Nurturing Women's Participation in STEM: An Analysis of Australian, Indian and Singaporean Government Policies and Programs

Kirsty Haynes

School of Social Sciences

Department of Politics and International Relations

University of Adelaide

Originally submitted February 2022

Declaration

I certify that this work contains no material which has been accepted for the award of any other degree or diploma in my name, in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. In addition, I certify that no part of this work will, in the future, be used in a submission in my name, for any other degree or diploma in any university or other tertiary institution without the prior approval of the University of Adelaide and where applicable, any partner institution responsible for the joint-award of this degree.

I give permission for the digital version of my thesis to be made available on the web, via the University's digital research repository, the Library Search and also through web search engines, unless permission has been granted by the University to restrict access for a period of time.

I acknowledge the support I have received for my research through the provision of an Australian Government Research Training Program Scholarship.

Signed:

Date: 13 October 2023

Dedication

To mum and dad

Thank you for your unconditional love, support and guidance. I'll forever be grateful for all that you have done and continue to do, for me.

To Brandon

You raised my spirits when times seemed tough.

To all of my family in Singapore, especially Mema and my late uncle and Amachi

Thank you for your encouragement. I am deeply blessed to have you all in my life.

Acknowledgements

I would like to acknowledge that my Faculty of Arts Divisional Scholarship was tied to Chief Investigator Emerita Professor Carol Johnson's ARC research grant (DP180100251 – In the Frame: Analysing Liberal and Labor Government Gender Equality Policy.

I would like to sincerely thank Emerita Professor Carol Johnson for all of her guidance, support and wisdom. I was able to learn so much throughout this PhD experience and I will forever be grateful. Thank you for always providing me with feedback and advice. I felt very supported, especially during tough times. It has been both a pleasure and privilege to have been your student.

I would also like to thank my co-supervisor, Dr Priya Chacko. Your expertise and knowledge enabled me to further my understandings about Indian politics as well as improve on existing material.

Thank you to Dr. Tanya Lyons for editing the thesis. I would also like to thank Ainoa Cabada and Declan Lawless for proofreading my thesis.

To my fellow colleagues in Room 324, thank you for your support, conversations, and wisdom. I wish you all the best in your future. Thank you to the PhDs and staff at the Politics and International Relations Department. You have all been incredibly kind and supportive.

Thank you to my examiners. Your suggestions have made this a stronger and improved thesis.

Abstract

This thesis makes a contribution to the field of feminist comparative policy with a focus on the role played by gendered discursive policy framing. The thesis is written from within the field of political studies; however, it provides insights from areas including gender studies, sociology and technology studies. The thesis examines Australian, Indian and Singaporean government policies and initiatives designed to increase the participation of girls and women in STEM education and occupations. Examined governments include the Australian federal government under Scott Morrison, the Indian government under Narendra Modi and the Singaporean government under Lee Hsien Loong. The thesis has analysed government policies and programs which were active as of February 2022.

The thesis explores how historical, social, cultural, political and economic factors have shaped policies and programs for women in Australia, India and Singapore. It also assesses how the governments of these three respective states have been similarly influenced by neoliberal principles that encourage women to pursue entrepreneurial roles, a pathway made easier because of technological advances.

The key research questions that this thesis addresses include: how have Australian, Indian and Singaporean governments attempted to increase the representation of women in STEM? Do those policies include any flaws that have limited their potential effectiveness? How can Australian, Indian and Singaporean governments strengthen policies and initiatives, and further improve on attempts to increase women representation in STEM? Are there lessons that the respective countries can learn from one another?

In order to answer the above research questions, the thesis will draw on relevant literature that analyses issues such as women and science, women and employment, women in Australia, India and Singapore, and gender and government policy. Given its subject matter, feminist theoretical and empirical analyses of women's underrepresentation in science and technology have proved to be particularly relevant to this thesis.

Australian, Indian and Singaporean governments have implemented some highly beneficial policies and programs, including the Australian federal government's Young Indigenous Women's academy, and India's KIRAN scheme. While the Singaporean government has not implemented many policies and programs designed exclusively for women in STEM due to its officially de-gendered meritocratic approach, it has created a range of general schemes that also aim to benefit women wishing to pursue STEM education.

However, by employing feminist analytical approaches, including a gendered discursive policy framing analysis approach, the thesis argues that the examined Australian, Indian and Singaporean policies and programs contain flaws that can potentially undermine attempts to increase the STEM participation rate for girls and women. In particular, the Australian, Indian and Singaporean policies and programs studied have been influenced by neoliberal ideology which limits the government's policymaking role because neoliberal ideology maintains that women are primarily responsible for their own economic and social position. Moreover, Australian policymakers have neglected to establish an evidence base for evaluating programs for girls and women in STEM. The Indian government has not adequately addressed the fact that most women in STEM are largely responsible for the care of children and elderly family members due to prevalent

social factors. Furthermore, the Indian government has reinforced this idea with few policies directed at Indian men wishing to assist with familial demands. The Singaporean government's meritocratic approach has not addressed gendered barriers that can deter women from obtaining a STEM education or career. The Singaporean government has also been contradictory in its view of women's roles given that policymakers have sometimes prioritised fertility policies over employment ones.

Based on such analyses, the thesis will provide some suggestions on how the examined schemes to increase women's participation in STEM education and occupations could be improved, as well as explore additional policies and programs that could be implemented. It will also note that, despite diverse cultural influences and differing women's participation rates, there are still useful lessons that the three countries can learn from each other and that provide useful contributions internationally. Indeed, by analysing three diverse countries from the Indo-Pacific region that are often neglected in research on women and STEM, the thesis makes an original contribution to the existing academic literature in the field.

Table of Contents

List of Acronyms and Abbreviations

AWARE Association of Women for Action and Research

CSIRO Commonwealth Scientific and Industrial Research Organisation

CURIE Consolidation of University Research for Innovation & Excellence

DSTA Defence Science & Technology Agency

FCP Feminist Comparative Policy

GATI Gender Advancement for Transforming Institutions

GiST Girls in STEM Toolkit

IT Information Technology

KIRAN Knowledge Involvement in Research Advancement through Nurturing

MP Member of Parliament

NASA National Aeronautics and Space Administration

NASSCOM National Association of Software and Service Companies

NFAW National Foundation for Australian Women

NGO Non-Government Organisation

PDF Portable Document Format

PAP People's Action Party

SET Science, Engineering and Technology

SERB-POWER Science and Engineering Research Board – Promoting Opportunities for Women in Exploratory Research

SG-WEN Singapore Women Entrepreneurs Network

STEM Science, Technology, Engineering and Mathematics

STEMM Science, Technology, Engineering, Mathematics and Medicine

TAFE Technical and Further Education

WISET	Women in Science, Engineering and Technology Group
WISETU	Women in Science, Engineering and Technology Unit
UNRISD	United Nations Research Institute for Social Development
US	United States
VET	Vocational Education and Training
WEP	Women Entrepreneurship Platform
WGEA	Workplace Gender Equality Agency
WISE	Women in STEM and Entrepreneurship Program
WOS	Women Scientist Scheme

Chapter 1: Introduction

1.1 Introduction to the Study

By utilising feminist analytical approaches, including a gendered discursive policy framing approach and a feminist comparative policy approach, this thesis argues that Australian, Indian and Singaporean governments' policy framing of women's participation in STEM has been influenced by particular social, cultural, economic and historical factors that at times, have impacted the effectiveness of policies and programs for women in STEM. In particular, flawed policy framing for women in STEM has not adequately addressed barriers which have been identified by the broader feminist literature, including work from Indian and Singaporean researchers. The thesis will also highlight that an underrepresentation of women in growing STEM fields poses significant disadvantages for gender equality in future employment and in society more broadly.

The thesis also argues that a comparative examination of Indian and Singaporean government policy with Australian policy via a case study approach, is warranted for a number of reasons. India and Singapore have economic and technological significance to Australia which will be examined in this chapter. Both have higher rates of women's participation in STEM when compared to Australian and other Asian regions. India and Singapore have also implemented policies and initiatives that have the potential to significantly increase the participation rates of women in STEM. These policies and initiatives have not been extensively explored as comparative work has been typically western-centric and as such, their inclusion as case studies will enable the thesis to explore differences, whilst also identifying similarities ranging from the influence of gendered stereotypes (albeit country-specific ones) to the influence of versions of

neoliberal ideology. (The political science and feminist comparative policy sense in which the term ‘case study’ is being used here will be explained and justified later in this chapter).

