue to support FE's transition to a local non-profit association, with activities to date including:

- facilitating capacity-building workshops (over videoconferencing) for financial management and writing grant proposals
- supporting grant proposal writing (over cloud collaborative documents)
- reviewing FE organisational policy
- reviewing and developing FE organisational strategy
- connecting FE leadership to the Tech Girls Movement Founder and CEO, Dr Jenine Beekhuyzen, for organisational strategy mentorship.

As the chance for any international travel in 2020 dwindled, we continued to pivot in the latter half of 2020 to how a remote Australian volunteer team could best support FE during COVID-19 uncertainty and into 2021. Most recently, we collaboratively prepared a grant proposal to the Returned Australian Volunteer Network (RAVN) Go Back<>Give Back initiative to support an FE capacity building project.

*School outreach capacity-building workshop Feto Enginhera*

Despite the uncertainty of a global pandemic and lockdowns pausing a number of FE's activities and community projects, they continue to push forward for gender equity where they can with a committed volunteer member network. Whilst we have established our remote ways of collaboration from Australia, once borders open I will definitely be back in Timor. And I can see this pattern of hybrid volunteering continuing—it's a win-win that works for FE and where I'm at and my commitments here in Australia. So, whilst COVID-19 changed what my original AVP and ongoing volunteering plans were, continually adapting to COVID-19 situations has organically emerged new norms for our ongoing and growing team collaboration.

**[Story 2]: Starting the Women in Engineering in Pacific and Timor-Leste network in late 2020, building on the success of the Feto Enginhera network in Timor**

**Co-authored by: Ms Heidi Michael & Ms Dulce Soares**

The Feto Enginhera (Women in Engineering) network in Timor-Leste has grown from a handful of passionate founders in 2004 to a highly committed network of over 100 volunteer members that is emerging as an exemplar of a grassroots gender equity movement in the APAC region. To further the gender equity reach in the region by sharing this model and success, one of the co-founders, Dulce Soares (Dili), together with Heidi Michael (Melbourne), a water, sanitation and hygiene (WASH) engineer and key long-time enabler for the network, convened the Women in Engineering Pacific and Timor-Leste network in September 2020. The timing to initiate this network during a global pandemic was in-part deliberate: the idea had been in the air for some time pre-COVID, and rather than waiting for stability, as the inequality of how COVID-19 affects different genders quickly became apparent, the need for the network catalysed.

The network's vision is for an engineering sector that is an inclusive and diverse profession which values and enables the contributions of women towards ensuring sustainable solutions and outcomes for communities in the Pacific region and Timor-Leste. Towards this vision, our mission is to build a community of women in engineering in Pacific and Timor-Leste to support, celebrate and advocate for women and the unheard voices in our communities, to overcome these barriers to reach their potential and inform sustainable solutions for communities.

Whilst all of us adopted videoconference meetings as our new norms through COVID-19, convening this network to meet monthly over a videoconference required navigation around different timezones and work commitments. Running 2-3 meetings per month to discuss the same agenda items enabled a choice of meeting days and times for diverse and inclusive participation from women engineers in Timor-Leste, Fiji, Vanuatu, PNG and Australia.

We launched the network in a hybrid event on 23 June 2021, the International Day of Women in Engineering (IDWiE). Satellite events are planned for Dili, Suva, Port Vila, Melbourne and Sydney to enable local networks to grow in addition to the online event connecting us all across the region. Please do join us for this launch event, and connect with us for collaboration!

Whilst it seems crazy to launch this regional network for gender equality in engineering in a pandemic, what we have learnt from COVID-19 is how inequity compounds to widen gaps in access to basic services, education and opportunity. So more than ever, we need collaboration, sharing learnings, and connected networks. To have different voices in the room heard is critical as we emerge from the COVID-19 pandemic, so that our new 'normals' are more inclusive and equitable than what we have lived in, and with, in the past.

## Story from Dr Han Zhe (Singapore)

**Senior Lecturer, National University of Singapore, Singapore (Pharmacy)**

*Dr Han Zhe*

2020 had been an unprecedented year. The concern of a new but deadly virus loomed at the start of the year and by April 2020, the pandemic had affected billions of people around the world as countries implemented safe distancing measures, movement restrictions and even lockdowns to contain the spread of this virus. Indeed, the COVID-19 pandemic has had far reaching and significant impact on the lives of many. Work from home became the default for working adults, our children adjusted to home-based online learning and our families acclimatize to virtual gatherings.

While social disruptions caused by COVID-19 were challenging for everyone, many feared that these disruptions might disproportionately affect women, who often had to take on greater share of the increased household labour as family members worked and learned at home throughout the day. The effect of the COVID-19 pandemic is particularly concerning in academia where higher female faculty members reported higher incidences of incivility from peers and students and performed more 'hidden labour' in student mentoring.

Singapore confirmed its first case of COVID-19 infection on 23 January 2020. While earlier cases were largely imported, fear of a lockdown loomed after the first locally transmitted case was reported in February 2020. Workplaces implemented safe distancing measures and business contingency plans allowing for staggered working hours and work-from-home arrangements on selected days.

At the National University of Singapore (NUS) where I am a senior lecturer with the Department of Pharmacy, restrictions on maximum class sizes were introduced in February 2020 and gradually tightened, and faculty members were asked to transition to fully online learning in the scenario that the country went into lockdown. This period of uncertainty was extremely challenging and at times frustrating as plans made for classes frequently had to change several times to comply with the latest restrictions. It troubled me deeply as an educator that I spent more time planning for the logistics of my classes rather than the content of the learning activities and assessment tasks themselves. I worried if I would be short-changing students of their learning and particularly in the context of health professional education, I feared that my students would be less competent patient care providers in the future. Some research projects were also delayed as time and manpower were prioritised for essential and urgent activities such as education and assessments.

*Photo from Dr Han Zhe*

When the country eventually went into lockdown (called 'circuit breaker') on 7 April 2020, most faculty members, including myself, were quite familiar with technological tools such as Zoom or MS Teams, that allow us to deliver teaching and learning activities synchronously online. Much of the logistic planning in the earlier months of the pandemic also meant that contingency plans were already in place for end-of-semester examinations, other essential activities, and even the new academic year that started in August 2020.

Even as Singapore emerged from the circuit breaker, campus reopening was a gradual process and much of the teaching in the first semester of the 2020–21 academic year was still delivered online. As the leader of the Year One curriculum in the new integrated Bachelor of Pharmacy (Honours) that went live in August 2020, my challenges in rolling out a new curriculum were compounded by online teaching and learning for freshmen who had never had the chance to meet one another, navigate campus and experience university life.

While the challenges were great and I missed international conferences to network with colleagues and overseas vacations with family, I still looked back at 2020 with much to be grateful for. I am thankful for colleagues who worked together collaboratively through difficult times, for students who were understanding of the situation and adjusted to last-minute changes, and most importantly for my family who were supportive.

Reflecting on the impact of the COVID-19 pandemic, I see the positives where I have learned new and more efficient ways to work, teach and assess learning. For instance, our integrated Bachelor of Pharmacy (Honours) program adopted the team-based learning (TBL) pedagogy and in order to orient incoming freshmen to this pedagogical strategy, I led an online TBL orientation workshop that engaged 205 students and 12 faculty across 41 breakout rooms! Admittedly, I might not be brave enough to experiment such a workshop through a virtual platform in the absence of COVID-19 restrictions. I was also challenged to re-evaluate student assessments to ensure that I am assessing application and higher order thinking rather than simply recalling of facts. I was pleasantly surprised by the improved attendance and participation at national committee meetings as colleagues who were tied to their workplace and unable to attend offsite meetings in the past were able to participate virtually. While all international travel remains on hold, I embrace opportunities to participate in more international conferences albeit virtually, and enjoy additional time that I get to spend with family and friends.