While the thesis acknowledges relevant cultural and other differences between those countries, it also identifies some key similarities. For example, all three have been influenced by neoliberal ideology. This thesis argues that neoliberal ideology fails to adequately recognise the importance of social reproduction and women’s unpaid labour which as feminist political economics argue is a means of sustaining the labour force and human species. For women in STEM, this has meant that few of the examined Australian, Indian and Singaporean policies and programs have assisted women with balancing familial and work responsibilities, or recognise that women may be financially disadvantaged by participating in STEM activities. Yet the feminist literature on barriers to women in STEM identifies caring responsibilities, that are predominantly constructed as women’s work, as being one of the major barriers they face in pursuing a STEM career. Other policies such as those explored in Chapter Six maintain the neoliberal ideal that women are largely responsible for their own economic and social standing and that government intervention in economic markets should be kept at a minimum. This has severely restricted the type and scope of actions that government can undertake to improve the position of women in STEM.

This thesis contributes to the study of feminist comparative policy analysis. More specifically, it analyses the discursive framing of government policies, programs and initiatives in Australia, India and Singapore that attempt to address the underrepresentation of women in education and occupations related to Science, Technology, Engineering and Mathematics (STEM). This thesis has analysed policies

and initiatives that were active as of February 2022 when the thesis was originally submitted, so it does not analyse policies and initiatives introduced after that date. Notably, the Albanese government's policies and programs for women in STEM are still a work in progress with the *Pathway to Diversity in STEM Review* final report and recommendations due to be presented to government in October 2023.[1] An evaluation on the federal government's policies and programs for women in STEM was also produced in June 2023 and publicly released on 15 August 2023. The thesis will very briefly allude to the report in later chapters.[2] The thesis argues that policies addressing women's underrepresentation in STEM are important because they can provide access to all individuals regardless of gender with the same opportunity to enter, pursue and excel in a STEM education or career and, as shall be seen, governments have assessed STEM as having a crucial role to play in employment. However, the way such policies are discursively framed has a significant bearing on their success.

The thesis has precluded a detailed study of educational curriculum content and educational policies related to them due to the extensive scope of this research project.[3] Additionally, it should be noted that in Australia and India, secondary education is largely a state government responsibility. As such, given that the thesis focuses on the federal government, a detailed discussion on secondary education has not been included. However, it is important to highlight that Australia, India and Singapore have made efforts to include STEM in the national curriculum, with some initiatives seeking to

[1] "Pathway to Diversity in STEM Review: Draft Recommendations", Department of Industry, Science and Resources, accessed August 30, 2023, https://consult.industry.gov.au/diversityinstem2.
[2] "Women in STEM Evaluation Final Report", Department of Industry, Science and Resources, accessed August 30, 2023, https://www.industry.gov.au/publications/women-stem-initiatives-evaluation-report. PDF available on webpage.
[3] Brigid Freeman, "Federal and State STEM Policies and Programmes Spanning Australian Education, Training, Science and Innovation", in *The Age of STEM*, ed. Brigid Freeman, Simon Marginson and Russell Tytler (London: Routledge, 2014).

address the underrepresentation of girls in STEM. For instance, the Australian government's National STEM School Education Strategy 2016-2026 acknowledges the inequities that currently exist in STEM noting that girls are less likely to engage in STEM education.[4] The national strategy calls for a collaborative approach to documenting change with a focus on girls. However, a recent study has revealed that women scientists are severely underrepresented in the Australian school curriculum.[5] Conversely, in 2019, the Indian state of Delhi announced the introduction of STEM education for girls in Delhi government schools. As part of the announcement, the Delhi government introduced a digital platform with STEM modules to further encourage girls to pursue STEM education.[6] The Singaporean government has stated that the Character and Citizenship Education curriculum support encourages students to explore education and career pathways while countering gender stereotypes.[7] There have also been targeted efforts to promote STEM careers to women.

A key reason why India and Singapore were selected as case studies for comparison with Australia is because current research indicates that Indian and Singaporean women have high participation rates in STEM. Approximately 69% of Indian young women aged between 15 and 19 years study STEM, while 63% are interested in a STEM related

[4] "National STEM School Education Strategy". Australian Government – Department for Education, accessed 28 August 2023, https://www.education.gov.au/education-ministers-meeting/resources/national-stem-school-education-strategy.
[5] Caitlin Cassidy, "Female Scientists Found to be Almost Entirely Absent from Australian High School Curriculum", *The Guardian*, August 28, 2023, https://www.theguardian.com/australia-news/2023/aug/28/female-scientists-absent-australian-textbooks.
[6] Economic Times – Government, "Delhi Government to Launch STEM Education for Girls in Schools", *Economic Times*, October 19, 2019, https://government.economictimes.indiatimes.com/news/education/delhi-government-to-launch-stem-education-for-girls-in-schools/71561801.
[7] "STEM" Ministry of Education Singapore, accessed 28 August 2023, https://www.moe.gov.sg/news/parliamentary-replies/20220111-stem.

career.[8] Indian women also make up 51.9% of all Information Technology (IT) degrees.[9] In Singapore, the representation of women in STEM occupations has been increasing. In 2015, Singaporean women made up 29.9% of those in STEM jobs and by 2020, this had increased to 32.4%.[10] As of 2021, it was claimed that the figure had jumped significantly with women accounting for 41% of the tech workforce in Singapore.[11] Although, it should be acknowledged that this latter figure may have included a significant number of women with non-technology backgrounds who had been attracted to the booming technology company sector but whose jobs within those companies may have been in non-technological fields.[12] In contrast, Australian women comprise only 16% of the STEM-skilled workforce.[13] Statistics also reveal that only 38% of Australian women completed STEM degrees (excluding health disciplines) in 2019.[14] Notably, India and Singapore also have high rates of women participating in STEM in comparison to other Asian countries. For instance, whilst China has claimed to make improvements with regards to gender equality, data indicates a low rate of women participating in STEM,

[8] ET Bureau, "69% of Indian Girls Pick STEM Courses: Mastercard Survey", *The Economic Times,* February 15, 2017, http://tech.economictimes.indiatimes.com/news/people/69-of-indian-girls-pick-stem-mastercard-survey/57158194.

[9] "Women in Science, Technology, Engineering, and Mathematics (STEM) (Quick Take)", Catalyst, accessed July 7, 2019, https://www.catalyst.org/research/women-in-science-technology-engineering-and-mathematics-stem/.

[10] "Oral Answer to PQ on Emerging Trends for Female Professions", Singapore Ministry for Manpower, accessed September 4, 2023. https://www.mom.gov.sg/newsroom/parliament-questions-and-replies/2022/0112-oral-answer-to-pq-on-emerging-trends-for-female-professionals.

[11] "Transcript of Speech by Ms Rahayu Mahzam, Parliamentary Secretary, Ministry of Communications and Information, in Response to Motion on Empowering Women", Ministry of Communications and Information, August 3, 2021, https://www.mci.gov.sg/pressroom/news-and-stories/pressroom/2021/8/transcript-of-parliamentary-secretary-for-communications-and-information-rahayu-mahzam-response-to-motion-on-empowering-women.

[12] "Boosting Women in Technology in Southeast Asia: Shifting from Awareness to Action on Gender Diversity", BCG, accessed 18 September 2023, https://www.bcg.com/publications/2020/boosting-women-in-southeast-asia-tech-sector.

[13] Australian Academy of Science, *Women in STEM Decadal Plan,* (April 2019), 3, https://www.science.org.au/files/userfiles/support/reports-and-plans/2019/gender-diversity-stem/women-in-STEM-decadal-plan-final.pdf.

[14] "STEM Equity Monitor: University Enrolment and Completion in STEM and Other Fields", Department of Industry, Science, Energy and Resources, accessed January 24, 2021, https://www.industry.gov.au/data-and-publications/stem-equity-monitor/university-enrolment-and-completion-in-stem-and-other-fields.

especially when compared to India and Singapore. It is estimated that Chinese women account for only 6% of academicians of the Chinese Academy of Sciences and 5% of academicians of the Chinese Academy of Engineering.[15] Therefore, given the significant differences in women's participation in STEM in Australia compared to both India and Singapore, an examination of Indian and Singaporean policies and programs for women in STEM is warranted. It presents an interesting opportunity to contribute to the wider literature and to assess whether analysing Indian and Singaporean approaches can be of benefit to Australia.

The thesis also seeks to counter western-centric biases and highlight how Indian and Singaporean governments are particularly worthy of study because both have implemented policies and initiatives that have the potential to significantly increase the participation rates of women in STEM. These policies and programs will be examined further in Chapters Four and Five. Additionally, both India and Singapore have an economic and technological significance to Australia which has resulted in bilateral agreements that have placed much emphasis on STEM research and innovation. Given Australia's need to counter the technological rise of China, India and Singapore will likely become of even greater significance to Australia in the coming years.[16]

Before explaining the thesis project in more depth, it is necessary to explain the definitions of STEM being used. The Australian, Indian and Singaporean governments all use the common acronym of STEM and acknowledge that it covers a broad range of

[15] "Women in Science Can Change the World", United Nations Development Programme – China, accessed 25 April 2023, https://www.undp.org/china/blog/women-science-can-change-world.
Chao Gu, "Women Scientists in China: Current Status and Aspirations", *National Science Review* 8, no.10 (October 2021): 2, https://doi.org/10.1093/nsr/nwab101.
[16] Jamie Gaida, Jennifer Wong Leung, Stephen Robin and Danielle Cave, "ASPI's Critical Technology Tracker – The Global Race for Future Power", Australian Strategic Policy Institute, accessed 25 April 2023, https://www.aspi.org.au/report/critical-technology-tracker.

industries and occupations in their documents, reports and statements. The Australian government does not include health in the definition of STEM.[17] Therefore, government initiatives such as the STEM Equity Monitor do not include health in its definition of STEM. Nonetheless, "health is recognised as a closely related field that people with STEM qualifications may enter. It is often included in broader definitions of STEM".[18] In India's case, government reports featuring statistical information also exclude health and medical disciplines from the participation rate of women in science although the Department of Science and Technology does include health science as an area of focus.[19] One of its divisions includes drugs and pharmaceutical research.[20] Moreover, the Indian minister of Science and Technology, Dr Jitendra Singh, has a health background.[21] Singaporean politicians have sometimes utilised a definition of STEM that includes healthcare.[22] (The Singaporean government particularly promotes scientific research around health).[23] Yet, government reports featuring statistical information on women's participation rates do provide detailed statistics which distinguish the amount of women undertaking health science and those pursuing natural, physical and mathematical sciences.[24] While Australian, Indian and Singaporean governments have sometimes used slightly different conceptions of the breadth of STEM, their focus remains on the four

[17] "STEM: Equity Monitor: Methodology", Department of Industry, Science, Energy and Resources, accessed March 24, 2021, https://www.industry.gov.au/data-and-publications/stem-equity-monitor/methodology.
[18] Department of Industry, Science, Energy and Resources, "STEM: Equity Monitor: Methodology".
[19] Notably, statistical rates of women undertaking medical science degrees are still recorded. See Government of India: Ministry of Education - Department of Higher Education, *All India Survey on Higher Education 2019-20*, (New Delhi, 2020) 1-290, https://www.education.gov.in/sites/upload_files/mhrd/files/statistics-new/aishe_eng.pdf.
[20] "Drugs & Pharmaceutical Research", Department of Science and Technology, accessed January 29, 2022, https://dst.gov.in/drugs-pharmaceutical-research.
[21] "Meet the Minister", Department of Science and Technology, accessed January 29, 2022, https://dst.gov.in/meet-minister.
[22] "STEM: Parliamentary Replies", Ministry of Education Singapore, accessed January 29, 2022, https://www.moe.gov.sg/news/parliamentary-replies/20220111-stem.
[23] "Human Health and Potential", National Research Foundation: Prime Minister's Office Singapore, accessed January 29, 2022, https://www.nrf.gov.sg/rie2025-plan/human-health-and-potential.
[24] Department of Statistics Singapore, *Yearbook of Statistics Singapore 2019*, (Singapore, 2019) 306-309, https://www.singstat.gov.sg/-/media/files/publications/reference/yearbook_2019/yos2019.pdf.

main areas covered in the acronym. This thesis utilises the Australian and Indian governments' narrower definition of STEM. It will focus on analysing policies that aim to increase women's participation in science, technology, engineering and mathematics. It will exclude broader healthcare services while acknowledging that Australian and Indian governments may also at times have included some health-related scientific knowledge areas. Comparative government figures used will be carefully assessed to ensure they are measuring equivalents.

1.1.1 Research Questions

The thesis is a comparative study of government policies and initiatives that aim to increase women's participation in STEM. The key (interrelated) research questions that this thesis wishes to address include:

- how have Australian, Indian and Singaporean governments attempted to increase the representation of women in STEM in the periods being studied?
- have policies and initiatives been effective and if not, what are the key policy flaws and causes for them?
- how can Australian, Indian and Singaporean governments strengthen policies and initiatives, and further improve on attempts to increase women's representation in STEM?
- are there lessons that the respective countries can learn from one another?

In addressing the above, the thesis will also examine how governments' and politicians' framing of the issue has been influenced by particular social, cultural, economic and historical factors and particularly how neoliberal ideologies have undermined attempts to increase the representation rates of women in STEM.

Additionally, this thesis acknowledges that the term 'neoliberalism' is contested.[25] For the purposes of this thesis, neoliberalism will be defined as a body of economic theory and a policy stance. Neoliberal theory and the related policy stance claims that a largely unregulated capitalist system embodies the ideal of free individual choice and achieves optimum economic performance with regard to efficiency, economic growth and technical progress.[26] Neoliberalism suggests that the state should have a very limited economic role under the belief that state intervention is likely to create more problems than it solves. In his work, David Harvey notes that neoliberals assume that the state does not possess enough information to predict market signals. Neoliberals contend that powerful interests will inevitably distort state interventions for their own benefit. Consequently, neoliberalism argues that state intervention should be kept at a minimum except when facilitating market relations.[27]

Conversely, feminist scholars have noted the tensions between neoliberalism and gender equality agendas, and explored how neoliberalism impacts how governments respond to gender equality issues. In their work, Rimmer and Sawer illustrate that governments of differing political persuasions influenced by neoliberal ideas are alike in how they focus on and address gender equality issues that "fit more easily with neoliberal agendas rather than other feminist claims".[28] Further sections of this thesis will examine how

[25] Rajesh Venugopal, "Neoliberalism as Concept", *Economy and Society* 44, no. 2, (2015): 66, https://doi.org/10.1080/03085147.2015.1013356.
[26] David Kotz, "Globalization and Neoliberalism", *Rethinking Marxism* 14, no. 2 (2022): 64. https://doi.org/10.1080/089356902101242189
[27] David Harvey, "Neoliberalism as Creative Destruction", *The American Academy of Political and Social Science* 610, no. 1 (2007): 22-23, https://journals.sagepub.com/doi/10.1177/0002716206296780.
[28] Susan Harris Rimmer and Marian Sawer, "Neoliberalism and Gender Equality Policy in Australia", *Australian Journal of Political Science* 51, no 4 (2016): 754, https://doi.org/10.1080/10361146.2016.1222602.

governments have been influenced by neoliberal ideology and how this has impacted policies and initiatives for women in STEM.

The thesis will cite literature related to women and the broader labour market throughout the thesis and particularly in Chapters Two, Six and Seven which acknowledge that women in STEM struggle with similar challenges to those faced by women in employment generally. Nonetheless, the thesis will also cite current and well-established research that establishes that women in STEM face additional issues and barriers when they attempt to enter or excel in their STEM education or career. Given this, the thesis sought to draw more extensively on feminist literature, theories and analysis that focus heavily on women in STEM and particularly, women in science and women in technology given the breadth of literature that exists to articulate the challenges faced by these cohorts of women in the different contexts of Australia, Singapore and India.

1.1.2 Why Studying Women in STEM is Important.

This thesis argues that there are numerous reasons why studying issues of women and STEM are important. Statistics from the World Economic Forum (WEF) demonstrate that women are underrepresented in STEM occupations. Less than 30% of the world's researchers are women with underrepresentation occurring in almost every region of the world. Later chapters of this thesis will provide additional information on the rates of Australian, Indian and Singaporean women engaging in STEM. Although, it should be noted that government data on the specific STEM areas where women are underrepresented is limited.[29] Furthermore, women make up only 8% of the enrolments

[29] Debra Panizzon, Deborah Corrigan, Helen Forgasz and Sarah Hopkins, "Impending STEM Shortages in Australia: Beware the "Smoke and Mirrors"", *Procedia - Social and Behavioral Sciences* 167 (January 2015): 72-74, https://doi.org/10.1016/j.sbspro.2014.12.644.
Also see Brigid Freeman, Simon Marginson and Russell Tytler, "Widening and Deepening the STEM Effect", ed. Brigid Freeman, Simon Marginson and Russell Tytler (London: Routledge, 2014), 3.

in education courses in STEM fields such as ICT and, engineering, manufacturing and construction.[30] Consequently, the lack of women's participation in STEM is regarded as concerning by many countries, organisations and businesses.

It can also be argued that STEM has emerged as a vital and necessary part of society, particularly given future global challenges such as a changing climate, disruptive technologies and increased healthcare demands.[31] Moreover, the COVID-19 pandemic has further highlighted the importance of STEM skills. Digital tools have played an instrumental role in keeping the economy moving with many businesses encouraging their employees to transition into working from home. Individuals requiring government aid during the pandemic have also had to rely on online services. STEM based businesses have also managed to adapt as well as address global supply issues by using automation, robotics and 3D printing to build medical equipment. The global COVID-19 pandemic has tested and placed pressure on IT professionals.[32] It is of little surprise then, that careers in STEM are growing significantly faster than in many non-STEM positions.[33] An underrepresentation of women in growing STEM fields then, poses significant disadvantages for gender equality in future employment and in society more broadly.