## Story from Mrs Jaana Dielenberg (Australia)

**Science Communication Manager, The University of Queensland, Australia (Ecology)**

COVID has delivered more benefit to me as a full-time working mother than a decade of industrial relations and government policy.

I work in a fast-paced and demanding role in a national research organisation and am almost constantly on call to the media, in addition to dozens of research teams around the country.

While COVID restrictions have created occasional inconveniences to my job (such as the additional paperwork and difficulty of having travel for field work approved), it has not had a negative impact on my home life.  When locked down, my high school aged children got on with their studies without requiring anything from me. Missing an overseas vacation is a very first world problem and shutdowns haven't seemed much of a hardship in sunny Brisbane.

Overall COVID has delivered a major improvement to my quality of life by rapidly making working from home with flexible hours more common and acceptable to employers and teams.

Despite working as many or more hours per week, stretched over a much greater number of hours in my day (often starting at 7 am and finishing at 10 pm), being able to stop for 30 mins here and there to put dinner in the oven or drop a child somewhere makes my work and home life far more harmonious.

*Working from home has many advantages, including for pets. Photo courtesy of Jaana Dielenberg*

I save a significant amount of commute time. I see my kids more. At 4 pm I can call out to a teenager to stack the dishwasher instead of just coming home to a sink full of dirty dishes. The pets are much happier.

Even prior to COVID the vast majority of people I speak to in a working day are not based at my university; they were on the phone or on zoom so the amount of face-to-face meetings I have has barely changed. Some of the meetings we would have flown for previously have gone online, and it has not had much of an impact—clearly we were wasting a lot of carbon before.

I do face employment uncertainty, but it is not a result of COVID, rather it is the product of fixed-term funding for research programs; eventually they all come to an end.

## Story from Dr Irfana Begum (India)

**Project Officer, EduSAT, Vigyan Prasar, India (Biology)**

### [Story 1] School safety during pandemic

On 21 March 2020, the honourable prime minister of India declared a complete lockdown for the country; later on, at different stages everything came out of lockdown but school, up to year eight, was still closed. Children in these grades are taking online classes through using different types of devices. Now after one year schools are going to be reopened. Therefore, teachers, management and other employees of the schools must be aware of how to make a safe environment for the children during the pandemic.

Vigyan Prasar, the autonomous organization of Department of Science and Technology GOI and National Institute of Disaster Management jointly organize online sessions on School Safety during the pandemic for teachers and trainee teachers and organize programmes in different languages like Hindi, English and Urdu. Though school structural safety is very important, in the present situation school non-structural safety is equally as important to protect our kids and others. Non-structural safety for schools depends on the behaviour of the staff, cybercrime, crime near the school, and the environment near the school.


*Photo from Dr Irfana Begum*

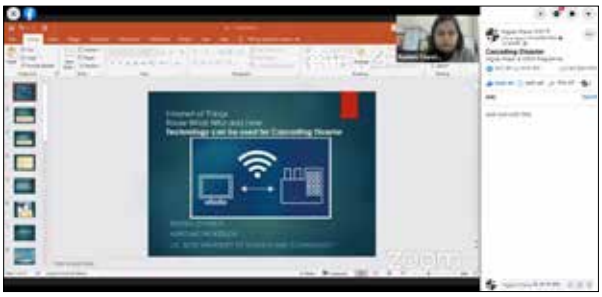

*Photo from Dr Irfana Begum*

To focus on the non-structural safety and on health during the pandemic, sessions are focused on two topics: 1. Science of soap and sanitizers, 2. Hygienic awareness among children.

Though the pandemic has been continuing since last year, most children have been staying inside the home and are not exposed to outside environments and are trying to use soap at home. As they go outside, they are trying to use a lot of hand sanitizer which is not good for the skin. Most people never check the concentration of alcohol in sanitizer.

Lower or higher amounts of alcohol than prescribed make sanitizer useless, low concentrations of alcohol will remain long on the skin and need to be wiped off while high concentrations of alcohol evaporate early without lasting effect on the virus.

Some people are facing skin allergies while using sanitiser and would preferably use soap. Teachers can't do everything in the limited time they have, as it is suggested by WHO that person-to-person distance should be at least two feet apart, and people should wear masks properly (nose and mouth should be covered). Most people expose their nose and keep their mask only on their mouth, some people keep their mask on their chin, and some are using their mask like a cap. In the rural areas of the country and in densely populated areas people are not using masks and not even taking precautions to save themselves. These teachers in turn teach their students how to behave in school during the pandemic.

In general, parents argue with the teachers to take the class in two or three shifts. But it is difficult for the teacher to manage this scenario; cutting short of the syllabus is also not a good solution for this. Therefore, to ensure their students are trained a teacher can share all the information with the students and arrange ample water to wash their hands regularly without wasting of water. We emphasise that Neem (*Azadirachta indica*) water and antibiotics are not affective on the virus. Therefore, without consultation do not prescribe antibiotics to anyone.


*Dr Irfana Begum*

During the lockdown period children become more tech-savvy. They spend most of their time on the internet, therefore, now it is important to monitor the children's activities in the computer lab as well as other places of the school campus. With the help of this training programme these teachers will be able to help to their students to protect themselves and others during the pandemic.

### [Story 2] Socio-psycho effect of COVID-19

During the pandemic, Dr Irfana Begum, Ms Chavi and Ms Rita from the Vigyan Prasar Department of Science and Technology and Dr Ajindar Walia from the National Institute of Disaster Management [NIDM] organised more than ten online sessions on the socio-psycho effect of COVID-19. These sessions are for teachers, students and working women. For the programme, team members prepared a registration format for the programme and circulated it to school principals [B.Ed., B.El.Ed] and working ladies for the registration of students and teachers. They later prepared a database of the participants. After that a meeting link was sent to all registered participants for participation in the programme.

The programme started with a discussion of sociological issues during the COVID-19 pandemic, it discussed different aspects of how the COVID-19 pandemic is affecting our society. Irrespective of age, gender and difference in ability, the pandemic created multi-faceted social problems. Due to the sudden lockdown, many across the country lost their jobs. Some of them are the sole bread winner of the family. They got stranded in far flung places away from their family and many became untraceable. There was a mass migration of immigrant laborers which made them vulnerable to the disease. Such stranded laborers, after returning home, had to face discrimination from their own society as villagers were afraid of allowing them to enter the village for the fear of them spreading the pandemic.

After that we discussed how to control the psychological effect of the COVID-19 pandemic on children, and found that engaging children at home with different type of activities during the lockdown and distributed handouts with useful information to engage kids with educational games along with games and activities for differently abled kids. If there is too much anxiety, there may be need for consultation with a psychiatrist as anxieties may arise out of different situations. During the pandemic people had to lock them up in their homes for a prolonged period, hampering normal schedules and other outdoor activities, resulting in depression. Such types of depression could be overcome by engaging in different creative activities and by avoiding repeated consumption of data on the pandemic by avoiding too much watching of TV news and social media updates, as they detrimentally affect mental health leading to different psychological problems.

During the lockdown period of the COVID-19 pandemic, working women faced too much mental stress. All offices, schools and other working spaces are closed, but all the people [male or female] are conducting their office work from home. Therefore, working women are facing double pressure, which is to complete their office targets on time, their workload at home. During normal days working in the office these working women get help from their support-staff and are able to reduce their mental stress. During the live sessions team members discuss these questions with the experts and communicate to the participants and encourage asking these questions of the psychiatrist if they feel too much anxiety.

Team member focused that counselling is not a signal of madness.