Furthermore, scholars such as Caroline Criado Perez argue that a lack of women's representation in STEM fields will mean that future technologies and innovations will

[30]"3 Things to Know about Women in STEM", World Economic Forum, accessed 23 November 2021, https://www.weforum.org/agenda/2020/02/stem-gender-inequality-researchers-bias/.
[31] Office of the Chief Scientist, *Australia's STEM Workforce: Science, Technology, Engineering and Mathematics* (Government of Australia, July 2020), 3, https://apo.org.au/node/307014.
Denham Sadler, "Tech Jobs on the Rise in Australia", *Information Age,* September 2, 2019, https://ia.acs.org.au/article/2019/tech-jobs-on-the-rise-in-australia.html.
[32] Deloitte, *ACS Australia's Digital Pulse 2020* (Australia Computer Society, 2020), 7, https://www2.deloitte.com/au/en/pages/economics/articles/australias-digital-pulse.html. PDF available on webpage.
[33] "STEM Jobs Growing Almost Twice as Fast as Other Jobs", Australian Government (Department of Education, Skills and Employment), November 2, 2020, https://www.dese.gov.au/newsroom/articles/stem-jobs-growing-almost-twice-fast-other-jobs.

not consider the experiences and needs of women.[34] Within the field of artificial intelligence for example, individuals are continuing to create biased algorithms on biased and gendered data. That is, in the tech world, the "implicit assumption that men are the default human remains king." [35] This has large repercussions for women. New STEM technologies may often be unable to aid women or in some cases, marginalise them further. There are also ways in which technology can also impact whether women undertake certain careers. For instance, technological programs used for hiring purposes have been shown to favour male resumes over women's.[36] This is due to the fact that during the trial phase, programs are overwhelmingly supplied with resumes from male applicants.[37]

A lack of women's representation in STEM can also significantly undermine other areas of everyday life. For example, women are more likely to report bad reactions to medications than their male counterparts. One reason is because an estimated 80% of drug studies are tested only on male mice in the animal testing phase. In more recent studies, studying medical conditions in female animals has led researchers to understand how some diseases progress differently in a female body.[38] Additionally, tools created to aid individuals working in STEM environments are often more suited to males. In 2020,

[34] Caroline Criado Perez, *Invisible Women: Exposing Data Bias in a World Designed for Men,* (London: Chatto & Windus, 2019).
[35] Blueprint for Living, "Humans are Making Biased Algorithms that Entrench Discrimination – Without Even Trying", *ABC Radio National*, September 7, 2019, https://www.abc.net.au/news/2019-09-07/why-artificial-intelligence-further-entrenching-discrimination/11473604.
[36] Blueprint for Living, "Humans are Making Biased Algorithms".
[37] Marie Hicks, "Why Tech's Gender Problem Is Nothing New", *The Guardian,* October 13, 2018, https://www.theguardian.com/technology/2018/oct/11/tech-gender-problem-amazon-facebook-bias-women.
[38] Rae Ellen Bichell, "A Fix for Gender-Bias in Animal Research Could Help Humans", *NPR,* February 10, 2016, https://www.npr.org/sections/health-shots/2016/02/10/464697905/a-fix-for-gender-bias-in-animal-research-could-help-humans.

the Australian Medical Association raised concerns that women were at risk of contracting diseases because a majority of masks did not correctly fit them.[39]

These few instances above highlight the fact that women's participation in STEM is vital. New and emerging technologies may be more likely to neglect or omit the needs and experiences of women if women are not involved. In other cases, technological applications have the potential to deter women STEM graduates from choosing a STEM career. As emphasised by Perez, "when we are designing a world that is meant to work for everyone, we need women in the room."[40]

For all the above reasons, the issue of increasing women's participation in STEM is a crucially important one that governments need to address. The issue of why a comparison of government policies in Australia, India and Singapore specifically has been chosen will be explained later in this chapter.

1.2 Theoretical Framework and Methodology

1.2.1 Feminist Comparative Policy

The examination of the key research questions set out earlier in this chapter has been deeply inspired by feminist comparative policy (FCP). FCP provides insight into the extent that states implement policies and programs designed to advance women's rights and gender equality. FCP also examines whether states have made progress in mitigating gender-based inequities.[41] Using FCP, this thesis assesses whether Australian, Indian and

[39]Matilda Boseley, "AMA Condemns "Appalling" Approach of Governments to Ill-Fitting Masks for Covid Healthcare Workers", *The Guardian*, 18 August 2020, http://www.theguardian.com/australia-news/2020/aug/19/ama-condemns-governments-appalling-approach-to-face-masks-for-covid-healthc-workers.

[40] Blueprint for Living, "Humans are Making Biased Algorithms".

[41] Amy Mazur and Season Hoard, "Gendering Comparative Policy Studies: Towards Better Science", in *Comparative Policy Studies: Conceptual and Methodological Challenges*, ed. Isabelle Engeli and

Singaporean government policies and initiatives adequately address the barriers that affect girls and women in STEM education pathways and occupations. The FCP approach can also highlight variations with how states frame gender into policy and programs.[42] In order to understand these variations as well as how they have been developed, the thesis analyses how Australian, Indian and Singaporean historical, social and cultural influences shaped and maintained gendered ideology which continues to be prevalent in policies and programs for women in STEM. The researcher draws from books, journal articles and primary sources that focus on how social, institutional, cultural and social influences associated STEM as a masculine area of study. For example, the work of Ann Moyal and Claire Hooker in Chapter Three provides historical insight into how STEM was deemed inappropriate and in conflict with feminine ideals in Australia. Correspondingly, in Chapter Four Neelam Kumar, Aparna Basu and Robin Jeffrey's work lays out how female education in India varied from one region to another when considering factors such as community, class, region, religion, ethnicity, caste, culture and language. In Chapter Five, Jean Lee, Kathleen Campbell and Audrey Chia provide insight into how politicians and policymakers reinforce cultural expectations on Singaporean women. Taken together, parts of Chapters Three to Five demonstrate the variances of each respective case study and explore how these variances are shaped by historical, cultural, social and political influences. As such, the FCP approach enabled the thesis to draw from the work of Australian, Indian and Singaporean scholars to explore variations with how the respective countries discursively framed gender into their policies and initiatives.

Christine Rothmayr Allison (London: Palgrave Macmillan UK, 2014), 207, https://doi.org/10.1057/9781137314154_10.

[42] Heidi Gottfried and Laura Reese, "Gender, Policy, Politics, and Work: Feminist Comparative and Transnational Research", *Review of Policy Research* 20, no. 1 (2003): 4, https://doi.org/10.1111/1541-1338.d01-2.

In addition, the FCP approach is problem-driven in that researchers identify problems and seek to provide suggestions.[43] Whilst this thesis draws from FCP, it does so from a political science disciplinary approach. As such, the thesis seeks to identify problems and provide suggestions on policies and initiatives at the level of elected governments and politicians rather than providing analysis that focuses on public administration issues. As will be explained later in this chapter, this thesis relies heavily on primary sources such as government documents and politicians' statements. Recognising that the subject matter, that is, the underrepresentation of women in STEM is currently generating much government and media attention, the researcher sought to utilise relevant media sources in Australia, India and Singapore including articles, interviews, and radio and television reports. Some of these included, for example, interviews with politicians that were unavailable elsewhere. A key advantage with using media sources was that the researcher was able to keep themselves updated on current discussions and events surrounding women in STEM. Many of the utilised sources included information regarding how women in STEM were impacted by certain policy settings as well how STEM industries had influenced the way in which women could pursue and excel in a STEM career. This enabled the researcher to develop deeper insight and consider suggestions which could address current and prominent barriers to women's representation in STEM. Moreover, media sources are "most useful in illustrating the social or political context" of a topic, generating leads on new research and potentially inspiring the researcher to pursue a new angle on a topic.[44] Yet, media outlets can be flawed as they may seek to attract readers by sensationalising information and data. In order to mitigate this, the researcher ensured

[43] Mazur and Hoard, "Gendering Comparative Policy Studies", 208.
[44] Kristin Natalier, "Research Design – Methods", in *Social Research Methods*: *Fourth Edition*, ed. Maggie Walter (Victoria: Oxford University Press, 2019), 38.

that where possible, information provided by a media piece was corroborated by other more reliable sources, and unsubstantiated opinion pieces were excluded.

A problem-driven approach also requires FCP scholars to examine a range of variables such as cultural, societal and historical influences that are related to the key issue.[45] As noted above, Chapters Three, Four and Five will provide sections that examine Australian, Indian and Singaporean historical, political, economic, social and cultural influences that have the potential to affect women's participation in STEM education and jobs. The addition of these sections will also support the identification of key similarities, with one being the influence of neoliberalism. Scholars working with FCP and particularly focused on the problem-driven approach, aim to provide policymakers, activists and organisations with knowledge on the causes of gender inequities.[46] This assists in the development of good policies and practices that strengthen women's representation in certain areas and spheres. Given this aim, Amy Mazur suggests that FCP can potentially make democracies more democratic and thus it is worthy of consideration here.[47]

Additionally, as this thesis has done, FCP research has sought to include more countries in systematic comparisons.[48] Yet, there are some concerns about this approach as some countries can have radically different cultural and political environments. In response to this, and as mentioned above, the thesis has drawn on scholarly work from Indian and Singaporean researchers as well as Australian ones. The inclusion of the Indian and

[45] Donald Green and Ian Shapiro, "Eight: Responses to Likely Counterarguments", in *Pathologies of Rational Choice Theory: A Critique of Applications in Political Science* (Yale University Press, 1994), 205.
[46] Mazur and Hoard, "Gendering Comparative Policy Studies", 208-9.
[47]Amy Mazur, "Feminist Comparative Policy: A New Field of Study", *European Journal of Political Research* 35, no. 4 (1999): 486, https://doi.org/10.1111/1475-6765.00457.
[48] Mazur and Hoard, "Gendering Comparative Policy Studies", 208, 214-5.

Singaporean academic literature means that the thesis will not overly rely on 'western' research that may generalise Indian and Singaporean women's experiences and barriers.[49] It also enables a deeper understanding of how India and Singapore have unique influences that potentially require policymakers to implement different measures for women wishing to engage in STEM. This thesis thus argues that India and Singapore are implementing beneficial policies and programs that have not received much academic discussion from western scholars and institutions. Given Australia's multiculturalism, it is possible that Australian policymakers may find the Indian and Singaporean case studies useful in understanding some of the barriers that may impact women from diverse cultural backgrounds.

1.2.2 Gendered Discursive Policy Framing Analysis

In order to answer the key research questions as noted in section 1.1.1., the thesis will draw on analysis of discursive policy framing analysis, using a gendered lens. The analysis of gendered discursive policy framing is an accepted methodological approach in feminist political science and other related disciplines.[50] As noted by Penny Griffin, analysing discourse means to understand discourse beyond language.[51] Discourse can be both product and producer of social, political and cultural formations. Discourse can include social configurations of political space, including language, and can also

[49] The researcher is particularly aware of these issues given that she has a combined Australian and Singaporean Indian background. She lived in Singapore for a period of time as a child and continues to sporadically visit.

[50] See Emanuela Lombardo, Petra Meier and Mieke Verloo, "Stretching and Bending Gender Equality: A Discursive Politics Approach" in *The Discursive Politics of Gender Equality: Stretching, Bending and Policy-Making,* ed. Emanuela Lombardo, Petra Meier and Mieke Verloo (New York: Routledge, 2009), 9.
Carol Johnson, "Gender Research and Discursive Policy Framing", in *Gender Innovation in Political Science: New Norms, New Knowledge,* ed. Marian Sawer and Kerryn Baker (London Palgrave: Macmillan, 2019), 196.

[51] Penny Griffin, "Gender, IPE and poststructuralism: problematizing the material/discursive divide", in *Handbook on the International Political Economy of Gender,* ed. Juanita Elias and Adrienne Roberts (Cheltenham: Edward Elgar Publishing Limited, 2018), 94.

influence or include "material conditions and effects, institutions, texts (visual and written), imparted wisdoms, linguistic and cultural contexts, ideologies, process of social production and reproduction, interactions and relationships".[52] Elaborating further, discourse can be both shaped by the material as well as helping to shape it.

The thesis draws on Carol Bachi and Jennifer Bonham's interpretation of Foucault's concept of 'discursive practices', albeit incorporating this into the concept of discursive framing rather than specifically using the term practices. In their work, Bacchi and Bonham explain that the term 'discursive practice/s' describes practices "of knowledge formation by focusing on how specific knowledges ("discourses") operate and the work they do."[53] Elaborating further, Bacchi and Bonham reflect that discursive practices refer "to the rules that explain how it becomes possible to say (or know) certain things" and to understand how 'things said' could be accepted as truth.[54] The inclusion of historical sources and sections in Chapters Two to Five illustrates how past governments, and social and cultural forces discursively framed ideas of STEM being a masculine area of study and employment as truth. The inclusion of the sections and such discourse, also assists in understanding how historical factors have contributed to current policymaking with regards to women in STEM. Notably, discursive approaches to politics have been deemed by feminist scholars as particularly suited to illustrate "the way power works in framing processes within both feminist and non-feminist debates".[55] Thus, discourse analysis used

[52] Griffin, "Gender, IPE and Poststructuralism: Problematizing the Material/Discursive Divide", 94.
[53] Carol Bacchi and Jennifer Bonham, "Reclaiming Discursive Practices as an Analytic Focus: Political Implications", *Foucault Studies* 17 (2014): 174, https://doi.org/10.22439/fs.v0i17.4298.
[54] Bacchi and Bonham, "Reclaiming Discursive Practices as an Analytic Focus",180.
[55] Emanuela Lombardo, Petra Meier and Mieke Verloo, "Stretching and Bending Gender Equality: A Discursive Politics Approach" in *The Discursive Politics of Gender Equality: Stretching, Bending and Policy-Making*, ed. Emanuela Lombardo, Petra Meier and Mieke Verloo (New York: Routledge, 2009), 9.

in this thesis will assist in revealing whether there are underlying beliefs or ideas that may have contributed to either high quality or inadequate policy framing.

Framing can be defined as "a thought organizer, highlighting certain events and facts as important and rendering others invisible".[56] In other words, discursive policy framing can shape factors such as how policy issues are understood, which are seen as significant or problematic and which solutions are considered appropriate and deemed likely to work. Furthermore, policies addressing gender issues can be incorporated into other, pre-existing policy frames that can limit or counteract their effectiveness.[57] Framing can be influenced by a range of gendered historical, social and cultural factors, including ideologies such as liberalism and nationalism. Framing can also be regarded as an interactive process as actors with agendas encounter and regard particular forms of discourse as opportunities which can be embedded or shaped with certain ideas, beliefs, norms and practices.[58]

Consequently, by drawing on established discursive policy framing approaches, the thesis focuses on analysing the content and underpinnings of policy discourse. Therefore, discursive policy framing analyses are somewhat different from analyses of discourse in disciplines such as linguistics which might focus more on, for example, the structure and strategies of language use or semiotics rather than policy content. Policy discourse includes political statements, press releases, official documents, reports, websites, policies, initiatives and other government material. These types of policy discourse can be analysed to illustrate how Australian, Indian and Singaporean policymakers have

[56] Charlotte Ryan and William Gamson, "The Art of Reframing Political Debates", *Contexts* 5, no.1 (2006):13, https://www.jstor.org/stable/41802788
[57] See Lombardo, Meier and Verloo, "Stretching and bending gender equality' and Johnson, 'Gender Research and Discursive Policy Framing'.
[58] Lombardo, Meier and Verloo, "Stretching and Bending Gender Equality", 10-12.

discursively framed the underrepresentation of women in STEM and maintained gendered beliefs, norms and practices, while situating such policy discourse in its broader, interconnected, social, economic and political context. For example, in Chapter Five, the thesis utilises discourse from former Singaporean Prime Minister Lee Kuan Yew to demonstrate how policies and programs were discursively framed in limiting ways that focused on enabling women to fulfil expectations from the state as well as cultural and societal roles. An analysis of Indian government materials such as budget documents and strategies highlights how some Indian politicians discursively framed policies and programs for women to focus on particular contributions to the state and economy. In other instances, the thesis will also assess how government materials including press releases, speeches, and policies and programs have been discursively framed by the neoliberal idea that women are largely responsible for their own economic and social mobility. For instance, Chapter Three analyses the Women in STEM Cadetship and Advanced Apprenticeship initiative and notes how it does not address many issues that deter women from pursuing a STEM education whilst working. These policy flaws reflect the neoliberal idea that governments should not heavily intervene in the market and moreover, that the individual is at fault for not succeeding. As such, the thesis has utilised discourse analysis which bases its "premise that documents are powerful objects, as they have the power to create new – and reinforce existing – beliefs and ideologies within society".[59] This form of discourse analysis can reach beyond surface meanings as it highlights and describes power relations, and considers which discourses can be challenged.[60]

[59] Aimee Grant, "Historical and Official Documents: Moving Beyond Simple Interpretations" in *Doing Excellent Social Research with Documents: Practical Examples and Guidance for Qualitative Researchers*, ed. Aimee Grant (Oxon: Routledge, 2019), 66.
[60] Grant, "Historical and Official Documents: Moving Beyond Simple Interpretations", 66-67.