*Photo from Dr Irfana Begum*


*Photo from Dr Irfana Begum*

## Story from Mrs Mashal Asif (Pakistan)

**Medical Technologist, Fazaia Ruth Pfau Medical College, Pakistan (Clinical Sciences)**

### A tale of women during COVID-19 infection

During the COVID-19 pandemic, when the whole world was shut down, it was a scary position and everyone was frightened about the current situation. I was working in the medical college, that time my institute was open on alternate days. So, I attended the college with the proper following of SOPs for COVID-19. After one week of joining, one day I had a sore throat with mild fever, headache and body pain with fatigue, but I didn't notice my condition and as usual, I stayed in my laboratory within the scheduled timings and at the end of my day I walked from college to the gate in very hot and sunny weather after completing 7 hours of work.

After reaching home I obeyed all the SOPs for COVID-19 which included change of dress and shower myself then collected my babies from my mother and did the usual household chores. On the same night my younger son who was only 8 months old developed a fever with loose motion and runny nose. In addition, my husband also had a sore throat with mild fever and body pains.

After 3 days he was COVID-19 positive, so he was isolated in one room, but I had to take care of both babies, husband, and mother-in-law with the usual household chores. It was a very hard time to spend working alone in a home in that condition, myself suffering from COVID-19 infection.

My whole family was experiencing COVID-19 including me, and I was the only person who took care of the entire family and doing other household chores when I was diagnosed with COVID-19. That day I remembered some of my colleagues and relatives behaved like I and my family were lepers and stayed away from us; maybe they were right as this disease is highly transmissible.

I was feeling so depressed, not with COVID-19 but the actions of people as no one came forward to comfort me, everyone made me feel like it was the end of life. I heard much news about victims of COVID-19 who lost their lives and they are buried all alone in the graveyard with no more than one relative, and only health care workers allowed in the graveyard to bury the dead body of the COVID-19 patients. This also made me so scared and depressed.

I am also worried about the health of my two little children, aged 3 years and 8 months, but fortunately, prayers of all the family especially my mother and father, both babies recovered, we also recovered after 5-6 days of infectious period and had no sore throat and fever. After 12 days I had a negative result, but the aftereffects of the disease were there, and I felt very weak for almost two months.

However, it was the policy of the college to allow rest for the whole period of isolation, and I was also doing office work from home. The government of Pakistan was also very vigilant and the National Command & Operation Centre issued policy advice in order to control this horrible disease. Now they have started vaccinations on mass scale and I am waiting for my turn.

The improved policies at national and local level prevented me for becoming economically and financially unstable in this period, which was sort of a great help during this pandemic. This support from my institute is laudable as they did not deduct my salary in this period of chaos.

I hope that this pandemic will go away but it will leave people with a worsened psychological state, or with PTSD and with their businesses at stake it will take many years to recover from the shock of the pandemic. Robust policies and action plans will be needed to heal this wounded world with management at every level.

## Story from Miss Meghmala Sheshrao Waghmode (India)

**Assistant Professor, PDEA's Annasaheb Magar Mahavidyalaya, India (Microbiology)**

### COVID-19 pandemic: Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis

My perspective towards the COVID-19 pandemic situation is different, which changed my views towards society and my profession. I am working in an academic field and have witnessed changes in academia during the pandemic. Due to lockdown I have had to face a reduction of my salary and economic crisis. This change was so unexpected that initially I could not tolerate the levels of ignorance within the nation about the plight of non grant teachers. Many teachers have to suffer a lot due to the economic crisis created by the effects of the lockdown and its impact on working hours. The 'education sector' which is the pillar of the nation, had to undergo drastic changes from offline mode of education to an online mode of education. This was the time when I as a teacher had to start online teaching. Online education was possible only for the students with the facilities of internet and appropriate electronic devices. Due to lack of these facilities, many students in India could not avail themselves of online education. Diagrammatic presentation of online education is given in Fig.1.

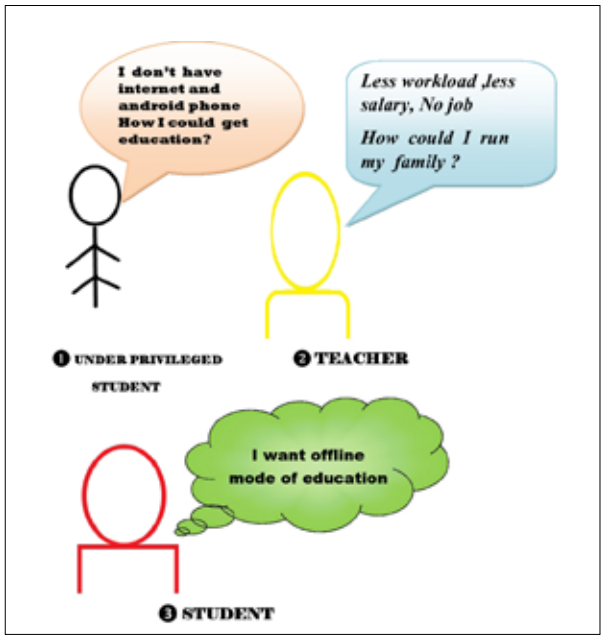


*Figure 1: Mindset of teachers and students towards online education.*

But despite all the odds, I have learnt the lesson of adopting professional skills and also implementing them while doing the service.

As an academician, I never put that much value on life changing skills before. People with skills do not only live a happy life but also survive in hostile conditions. Keeping a valuable income source, women should get involved in empowering and strengthening the immunity of mind. Health is important along with an engaged, peaceful mind.

Lockdown, which restricted the interaction, has shown the importance of society and its status in human life. But thanks to the electronic media, which makes the world better and an interactive place.

Still the physical presence of a person (relatives, friends, teachers and neighbours) is an energy booster for every human being. The lack of personal interaction was the second thing that leads to mental illness. This social distancing was good for the prevention of viral infection but was not good for communal life. Families in which family members were under one roof but in quarantine, showed the beauty of sharing things, thoughts, food and place. In India, rituals are being followed during birth as well as in death. These rituals were subsided and were of less importance considering the situation of the COVID-19 pandemic. Funerals for dead bodies were thoroughly monitored by the government without the significant involvement of relatives. This thing was so disturbing, but this was the time where we had to follow/operate/facilitate science and not tradition.

The concept of medical ethics again became important, and every nation had to follow them. In medical ethics, there is one important concept of 'distributive justice in treatment'. Vectors for the viral spread were animate objects as well as inanimate objects, which lead to proper care of all the citizens without any economic, gender, status, and racial preferences. Every nation started strengthening their medical facilities and pharmaceutical profession. Diagrammatic presentation of important objectives of the nation is given in Fig.2.

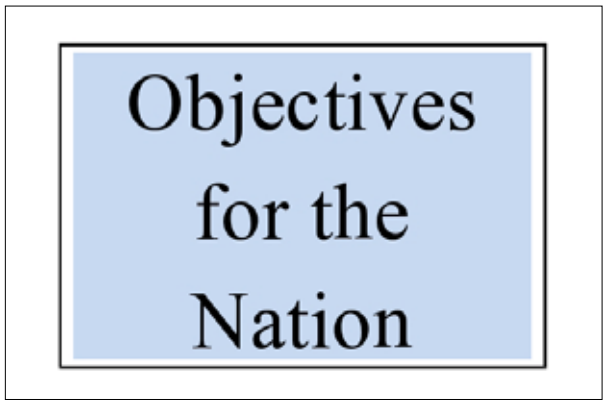


*Figure 2: Objectives for the nation*

This pandemic has affected the world adversely and brought about unusual changes in our lifestyle, it has also coalesced all the nations to fight against the virus. We are proud that India is leading in the vaccine, and I hope that the pandemic conditions will be normalised soon.

If we consider the impact assessment of the COVID-19 pandemic situation, it leads to an awakening for people, public representatives, and international health organisations.

Based on the COVID-19 pandemic situation, I learnt to build the money earning skills, to give emphasis on money savings, the importance of family and health. This was the time which I positively used to publish 3 research papers, one review, one book chapter and 3 online courses. An individualistic approach to fight against the COVID-19 pandemic is mentioned in Fig.3.

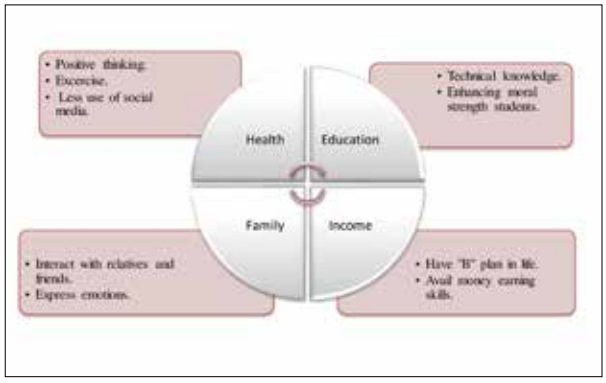


*Figure 3: Individualistic approach to fight against COVID 19 pandemic situation*

## Story from Mrs Natalia Indira Vargas-Cuentas (Peru/Bolivia)

**Researcher, Universidad de Ciencias y Humanidades (UCH), Peru (Engineering / Remote Sensing)**

My name is Natalia Indira Vargas-Cuentas; I am an electronic engineer. I am proudly Bolivian, but I have lived in Lima, Peru, for more than six years.

I chose to study a STEM career because I always helped my dad fix appliances in our house when I was a child. He taught me the name and operation of all his tools. He taught me that I could fix anything in my house with tools and a little knowledge. Above all, he taught me that I have the power to do anything on my own. That initiated my interest in electronics.

When I was in school, I was very good at mathematics and physics. My mother told me that I inherited her talents because she was an excellent student in those courses when she was in school. Still, unfortunately, she could not study at the university for economic reasons. I remember that she used to tell me the stories of when her father used to take her to his job. My grandfather worked as an aircraft mechanic in a Bolivian airline. He used to take her to fly to test the correct operation of the planes that he repaired. Those stories also initiated my interest in aeronautics.

In my last years of school, I had a physics teacher who helped us carry out a project to participate in a student fair. What we did was an intelligent elevator, and for that, he taught us the basic principles of programming and electronics. With that experience, I ended up deciding that I wanted to pursue a career in electronic engineering.

Once at the university, in my fourth year of the electronic engineering degree, I took the antenna propagation course with a teacher who had worked in the aeronautics area in Bolivia. After his class, I approached him to comment on my interests in the area. He took the time to recommend some interesting books and also suggested where I could do my internships. I always thank the time that this teacher took to guide me because thanks to him, I did an internship in the Administration of Airports and Auxiliary Services to Air Navigation in Bolivia. My dream came true. I did my internship at El Alto airport in La Paz, Bolivia. There, I met other professionals who guided me and made grow my interest in aeronautics. Thanks to that experience, I was able to find my thesis topic to graduate from university.


*Photo from Mrs Natalia Indira Vargas-Cuentas*


*Photo from Mrs Natalia Indira Vargas-Cuentas*


*Photo from Mrs Natalia Indira Vargas-Cuentas*

In the last year of university, I did not know what I wanted to do after finishing my degree. One day, an email from the Space Generation Advisory Council (SGAC) came to me indicating that there were scholarships available to attend the International Astronautical Congress (IAC) and that the call was open to all countries. I applied because I had read that it was the largest congress in the world in astronautics and space. Months later, they notified me that I was one of the selected students to travel to Toronto, Canada and attend the congress. I was thrilled; it was the first time I had made an international trip; I remember that I had to get my first passport. I attended the conference, and I met students and professionals from all over the world. I saw the directors of the most important space agencies in the world. I met astronauts that had travelled to the International Space Station. I realized that there was something beyond airspace, which was outer space, something even more infinite. Although it sounds strange, I had never thought about it until that moment, so when I returned to Bolivia, I decided to do a master's degree related to space.

A year after finishing my professional career, I decided to marry my boyfriend. We both found work in a research laboratory in Lima, Peru. After we decided to settle there, my master's degree was still a pending dream for both my husband and me. He told me that he wanted me to have the same opportunities he had and said that he would support all my professional dreams. In 2016 the Bolivian Space Agency (ABE) made a call for master's scholarships to carry out specialization studies related to space technology in China.

Sincerely, I was terrified to apply, first because of my new family, since I had not even been married for a year. I was afraid to live on the other side of the world immersed in a culture different from mine. But my husband kept his word and encouraged me to apply. In the beginning, he told me that we should go one step at a time. He encouraged me to apply at least to know how the application process is because I did not know if I would be selected. That year, three scholarships were offered in total and only one for the specialization that interested me. I decide to apply, and it was my great surprise when they selected me as one of the three Bolivian scholarships. Again, with my family and my husband's support, I started that new adventure in China. It was a great life experience to do this master's degree for my academic, professional and personal field. I had learned a new language. I was able to study at a top university in astronautics and space. I had the privilege to meet teachers with a lot of experience in the area and forged friendships for life. In 2018 I graduated and obtained a master's degree in Space Technology Applications with a major in Remote Sensing and Geographic Information Systems (GIS); my dream come true.

I currently work as a researcher at the Universidad de Ciencias y Humanidades (UCH) in Peru. I am the coordinator of the Image Processing Research Laboratory (INTI-Lab). I am not a mother yet, but with my husband, we desire to be parents soon. Although, before we have the dream to pursue a doctorate. We hope that the COVID-19 pandemic can be contained to start with that new dream because, as my dad always told me, not even the sky is the limit when you are dreaming.

## Story from Dr NK PRASANNA (India)

**Scientist, CSIR-NISCAIR, National Institute of Science Communication and Policy Research, New Delhi, India (Biochemistry and Biophysics)**

**Contribution of Women Scientists during COVID-19 Pandemic: Challenges and Perspectives in Indian Scenario**

*Dr NK Prasanna*

The pandemic has introduced a new world to the globe where everyone is locked in their homes and also are taking all the precautionary measures that are required for survival. When we were enjoying our family time at home, in contrast, few were constantly working for us to eradicate/mitigate the virus and they are our scientists and health frontline workers who are working in their laboratories/health centres round the clock to provide us the best medicines to make us more comfortable. Women scientists too, move heaven and earth by providing their best during the pandemic.

COVID-19 has not changed the pattern of science and routine work of a scientist, although it has leveraged us to give the full potential of many woman scientists. Juggling between family and routine work is not as easy as it seems to be, but it is far from our imagination when it comes to women. They certainly know how to manage any situation as it arises in every profession or job with the same kind of perseverance, enthusiasm, and hard work with honesty. She perfectly searched out a balanced formula to apply between family, science, and COVID-19; this requires a lot of skill and the full working of the brain 24-7. The paradigm shift from basic and routine science to virtual science is fascinating as well as exhausting. Similarly, under laboratory conditions, you need to plan your immediate research goals, utilize your available resources (students, colleagues, infrastructure and finance), to develop a technical solutions for an unsolved problem/question posed by the public domain in day to day life.

Being a women scientist, I have also faced lots of challenges that are bound up with the pandemic including taking online lectures, as well as to shoulder the bulk of household chores and responsibilities of a family. It not only posed challenges for us, but this crisis has also heightened my interest in science research. Learning new technologies, adapting to them, and using them to produce something new was quite exotic.