Framing can provide insight into what elements of a particular studied Australian, Indian and Singaporean policy or program are essential and what are "out of the picture". For instance, Chapter Five notes how the Singaporean program, SkillsFuture does not address some of the barriers women face as they attempt to balance studying with other familial commitments. The program is framed in a manner which neglects how women can often struggle to commit to education courses that are not flexible in timing and have rigid schedules. For instance, a mother may be deterred from a SkillsFuture course if the timing occurs near the end of the school day. In other cases what is 'in' and 'out' of a picture can be particular cohorts of women. Analysis on Australia's Women in STEM Cadetships and Advanced Apprenticeships program highlights how women with lower financial means can be deterred from participating and excelling. Frames and considerations of what is 'in' and 'out' of a frame are rooted in explicit agency and intention as actors including politicians and policymakers may apply rules and routines unaware or not conscious of the fact that they are, in fact, rules and routines.[61]

Analysing policy framing from a gendered perspective is important because it highlights the ways that women are being marginalised or excluded from policy decisions.[62] Carol Johnson explains that neoliberal policies are often framed in ways that neglect how women contribute to the broader economy. Discursive framing "provides an inadequate picture of how the economy operates and the role of (predominately female) non-paid, non-market work in its functioning."[63] A discursive framing that neglects gender can often silence the experiences of women or neglect to address the issues that arise from policies that do not consider how women may be affected. An analysis of policy with a

[61] Lombardo, Meier and Verloo, "Stretching and Bending Gender Equality", 12.
[62] Carol Johnson, "Gender Research and Discursive Policy Framing", in *Gender Innovation in Political Science: New Norms, New Knowledge,* ed. Marian Sawer and Kerryn Baker (London Palgrave: Macmillan, 2019), 196.
[63] Johnson, "Gender Research and Discursive Policy Framing", 198.

gender focus can also potentially illustrate how governments reinforce gendered norms, beliefs and practices. As Carol Bacchi notes, policies have the potential of constituting who individuals are.[64] Governments could be maintaining ideas about what is considered as appropriate women's work and men's work and framing these ideas within policies and programs for women in STEM. Consequently, this thesis will explore how discourse including policies are designed to reinforce ideas about the types of work undertaken by women particularly, in Chapter Four and the Conclusion, where Indian governments have not implemented schemes to support men undertaking domestic work.

Examining policy with a gender perspective can provide insight into how policies for girls and women in STEM neglect to adequately address barriers. For instance, Carol Bacchi demonstrates that policies designed to encourage girls to choose non-traditional occupational study areas are often framed in a manner that implies that girls are the problem.[65] This framing ignores social, cultural, political, economic and institutional influences that play a large role in determining whether a girl will pursue a non-traditional study area or occupation. Recent academic work has also assessed how girls in preschool do not have the same access to STEM activities as boys.[66] This can impact girls later in life as they have less confidence in engaging with STEM subjects than boys. Consequently, the policy framing may not be addressing significant barriers that impact girls' participation in STEM. Policymakers may also be losing opportunities to address barriers earlier. The policy framing also limits a wider understanding of the issues given

[64] Carol Bacchi, "Policies as Gendering Practices: Re-Viewing Categorical Distinctions", *Journal of Women, Politics & Policy* 38, no. 1 (2 January 2017): 20–21, https://doi.org/10.1080/1554477X.2016.1198207.
[65] Carol Lee Bacchi, *Women, Policy and Politics: The Construction of Policy Problems* (London: SAGE Publications, 1999), 66.
[66] Marilyn Fleer, "Re-Imagining Play Spaces in Early Childhood Education: Supporting Girls' Motive Orientation to STEM in Times of COVID-19", *Journal of Early Childhood Research* 19, no. 1 (1 March 2021): 4-5, https://doi.org/10.1177/1476718X20969848.

that it does not seek to examine factors such as 'race' and 'wealth'. Thus, policy analysis with a gender focus will enable this thesis to provide deeper insight into how programs for girls and women in STEM are discursively framed. It will also explain how policies may not be addressing issues that affect particular groups of women.

Therefore, discourse analysis has enabled this thesis to uncover discursive framings that have shaped policies as well as some of the ways that politicians and policymakers have sought to represent their actions in texts, language, and government policies and programs.[67] However, there are some limitations with using government sources and discourse. For instance, information can be written in a way that adheres to a political goal, objective, belief or idea. Information about a policy or program may also be discursively framed in a manner that justifies how a particular policy or program achieves positive outcomes as identified by policymakers rather, than critically assessing its flaws. Moreover, official documents can be embedded with systemic bias and reflect particular norms, meanings and intentions.[68] Authors need to be alert to such issues and the analysis of discursive policy framing underpinning this thesis has assisted in throwing light on when this is the case. Gaps in the information, statistics and evaluations of programme outcomes provided by government have also been identified and highlighted.

1.2.3 Broader Feminist Theory Relevant to Gender and STEM

While the thesis will be undertaking a feminist comparative policy and gendered discursive framing analysis, the project will also draw on, and integrate, the broader work of feminist analyses of women in science, feminist sociologists and political scientists amongst others to help explain the cultural, familial and societal expectations that may

[67] Keith Jacobs, "Discourse Analysis", in *Social Research Methods Ebook*, ed. Maggie Walter (Victoria: Oxford University Press, 2019), 319.
[68] Grant, "Historical and Official Documents: Moving Beyond Simple Interpretations", 62.

limit women's participation in STEM. Feminist theories will highlight how girls and women in STEM continue to be impacted by structural and institutional barriers. For example, feminist political economists have argued that neoliberalism has reshaped aspects of human life according to market criteria of efficiency and rationality. Isabella Bakker notes that "from the vantage point of social reproduction, this means that responsibility for systemic problems is being downloaded onto the individual, especially women."[69] Feminist political economists have also remarked how much of women's labour has not been recognised as important to public policy in terms of benefits or costs. This is despite the fact that women's unpaid labour which occurs predominately at the household level "is a means of sustaining and reproducing the human species as well as the labor force that is essential for capital accumulation and undergirds their exploitation".[70] Subsequent chapters of this thesis will illustrate how neoliberal ideas coupled with perceptions around women's unpaid labour has been reflected in policies and programs which do not sufficiently addressed concerns faced by women. Chapters Three, Four and Five will also explore how Australian, Indian and Singaporean women are affected by political and economic influences that limit their ability to pursue and maintain STEM education and employment pathways. The work of feminist scholars will be used to assess whether the studied Australian, Indian and Singaporean policies and initiatives address issues affecting girls and women in STEM as identified by the academic literature.

Chapter Two of this thesis will examine the wider academic literature that focuses on women in STEM from a 'western' lens. Work from academics will be used to explore

[69] Isabella Bakker, "Social Reproduction and the Constitution of a Gendered Political Economy", *New Political Economy* 12, no.4 (2007): 553, https://doi.org/10.1080/13563460701661561.
[70] Isabella Bakker and Stephen Gill, "Rethinking Power, Production, and Social Reproduction: Toward Variegated Social Reproduction", *Capital & Class* 43, no. 4 (8 November 2019): 507, https://doi.org/10.1177/0309816819880783.

how policy tools such as the 'STEM leaky pipeline model' are flawed in their ability to account for diverse experiences.[71] Research from feminist scholars such as Susan Rosser and Vanessa Jean et al., will demonstrate how women struggle to balance familial responsibilities with competing work demands due to a lack of government and institutional initiatives.[72] Additionally, a focus on feminist scholars will explain how STEM was and continues to be, regarded as a masculine area of study.[73] These scholars also note how pervasive social and cultural constructions continue to influence the extent to which women can engage with STEM. The research from these feminist scholars will be used to illustrate how the examined Australian, Indian and Singaporean policies may not be adequately addressing the challenges faced by women wishing to pursue STEM pathways.