Working on deadlines seems to be a very interesting and enjoyable part of my job. In this time of crises, challenges for me were like a mountain of obstacles but I did manage everything with my constant belief in myself and in my ability. Being an editor of a Science Indexed Journal, it was my duty to regularly publish the research articles in the bimonthly journal, the Indian Journal of Biochemistry and Biophysics. Not only handling journals was enough for me rather I must constantly engage in the virtual laboratory programs for school students and organizing webinars and showing a virtual herbarium were the things I cannot forget. It was a memorable moment for me where I found a blessing in disguise. Hurdles have not ended here, but my small daughter who loves to play finds it difficult sitting at home, she finds it a quite boring situation. At that moment I am becoming her toy, friend, and mother also. No matter how busy I am with my work, simultaneously it is becoming my duty to play with her.

So many bittersweet memories are associated with our life during this tough time of the pandemic. Even today, those memories leave a slight smile on our face. The journey was quite challenging, but many lessons were also learned; hidden beneath every problem, the COVID-19 phase has increased the faith in everyone especially in myself, that I am capable enough to handle every situation and any role in my life be it as a mother, an editor, a scientist, or a wife.

## Story from Dr Rosa Helena Bustos (Colombia)

**Associated Professor, Universidad de La Sabana, Colombia (Pharmacology / Nanotechnology)**

*What are the cultural stereotypes about women that present challenges in your society?*

There are some cultural stereotypes such as gender inequalities in education, academic work, empowerment of women and professional development. Combining academic work with personal life presents a slower development in the scientific field compared to men. Implicit stereotypes would act in the case of girls and women as a stereotypical threat, causing them to avoid these areas for fear of what they think of their abilities and what they know society thinks about them.

*How and why were you drawn to studying in STEM fields? What led you to choose your career?*

I was attracted from a very young age by a taste for science, to discover new things that could help people. I chose my career, out of vocation and interest in studying aspects related to human health from the pharmaceutical sciences that complement the medical area.

*In your STEM career area, if women experience marginalization, what forms has this taken in your experience/opinion?*

In my professional area, women experience a hierarchical difference with their academic peers. However, with work, persistence, perseverance, and teamwork, I have made them trust and believe in me as a professional. I have had the support of my family, husband, and children to motivate me to continue in this area and although it has not been easy, I have managed to overcome obstacles related to gender differences and the empowerment of women.

*In your country/economy/region/city, how does your society deal with the measures introduced to manage the COVID-19 pandemic? (for example, regional closures, school closings, workplace restrictions, work from home, etc.)*

We must be aware that the pandemic limits us in some things that we were used to. However, changing our mentality to mitigate and prevent the risk of contagion from COVID-19 is an obligation as support to society. The closure has shown differences and inequity in people's education, career opportunities and job loss.

*Photo from Dr Rosa Helena Bustos*

*How is the COVID-19 pandemic challenging your life, especially professional development? Positive or negative?*

The COVID-19 pandemic has changed the way I develop my academic career. Although there have been delays in my experiments in the lab, it has allowed me to transform my classes so that students are passionate about topics in the area I work in. I have also been able to develop activities with social projection and projects with research that can help stop the infection by this virus. I have been able to develop my academic work together with my family at home, with the virtual education of my children. It has not been easy, but it has positively changed my perception of the academy and life.

*If applicable, how is the COVID-19 pandemic challenging the life of your husband/wife/partner and has this influenced your personal life?*

The COVID-19 pandemic has undoubtedly been a challenge to combine my professional life and my personal life. It has positively influenced my relationship with my partner because we have been able to work from home, facing the challenges of virtual education for my children. We have tried to organize the times, enjoy recreational activities with them. We would like them to be able to go back to school but make the most of what we now face.

*Do you have a mechanism to negotiate with your employer to organize housework/care tasks during the COVID-19 pandemic?*

The University where I work has allowed me to organize tasks from home during the COVID-19 pandemic. It has allowed me to work and create new projects and challenges in health to help mitigate the infection.

*Has your organization taken specific actions that have directly or indirectly supported women in your workforce to overcome the challenges brought on by COVID-19? What were these actions and what has been the impact on the productivity of the organization or the continuous participation of women, men, and other personnel?*

The organisation has directly supported my professional performance and has encouraged me to continue in my scientific and research work. It has trained us with courses to improve teaching with technological tools.

## Story from Dr Sandeep Kaur-Ghumaan (India)

**Associate Professor, Department of Chemistry, University of Delhi, Delhi, India**

Born and brought up in a small town in the eastern part of India in a conservative north Indian family, it has not been easy to choose a career in STEM. After the struggles faced in 1984, my family finally decided to settle in the eastern part of India. My father who had lost his parents at a very young age, could not complete his schooling and faced many hardships in his life before he became a successful businessman. Though my grandfather was a doctor, the circumstances prevented my father from getting a good education. My mother who hailed from a village in the northern part of India, was sent to school only up to the 5th grade just to be able to write her name. The reason given to her was that girls only had to get married and look after the house and family. But as I know from my mother, she enjoyed school, wanted to complete school and be independent, which I believe is true for many other young girls. I remember, that this was one of the biggest driving forces behind my brother and me in getting a good education. My parents were very clear in their minds about the importance of education and the environment they wanted to give us.

As far as choosing a career in STEM was concerned, there was never any pressure from my parents or teachers. I was always given full freedom to choose the subject as well as the career path I wanted to take. I chose a career in STEM (Chemistry), because I liked sciences and the subjects always fascinated me. The idea of solving problems and creating new knowledge excited me. I liked to spend my time in the laboratory. Moreover, my teachers and role models showed me the different career paths I could take by studying sciences. Till the end of earning a bachelor degree I was not sure whether I wanted a career in STEM as a researcher or as an academician. It was only while doing my PhD that the realization of being both a teacher and researcher dawned on me. I drew a lot of power and strength from the support and environment given by my parents and teachers to finish school, go to college and university and finally earn a doctorate, followed by postdoctoral research in various national and international laboratories.

Currently, working as a teacher and researcher in one of the premier institutes in the country, I now try to inspire the younger generation, especially young girls. There are many challenges: fighting stereotypes, gender bias, one has to face, but I believe that it is true for any career path.

The current challenge however, is in retaining women in the STEM fields, for example in my University the % of women earning doctorates is much higher than men. But most of the women do not continue in STEM after they graduate. This could be addressed by improving strategies to recruit and retain female scientists and implementing policies that foster an inclusive workplace.

The pandemic has posed other set of challenges for women in STEM. With the major burden of home-schooling children, meal preparation and general housework, attending STEM workplaces has been a challenge. This has affected academic output, submission of manuscripts and grant applications. There has been a reduction in the quality and quantity of research publications which is likely to harm funding prospects in the future. Furthermore, the economic impact of COVID-19 could impact all progress that has been made in achieving diversity in STEM workforce.

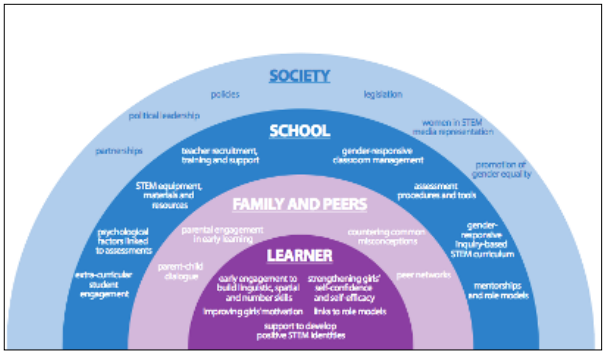


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***Figure submitted by Dr Sandeep Kaur-Ghumaan***

## Story from Miss Shawon Shyla (Bangladesh)

**Additional SP of Bangladesh Police, now serving in UN Mission MONUSCO, DR Congo, University of Dhaka, Bangladesh (International relations)**


*Miss Shawon Shyla*

Undoubtedly this COVID-19 situation adds some extra layers of challenge to all UN personnel. Apart from these challenges as a peacekeeper I learned a lot from this pandemic. They are listed below.

1. The most important lesson I learned is that we can't achieve peace and security alone and there is no alternative way of cooperating.

2. The second most important thing I realized is that deadly infections can be more harmful to mankind than war and conflict so we should be more prepared to defeat any pandemic for our future generations.

No matter how difficult the situation is, COVID-19 makes me see my life in a similar way and cherish the many valuable lessons I have already learned from this circumstance. Some of them are as follows:

1. During my work, I realised that all human beings in this world are interdependent. That is why if we want to defeat this pandemic, we have to do it from everywhere in the world.
2. This COVID-19 situation reminds me of the value of cooperation, and I feel intensely now that we can achieve peace when we can work together without considering our nation, culture, and religion.
3. I have learned to value the role of all people in this society. It forces us to evaluate all people's contributions around the world.
4. I have learned how to adjust to changes and difficulties.
5. Living with uncertainty, with hope, and courage is another lesson from this pandemic.
6. From the restrictions on movement, I have learned how to value freedom in human life.
7. I am much more courageous now dealing with the panic. And finally,
8. I realised that in many cases we can't control our destinies though we think we can.

## Story from anonymous contributor 1

In your professional STEM area, if women experience marginalisation, what forms has this taken in your experience/opinion?

We are many women who work in the training of mathematics teachers. However, at the national level it is an area that has been taken over by male colleagues, especially some who hold prizes in the area of pure/applied mathematics. These mathematicians act as managers of the larger projects in the area. Women with training in the area are usually not included in these projects. Most of the resources are then distributed among other mathematical collaborators instead of those of us who trained in the specific area.

At least in my country, the area of mathematics education has been taken over by mathematicians who claim they are interested in improving mathematics education but are looking for more prizes and acknowledgments.

In this way, most women are marginalized, and those that are included must be willing to enter the circle of power with the conditions that this implies, especially being made invisible. Going against this may even mean that you could be publicly humiliated at conferences.

## Story from anonymous contributor 2

In March 2020, while the pandemic itself was nascent in India and was amenable to control via strict controls and quarantine in airports plus tracing-testing, India went under a super-strict lock-down with barely four hours of warning. I, myself, live in a comfortable small green and friendly enclave, where we got groceries and fresh milk door-delivered, and where the neighbours were sensible, maintained physical distance but also social warmth, and the internet was mostly working.

Right outside our gate, however, was a labour camp of 100 migrant workers constructing a school. The school is run by a convent and we know the nuns, and buy occasional vegetables and fruits from their farm. But when the lockdown was declared without warning, the migrant workers in the labour camp, who had just sent their monthly salary off to their families were, overnight, left without money to buy food, were without transport (buses and trains) to go to their homes hundreds of kilometres-distant, and no supervisor who would take responsibility for them-not even the nuns... I and a few of my neighbours ended up working on getting them just basic cooked food to start with, then basic food rations, and also masks, sanitisers etc. This meant getting the attention of the city management or other NGOs that were able to get permits from the police to drive around supplying food rations. This became an all-consuming activity, even with all our savviness, linguistic abilities, even 'contacts' in the bureaucracy. Mostly because no one, not individuals, not voluntary organisations and not the city government, were prepared for this, and all were short handed, and short of supplies. After a couple of months of this, special trains were finally launched to take migrant workers home. When this happened it was another all-consuming effort for the handful of us to get these neighbours of ours onto the right trains to take them home... So for these months it seemed hardly appropriate for me to worry about the fact that I was not able to focus on my scientific research.

My PhD student in his fourth year, lives with his family in this city. He had gotten a prestigious 5-year national government scholarship for his PhD but his monthly stipend and research grant has not been paid for over a year now. Meanwhile he decided to volunteer for the city council in their COVID19 operations ('COVID warriors' they are called)—which meant handling the data base of COVID-19 tests, following up on infected patients, doing primary contact tracing, checking telephonically on patients and contacts in quarantine/isolation, over a good bit of last year. And then during the more recent disastrous second wave it has involved looking for high-dependency beds across the city, helping people without cell phones and internet to access hospitals, supplying medications etc. Again, a nearly full-time preoccupation. And as a citizen with some privileges of basic support from his middle-class family, it only seemed appropriate that he give his maximum to the current crisis.

The overall situation is such that full-blown action by a parallel system of volunteers, voluntary organisations, NGOs and individuals is a national imperative. It's possible that most of the STEM workforce has not set aside their time for this effort, but a significant number has.

A major obstacle here to a reasonable response to the pandemic has been the proliferation of unscientific as well divisive "truths" that are perpetuated by people holding public office as well as the media, especially the digital media and in regional languages. So then it becomes the responsibility of scientists to counter this in every way possible in all languages that each of us knows. This is also very time-consuming, though it is totally avoidable -if only the citizenry were not swayed by fake news.

## Story from anonymous contributor 3

In an event, I met this person who shared her story during the lockdown regarding the difficulty she encountered with her family towards her gender identity. This person has impressed me quite a lot with her strong passion for learning, and clear thinking about many issues she observed. However, those around her would have to create a non-judgemental ambience and have patience to allow her to articulate her story if she has to feel any sense of belonging.

This kind of voice is very much unheard in many societies. Her story brings a 'should-not-be-ignored' perspective in terms of the diverse society we aim to achieve. I think it's palpable from her input impact of the pandemic-related lockdowns and the move to online classes-only have had on her mental health, but often in ways that are not obvious, in addition to those that are of direct impact (such as lockdown and travel restrictions). Just so you know, the institution that she is in is actually one of the very old educational institutions of the city, has at least a few teachers/administrators in leadership positions who have brought a very progressive facet to the institution—and this has been particularly true in politically hard times. So there are some positives in her institution, but many of those positives would sort of become irrelevant when students cannot step into the campus.

*[*Paragraphs below have been rewritten by the Australian Academy of Science in order to protect the contributor's anonymity]*

Yasmin* (*not her real name) is a 24-year-old undergraduate student majoring in physics and mathematics at a university in India.

She started her studies this year at her family home in a different state to which her university is located, due to the lockdown and inability to travel.

Yasmin is transgender, and has not been supported by her family, who have harassed her about her gender identity and forced her to undergo 'conversion therapy' since the age of 14. As Yasmin has not transitioned back to being male, her family has threatened to put her through this treatment again. At home, she has been forced to behave in particular ways and her hair was cut off.

With this background, concentration on her studies and learning from home is difficult for Yasmin due to family conflict and other family members being in the house. She also lives with autism.

By the fourth semester, her academic performance declined further.

Her inability to keep up with her studies has been a source of deep worry for Yasmin, who had been enthusiastic learning on campus and was looking forward to learning about electromagnetism, and one day, focusing on organic chemistry.

Most distressingly, Yasmin has been unable to access previous support offered by the counsellor on her university campus. Without access to support, Yasmin attempted to take her life twice, which has resulted in hospitalisation.

Yasmin describes her own situation as scary.

This story highlights how the pandemic has exacerbated the challenges of engaging with STEM education alongside family conflict, social isolation and individual wellbeing.

This could lead to attrition from STEM education, particularly for those enduring intersectional barriers.