---

[71] Heather Metcalf, "Stuck in the Pipeline: A Critical Review of STEM Workforce Literature", *InterActions: UCLA Journal of Education and Information Studies* 6, no. 2 (27 May 2010), https://escholarship.org/uc/item/6zf09176.
Matthew A. Cannady, Eric Greenwald, and Kimberly N. Harris, "Problematizing the STEM Pipeline Metaphor: Is the STEM Pipeline Metaphor Serving Our Students and the STEM Workforce?", *Science Education* 98, no. 3 (1 May 2014): 444, https://doi.org/10.1002/sce.21108.
Marc Goulden, Mary Ann Mason, and Karie Frasch, "Keeping Women in the Science Pipeline", *The ANNALS of the American Academy of Political and Social Science* 638, no. 1 (November 2011): 141-162, https://doi.org/10.1177/0002716211416925.
Jill A. Marshall, "Escape from the Pipeline: Women Using Physics Outside Academia", *The Physics Teacher* 46, no. 1 (18 December 2007): 20-24, https://doi.org/10.1119/1.2823995.
[72] Sue V Rosser, "Using POWRE to ADVANCE: Institutional Barriers Identified by Women Scientists and Engineers", in) *Removing Barriers: Women in Academic Science, Technology, Engineering, and Mathematics*, ed. Jill Bystydzienski and Sharon Bird (Bloomington: Indiana University Press, 2006), 87, https://ebookcentral.proquest.com/lib/adelaide/reader.action?docID=278894&ppg=8.
Vanessa A. Jean, Stephanie C. Payne, and Rebecca J. Thompson, "Women in STEM: Family-Related Challenges and Initiatives", in *Gender and the Work-Family Experience: An Intersection of Two Domains*, ed. Maura J. Mills (Cham: Springer International Publishing, 2015), 291-311, https://doi.org/10.1007/978-3-319-08891-4_15.
[73] Mary Barbercheck, "Mixed Messages - Men and Women in Advertisements in Science" in *Women, Science and Technology: A Reader in Feminist Science Studies*, ed. Mary Wyer, Mary Barbercheck, Donna Geisman, Hatice Örün Öztürk and Mara Wayne (New York: Routledge, 2001), 117-31.
Lucy Wandiri Mbirianjau, "Why Fewer Kenyan Women Are Choosing or Completing STEM Courses", *The Conversation*, September, 20, 2018, http://theconversation.com/why-fewer-kenyan-women-are-choosing-or-completing-stem-courses-91706.
"Alignment with Gender Stereotypes Predicts Success in Tech", The Clayman Institute for Gender Research, accessed November 5, 2018, https://gender.stanford.edu/news-publications/gender-news/alignment-gender-stereotypes-predicts-success-tech.
Ulf Mellström, "The Intersection of Gender, Race and Cultural Boundaries, or Why Is Computer Science in Malaysia Dominated by Women?", *Social Studies of Science* 39, no. 6 (2009): 885-907, https://www.jstor.org/stable/27793329.

Furthermore, research from feminist scholars in Chapter Three will be examined to illustrate how the field of botany was regarded as an appropriate area of work and study for Australian women during the nineteenth century.[74] Their research will also demonstrate that Australian women were confined to role of an 'assistant' and were restricted in their ability to actively participate further in STEM. This thesis will thus suggest that Australian women in STEM continue to be significantly limited in how they engage with STEM education and occupations. An examination of research from feminist academics such as Yolanda van Gellecum et al., and Louise Dalingwater will explore how Liberal and Labor federal government (both Labor and Liberal Coalition ruling parties) have been influenced by neoliberal ideals.[75] The adoption of neoliberal ideals have fuelled the perception that policymakers should not implement progressive gender equality schemes because women are predominately responsible for their own economic status. Moreover, scholars in the field of feminist political economy have also noted how the work of social reproduction which occurs at the household level and includes the caring of children, elderly and everyday housework, has no monetary value within conventional economics.[76] As such, the social reproduction work undertaken by many Australian women has often been neglected by policymakers who have not adequately

[74] Claire Hooker, *Irresistible Forces: Australian Women in Science* (Melbourne: Melbourne University Press, 2004), 10-24.
Ann Moyal, "Invisible Participants. Women in Science in Australia, 1830 — 1950", *Prometheus* 11, no. 2 (1 December 1993): 175-87, https://doi.org/10.1080/08109029308629352.
[75] Yolanda van Gellecum, Janeen Baxter, and Mark Western, "Neoliberalism, Gender Inequality and the Australian Labour Market", *Journal of Sociology* 44, no. 1 (1 March 2008): 45–63, https://doi.org/10.1177/1440783307085842.
Louise Dalingwater, "Neo-Liberalism and Gender Inequality in the Workplace in Britain", *Revue Française de Civilisation Britannique. French Journal of British Studies* XXIII, no. XXIII–1 (15 March 2018), https://doi.org/10.4000/rfcb.1802.
Susan Harris Rimmer and Marian Sawer, "Neoliberalism and Gender Equality Policy in Australia", *Australian Journal of Political Science* 51, no. 4 (1 October 2016): 742–58, https://doi.org/10.1080/10361146.2016.1222602
Carol Johnson, *Governing Change: Keating to Howard* (St Lucia: University of Queensland Press, 2000), 70-87.
[76] Isabella Bakker and Stephen Gill, "Rethinking Power, Production, and Social Reproduction: Toward Variegated Social Reproduction", *Capital & Class* 43, no. 4 (8 November 2019): 507, https://doi.org/10.1177/030981681988078.

provided policy measures to support women as they balance familial and work responsibilities. However, as the above feminist scholars argue, this framing neglects the influence of social, cultural, economic and political factors that have the potential to significantly undermine women's engagement in STEM. Subsequently, insights from Australian feminist scholars will demonstrate how the prevalence of neoliberal ideals has impacted policies and programs for Australian girls and women in STEM.

Chapter Four will examine research from Indian feminist scholars engaged in examining the barriers impacting Indian women in STEM. Carol Mukhopadhyay's essential work on Indian family models and particularly, on the patrifocal family model will demonstrate how girls face numerous barriers when they attempt to undertake STEM education and employment.[77] Mukhopadhyay's feminist work will also be used to explore how education decisions within a family are deeply complex and are influenced by economic and social factors. Lalita Subrahmanyan's research will be used to examine how STEM education and employment undermine a woman's marriageability.[78] Work from other scholars will also assess how STEM education and occupations have slowly been appropriated as beneficial by some Indian households who struggle with dowry demands.[79]

---

[77] Carol Mukhopadhyay, "How Exportable Are Western Theories of Gendered Science? A Cautionary Word", in *Women and Science: A Reader*, ed. Neelam Kumar (New Delhi, Oxford University Press, 2009), 137–77, 148-149.

[78] Lalita Subrahmanyan, *Women Scientists in the Third World: The Indian Experience* (New Delhi: SAGE Publications, 1998).
Lalita Subrahmanyan, "Patrifocality and the Entry of Women into Science", *Higher Education*, 30, (1995): 86. https://doi.org/10.1007/BF01384050

[79] Suchitra Shenoy-Packer. *India's Working Women and Career Discourses: Society, Socialization, and Agency* (Lanham: Lexington Books, 2014), 9-43.
Rajni Palriwala, "The Spider's Web: Seeing Dowry, Fighting Dowry", in *Dowry: Bridging the Gap Between Theory and Practice*, ed. Tamsin Bradley, Emma Tomalin, and Mangala Subramaniam (London: Zed Books, 2009), 144–76.
Kate Jehan, "Heroes or Hondas? Analysing Men's Dowry Narratives in a Time of Rapid Social Change", in *Dowry: Bridging the Gap Between Theory and Practice*, ed. Tamsin Bradley, Emma Tomalin, and Mangala Subramaniam (London: Zed Books, 2009), 59–86.

Chapter Five will draw on Singaporean feminist scholars who have been able to highlight some of the barriers faced by Singaporean women.[80] Work by Kho Ee Moi will provide in-depth insights into education policies established by the Singaporean government during the 1950s to 1960s.[81] Michelle Lazar's concept of strategic egalitarianism will also illustrate how the Singaporean government has provided certain rights and opportunities to women only where there is a pragmatic reason to do so.[82] The concept of strategic egalitarianism will be used to highlight how Singapore has and continues to be, contradictory in its approach for women's policies. There is a gap in the wider academic literature when examining the specific barriers faced by Singaporean women in STEM. Despite this, insights provided by Singaporean women's advocacy group AWARE (Association of Women for Action and Research) will provide essential insights into how the government implemented legislation for women following Singapore's independence.[83] Moreover, research obtained from AWARE will highlight how the Singaporean government under the leadership of Lee Hsien Loong promoted the narrative that women both educated and employed in STEM make a vital contribution to national development.

Chapter Six argues that technology has provided more opportunities for women to undertake paid work. Research from Celestine Ukpere et al., will be used to illustrate that

---

Padma Srinivasan and Gary R. Lee, "The Dowry System in Northern India: Women's Attitudes and Social Change", *Journal of Marriage and Family* 66, no. 5 (2004): 1108–17.