# Appendix: Survey questionnaire

## Part I: General information

### DEMOGRAPHIC QUESTIONS

**9. Which country or economy do you live in?**

--- Dropdown menu of specific countries

☐ other (please specify):_____

**10. Please indicate which age group you belong to?**

☐ under 18
☐ 18-24
☐ 25-34
☐ 35-44
☐ 45-54
☐ 55-64
☐ over 65

**11. Please indicate which gender you identify as?**

☐ woman
☐ man
☐ non-binary/non-conforming
☐ prefer not to say
☐ other (please specify):_____

**12. Do you identify as the following (Select all that apply)?**

☐ person living with disability
☐ cultural and linguistically diverse (e.g. ethnic minority)
☐ member of an Indigenous group
☐ lesbian, gay, bisexual, queer, other
☐ do not wish to disclose
☐ other (please specify):_____

### EDUCATIONAL INFORMATION

**13. What is your highest science tertiary qualification?**

☐ diploma
☐ bachelor degree (including honours)
☐ graduate diploma
☐ masters degree
☐ doctorate/PhD
☐ other (please specify) :_____

**14. In which branch(s) of science did you qualify?**

--- Dropdown menu of specific disciplines

[agricultural science ; biology ; biochemistry botany ; chemistry ; computer science ; engineering ; environmental science ; food science/technology ; forestry ; geology/ geosciences ; marine science ; materials/ metallurgy ; manufacturing ; microbiology ; medical Science ; pharmacology ; physics ; mathematical sciences ; surveying ; veterinary science]

☐ other (please specify):_____

## Part II: Employment and career development in the stem fields

### EMPLOYMENT INFORMATION

**15. How many years have you been in the paid workforce?**

☐ 0-5
☐ 5-10
☐ 10-15
☐ 15-20
☐ 20-25
☐ 25-30
☐ 30+
☐ not applicable
☐ other (please specify):_____

16. **Please describe your employment situation.**

- ☐ unemployed: not actively seeking work
- ☐ unemployed: actively seeking work
- ☐ self-employed
- ☐ independent researcher/professional
- ☐ casual or temporary position
- ☐ fixed-term contract position
- ☐ permanent/ongoing position
- ☐ retired
- ☐ not applicable
- ☐ other (please specify):_____

17. **How many days a week do you have paid employment?**

- ☐ 1-day
- ☐ 2-days
- ☐ 3-days
- ☐ 4-days
- ☐ 5-days
- ☐ 6-days
- ☐ 7-days
- ☐ not applicable
- ☐ other (please specify):_____

18. **If you work part-time, is this due to:**

- ☐ caring responsibilities
- ☐ study commitments
- ☐ difficulties securing full-time paid work
- ☐ personal preference
- ☐ not applicable
- ☐ other (please specify):_____

19. **Which of the following best describes your career engagement? (Select all that apply, for example for joint appointments)**

- ☐ university
- ☐ education
- ☐ hospital
- ☐ government
- ☐ government-related research organization
- ☐ Private sector research institution
- ☐ industry
- ☐ not-for-profit (or non-government) organization
- ☐ not applicable
- ☐ other (please specify):_____

20. **Which of the following best describes the industry in which you are mainly engaged?**

--- Dropdown menu of specific industries

[consulting & technical services ; medical research institutes ; construction ; mining (inc. oil/gas extraction) ; electricity, gas, water & waste ; information media and telecommunications ; defence ; public administration and safety ; health ; education and training ; manufacturing (inc. chemical) ; forestry ; agriculture]

- ☐ not applicable
- ☐ other (please specify):_____

21. **What field of STEM do you work in or use in your role?**

--- Dropdown menu of specific disciplines

[agricultural science ; biology ; biochemistry botany ; chemistry ; computer science ; engineering ; environmental science ; food science/technology ; forestry ; geology/ geosciences ; marine science ; materials/ metallurgy ; manufacturing ; microbiology; medical science ; pharmacology ; physics; mathematical sciences ; surveying ; veterinary science]

- ☐ I am currently not working in a STEM field
- ☐ other (please specify):_____

22. **Which of the following best describes your main job responsibility?**

--- Dropdown menu of specific responsibility

[analysis & testing ; quality control & production ; research & development (inc. product development) ; management ; sales/ marketing ; teaching or training ; exploration (inc. mining) ; quality assurance ; computing ; general veterinary practice]

- ☐ not applicable
- ☐ other (please specify):_____

23. **Which of the following best describes the institutional support at your workplace? (Select all that apply)**

- ☐ equal opportunity policy (e.g. gender equality, anti-discrimination and diversity policy)
- ☐ paid leave (e.g. maternity leave, sick leave, and annual leave)
- ☐ health insurance
- ☐ social welfare support (e.g. superannuation)
- ☐ career and professional development (e.g. training opportunities)
- ☐ career advancement opportunities (e.g. promotions)
- ☐ none of above
- ☐ not applicable
- ☐ other (please specify):_____

## CAREER DEVELOPMENT DURING THE COVID-19 PANDEMIC

24. ***How stable was the STEM workforce before the COVID-19 pandemic in your professional area within your country? Please rate on a scale of 1 to 10.**

unstable highly stable

○ ○ ○ ○ ○ ○ ○ ○ ○ ○

25. **How much has the COVID-19 pandemic affected the security of the work in your professional area within your country? Please rate on a scale of 1 to 10.**

decreased job security increased security

○ ○ ○ ○ ○ ○ ○ ○ ○ ○

26. **What do you expect for your career development in the short term (e.g. 1 year or so) in relation to STEM fields?**

- ☐ enter a career in STEM fields
- ☐ be in the same or similar role
- ☐ job promotion
- ☐ pursuing a higher STEM degree
- ☐ change employers/jobs while staying in a similar field
- ☐ change careers, while staying inside STEM fields
- ☐ change careers and open to possibilities outside the STEM fields
- ☐ leave workforce
- ☐ retirement
- ☐ not applicable
- ☐ other (please specify):_____

27. **In the longer term of your career development, how likely are you to stay in the STEM fields? Please rate on a scale of 1 to 10.**

very unlikely likely

○ ○ ○ ○ ○ ○ ○ ○ ○ ○

28. **Which of the following best describes your reasons to stay in STEM fields? (Select all that apply)**

- ☐ good income
- ☐ career advancement (e.g. job promotion)
- ☐ support from family, friends and colleagues
- ☐ social responsibility
- ☐ work fulfillment
- ☐ personal passion, interests and drive
- ☐ in pursuit of self-development
- ☐ no special reason
- ☐ not applicable
- ☐ other (please specify):_____

29. **Which of the following best describes the possible reasons that you may not wish to stay in STEM, or eventually you decide to leave? (Select all that apply)**

- ☐ job insecurity
- ☐ lack of opportunities (e.g. limited grant funding, or poor job promotion opportunities)
- ☐ family responsibilities
- ☐ health concerns
- ☐ mental health concerns
- ☐ worried about contracting COVID-19
- ☐ personal circumstances exacerbated by the pandemic
- ☐ lack of support from family or friends
- ☐ changing interests to other careers
- ☐ workplace gender discrimination
- ☐ non-inclusive working environment
- ☐ not applicable
- ☐ other (please specify):_____

## Part III: Interactions between personal life, work and society during the covid-19 pandemic

*Please be informed about our content warning in the following sections regarding sensitive issues, such as domestic/family violence, discrimination and sexual harassment.

### DOMESTIC AND PERSONAL LIFE

30. **Do you currently have any caring responsibilities? (Select all that apply)**

- ☐ no
- ☐ yes: children, school age or below
- ☐ yes: elderly relative
- ☐ yes: someone experiencing short-term illness
- ☐ yes: someone experiencing long-term illness
- ☐ yes: physically or mentally disabled persons
- ☐ yes: own or partner's pregnancy
- ☐ other (please specify):_____

31. **How has the COVID-19 pandemic created conflict between work and your domestic life?**

Please rate on a scale of 1 to 10.

little conflict strongly conflict

○ ○ ○ ○ ○ ○ ○ ○ ○ ○

**32. How did the COVID-19 pandemic change your time usage at home?**

- ☐ I had more time at home (e.g. working-from-home or job loss).
- ☐ I had less time at home (e.g. hotel-quarantine, heavy frontline workload). *Please go to Q26
- ☐ no difference. *Please skip Q25-26 and go to next page Q27

**33. Which domestic issues have you experienced as result of spending more time at home? (Select all that apply)**

- ☐ increased housework
- ☐ additional caring responsibilities (e.g. children, elders, ill/disabled persons)
- ☐ taking leave from work
- ☐ relationship challenges (e.g. communication difficulties)
- ☐ relationship changes (e.g. separation or divorce)
- ☐ changes in living arrangements (e.g. housing instability or moving back into parental home)
- ☐ domestic/family violence (including verbal, physical, psychological, emotional, sexual, spiritual or religious, harassment and stalking, reproductive, image-based or financial)
- ☐ I do not wish to answer
- ☐ not applicable
- ☐ other (please specify):_____

**Please continue with question 26*

**34. Which domestic issues have you experienced as a result of spending less time at home? (Select all that apply)**

- ☐ housework piling-up
- ☐ conflict with caring responsibilities (such as finding day-care or age-care)
- ☐ missing important family milestones/ activities
- ☐ relationship challenges (e.g. communication difficulties or housework arrangements)
- ☐ relationship changes (e.g. separation or divorce)
- ☐ changes in living arrangements (e.g. living in work accommodation)
- ☐ domestic/family violence (including verbal, physical, psychological, emotional, sexual, spiritual or religious, harassment and stalking, reproductive, image-based or financial)
- ☐ I do not wish to answer
- ☐ not applicable
- ☐ other (please specify):_____

## HEALTH AND MENTAL HEALTH

**35. How has the COVID-19 pandemic influenced your physical health?**

Please rate on a scale of 1 to 10

less healthy more healthy

○ ○ ○ ○ ○ ○ ○ ○ ○ ○

**36. How has the COVID-19 pandemic influenced your anxiety or mental health either in relation to your work or home life? Please rate on a scale of 1 to 10**

I feel bad — I feel good

○ ○ ○ ○ ○ ○ ○ ○ ○ ○

**37. Which of the following describe your concerns about home life in response to the COVID-19 pandemic? (Select all that apply)**

- ☐ work-life balance difficulties
- ☐ work/family responsibilities conflicting (e.g. caring roles)
- ☐ relationships with partner/family members/children affected
- ☐ disclosure of privacy (e.g. gender identity or relationship status being passively discovered, such as through online meetings while working from home)
- ☐ concerns for my safety at home
- ☐ not applicable
- ☐ other (please specify):_____

## CIRCUMSTANCES AT WORK

**38. Has the COVID-19 pandemic affected your work? Please rate on a scale of 1 to 10.**

not at all — a great deal

○ ○ ○ ○ ○ ○ ○ ○ ○ ○

**39. How negatively or positively has your job been affected as a result of the COVID-19 pandemic?**

Please rate on a scale of 1 to 10.

negatively affected — positively affected

○ ○ ○ ○ ○ ○ ○ ○ ○ ○

**40. Have you experienced job or career changes due to the COVID-19 pandemic? (Select all that apply)**

- ☐ I had difficulty finding a job
- ☐ my circumstances have remained the same
- ☐ I lost my job (e.g. contract not being renewed)
- ☐ I have entered (or re-entered) my career
- ☐ I took additional jobs (e.g. to have additional income to support living expenses)
- ☐ I have changed to a different job in a similar field
- ☐ I have changed my career (e.g. leaving the STEM fields)
- ☐ not applicable
- ☐ other (please specify):_____

**41. What aspects of your work circumstances have been affected by restrictions introduced in response to the COVID-19 pandemic? (Select all that apply)**

- ☐ working from home
- ☐ restrictions to workplace access (e.g. lab, office and field-sites etc.)
- ☐ closure of caring institutes (e.g. schools, day-care and age-care)
- ☐ travel restrictions (e.g. cancelation of international/domestic work plans)
- ☐ regional lockdown
- ☐ quarantine requirements
- ☐ adopting protective items/equipment (e.g. wearing a mask)
- ☐ not applicable
- ☐ other (please specify):_____

**42. Has your income or workload been influenced by the COVID-19 pandemic? (Select all that apply)**

- ☐ my income has increased
- ☐ my income has decreased
- ☐ I have increased workload (e.g. administration responsibilities or new tasks)
- ☐ I have decreased workload (e.g. working hours cut)
- ☐ I have unpaid/independent working hours
- ☐ my productivity has increased
- ☐ my productivity has decreased
- ☐ not applicable
- ☐ other (please specify):_____

**43. Have you encountered the following circumstances in relation to your work arrangements due to the COVID-19 pandemic? (Select all that apply)**

- ☐ inadequate work support (e.g. equipment or facilities, lack of work space)
- ☐ limitations to work productivity (e.g. data processing/analysis)
- ☐ disruption of work time (e.g. disturbance from family members)
- ☐ changes in strategy, goals, or direction of work (e.g. online material development)
- ☐ flexible working arrangements (e.g. workplace or work hours)
- ☐ increased productivity
- ☐ insufficient recognition from colleagues (e.g. invisible due to working from home)
- ☐ face-to-face work meetings have been replaced with other options
- ☐ establishing online or unconventional work collaborations/networks (e.g. webinar, virtual conferences)
- ☐ not applicable
- ☐ other (please specify):_____

## WOMEN'S GENDER ROLES IN THE WORKPLACE AND SOCIETY

**44. Does your working environment have more or less gender diversity as a result of COVID-19 pandemic? Please rate on a scale of 1 to 10.**

less diversity ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ more diversity

**45. In your workplace, have any of the following issues about women's status at work have become more of a concern during the pandemic? (Select all that apply)**

- ☐ gender imbalance at work
- ☐ gender-based discrimination in the workplace (e.g. lower pay or fewer opportunities for promotion)
- ☐ non-professional work obligations or engagements (e.g. women being asked to do non-work-related tasks)
- ☐ cultural bias or expectations of women's roles in society
- ☐ sexual harassment
- ☐ not applicable
- ☐ other (please specify):_____

**46. Would you agree with this statement: "Women are marginalised, underrepresented, or disadvantaged in my sociocultural background"? Please rate on a scale of 1 to 10.**

strongly disagree ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ strongly agree

47. **In your country/economy, which options describe the impact of the COVID-19 pandemic on gender issues? (Select all that apply)**

- ☐ it improves gender equality
- ☐ it worsens gender inequality
- ☐ it creates opportunities for women to better balance work-life commitments
- ☐ it encourages society to value women's contributions
- ☐ it creates challenges for women
- ☐ it creates opportunities for men to better balance work-life commitments
- ☐ it creates challenges for men
- ☐ It encourages society to value men's contributions
- ☐ no difference
- ☐ other (please specify):_____

48. **Which options will better support women's working conditions in the STEM fields in your country/economy to cope with the COVID-19 pandemic? (Select all that apply)**

- ☐ flexible working arrangements (e.g. work hours or work space)
- ☐ flexible measures of work productivity (e.g. publication records)
- ☐ formal guidelines for institutions/ employers in considering the impacts of the COVID-19 pandemic on work
- ☐ collaborative work possibilities and professional social networks
- ☐ personal financial support (e.g., research grants)
- ☐ financial support for industry (including private business)
- ☐ financial support for research organisations/institutions
- ☐ not applicable
- ☐ other (please specify):_____

**This is the end of the survey.**
**Thank you very much for your participation**