[80] Youyenn Teo, "Gender Disarmed: How Gendered Policies Produce Gender-Neutral Politics in Singapore", *Signs* 34, no. 3 (2009): 533–58, https://doi.org/10.1086/593332.
Karlien Strijbosch, "Single and the City: State Influences on Intimate Relationships of Young, Single, Well-Educated Women in Singapore", *Journal of Marriage and Family* 77, no. 5 (2015): 1108–25, https://doi.org/10.1111/jomf.12221

[81] Kho Ee Moi, "Construction of Femininity: Girls' Education in Singapore, 1959-2000" (PhD Thesis, National University of Singapore, 2004), https://scholarbank.nus.edu.sg/handle/10635/14184?mode=full.

[82] Michelle M. Lazar, "For the Good of The Nation: "Strategic Egalitarianism" in the Singapore Context", *Nations and Nationalism* 7, no. 1 (2001): 59–74, https://doi.org/10.1111/1469-8219.00004.

[83] "Education", AWARE: Women's Action, accessed July 20, 2019, http://womensaction.sg/article/education.

technology has presented women with ways to counter barriers impacting on their ability to work.[84] Moreover, Victoria Crittenden's et al. work will explain how technology has enabled women from disadvantaged backgrounds to join online communities to reduce feelings of isolation as well as support members.[85] The work from the above authors will be used to highlight why Australian, Indian and Singaporean governments have implemented beneficial programs for women wishing to pursue entrepreneurial pathways. Research from academics will also be examined to explain how entrepreneurial pathways can potentially exacerbate gender ideology that maintains that women are ill-suited to entrepreneurial roles because they are not as driven as their male counterparts.[86] Literature from researchers will provide deeper insights into how social and cultural forces have continued to emphasise that women's work should be in the home.[87] Moreover, academic work from scholars will emphasise how entrepreneurial careers can create additional pressures on women, particularly given the barriers they face.[88] Their research demonstrates that women can potentially face severe financial consequences in pursuing an entrepreneur career.

---

[84] Celestine Lugaye Ukpere, Andre D. Slabbert, and Wilfred I. Ukpere, "Rising Trend in Social Media Usage by Women Entrepreneurs across the Globe to Unlock Their Potentials for Business Success", *Mediterranean Journal of Social Sciences* 5, no. 10 (3 June 2014): 551.

[85] Victoria L. Crittenden, William F. Crittenden, and Haya Ajjan, "Empowering Women Micro-Entrepreneurs in Emerging Economies: The Role of Information Communications Technology", *Journal of Business Research* 98 (1 May 2019): 191–203, https://doi.org/10.1016/j.jbusres.2019.01.045.

[86] Tiantian Yang, and María del Carmen Triana, "Set Up to Fail: Explaining When Women-Led Businesses Are More Likely to Fail", *Journal of Management*, 45, no.3 (1 March 2019): 926–54. https://doi.org/10.1177/0149206316685856.

[87] Camilla Nelson, "The Rise of the Digital 'Mumpreneur'", *ABC News*, October 19, 2018, https://www.abc.net.au/news/2018-10-19/rise-of-the-digital-mumpreneur-turning-kids-into-brands/10393140.

Meraiah Foley, "Becoming a 'Mumpreneur' is an Option of Last Resort for Many Working Mothers", *The Sydney Morning Herald*, May 4, 2016, https://www.smh.com.au/opinion/becoming-a-mumpreneur-is-an-option-of-last-resort-for-many-working-mothers-20160504-golrkl.html.

[88] Piers Thompson, Dylan Jones-Evans, and Caleb Kwong, "Women and Home-Based Entrepreneurship: Evidence from the United Kingdom", *International Small Business Journal*, 27, no.2 (1 April 2009): 227-39, https://doi.org/10.1177/0266242608100492.

Brownhilder Neneh, "Why Foreignness Matters: The Impact of Business-Family Interference on the Exit Intentions of Women Entrepreneur", *Journal of Small Business Strategy*, 30, no.1, 83–96,

This thesis will therefore draw on the scholarly work of feminist theorists and academics to illustrate the cultural, familial and societal expectations that may limit women's participation in STEM education and careers. The thesis will also examine literature from Australian, Indian and Singaporean researchers to provide insight into other barriers that have not been expressed in Chapter Two due to differing socio-cultural contexts. The work of researchers noted in this section will also assist in determining whether the examined Australian, Indian and Singaporean policies adequately address girls and women in STEM as well as those wishing to pursue entrepreneurial careers.

1.2.4 Case Study Approach

The thesis also utilises a case study approach to explore the mechanisms that guide decision-making with regards to women in STEM. As Helen Simons explains case studies are an "in-depth exploration from multiple perspectives of the complexity and uniqueness of a particular project, policy, institution, programme or system in a 'real life' context."[89] Furthermore, a case-study approach is inclusive of different methods. In a collective case study, researchers may explore individual cases before amalgamating across cases.[90] Similarly, this thesis explores Australia in Chapter Three, India in Chapter Four and Singapore in Chapter Five. The Conclusion examines key differences and similarities across the cases. The thesis will draw from Leslie Pal's definition of a 'case study as being based on a "single unit of analysis", an 'individual' (either a person or a

https://www.proquest.com/docview/2465478601/fulltextPDF/8F4DFA591C524B82PQ/1?accountid=8203.

Dilani Jayawarna, Julia Rouse, and John Kitching, "Entrepreneur Motivations and Life Course", *International Small Business Journal* 31, no. 1 (1 February 2013): 34–56, https://doi.org/10.1177/0266242611401444.

[89] Helen Simons, *Case Study Research in Practice*, (London, SAGE Publications, 2009), 23, http://ebookcentral.proquest.com/lib/adelaide/detail.action?docID=743724.

[90] Sarah Crowe et al.., "The Case Study Approach", *BMC Medical Research Methodology* 11, no. 1 (27 June 2011): 7, https://doi.org/10.1186/1471-2288-11-100.

collectivity)." [91] The use of the term 'case study' is prominent in the field of policy sciences and can be used to refer to the specific identifiers for defining a case such as the analyses of policies within a country.[92] Additionally, the term 'case study' as defined by Pal is also used by feminist comparative scholars with the two fields of study sharing some "common concepts, theoretical questions and approaches to research".[93] In her work, Rossella Ciccia also notes that case studies remain a favoured method by feminist researchers undertaking comparative analysis.[94] As such, this thesis uses the term 'case study' in the same way it is used in the fields of policy sciences and feminist comparative studies which can differ from how it is used in some more quantitative fields. The term 'case study' in this thesis will refer to the analysis of a country's policies and initiatives for women in STEM.

Adopting a case study approach has a number of advantages. Simmons notes that case studies enable researchers to explore multiple perspectives, explore contested viewpoints and demonstrate how actors and events influence policy development. By providing knowledge and interpreting events, researchers "can determine the factors that were critical in the implementation of a programme or policy."[95] Case study research can also require researchers to demonstrate how, and in what ways, the findings made are applicable to other contexts or can be used in other settings. In addition, incorporating three case studies enables this thesis to explore whether Australia, India and Singapore

[91] Leslie Pal, "Chapter 11: Case Study Method and Policy Analysis", in *Thinking Like a Policy Analyst: Policy Analysis as a Clinical Profession*, ed. Iris Geva-May (New York: Palgrave Macmillan, 2005), 235.
[92] Pal, "Chapter 11: Case Study Method and Policy Analysis", 231.
[93] Amy Mazur, "Feminist Comparative Policy: A New Field of Study", *European Journal of Political Research* 35 (1999): 489, DOI:10.1023/A:1007027508159.
See also Sara O'Shaughnessy and Naomi Krogman, "A Revolution Reconsidered? Examining the Practice of Qualitative Research in Feminist Scholarship", *Signs: Journal of Women in Culture and Society* 37, no. 2 (2012): 507, https://doi.org/10.1086/661726.
[94] Rossella Ciccia, "Qualitative Comparative Analysis as a Tool for Concept Clarification, Typology Building, and Contextualized Comparisons in Gender and Feminist Research", *Politics & Gender* 12 no. 3 (2016): 1, doi:10.1017/S1743923X16000374.
[95] Simons, *Case Study Research in Practice*, 23.

share issues or are diverse from one another in relation to policies and programs aimed at women in STEM. This thesis will also examine whether there are any interconnecting themes between the three cases that can be regarded as a form of cross-case generalisation.[96] This approach will ensure that meaning is grounded within the context of the cases. The exploration of scholarly work from Indian and Singaporean academics, institutes and organisations will enable the thesis to draw attention to additional and unique pressures that are faced by Indian and Singaporean women in STEM. Consequently, this thesis will mitigate the risks associated with generalising or viewing the Indian and Singaporean case studies from a western lens.

This thesis has also adopted elements of a comparative policy study approach. As explained by Alexander George and Andrew Bennett, comparative case studies allow a researcher to identify and examine contextual factors including social, cultural, economic and political elements.[97] Comparative policy studies contend that, it is "only through analysis incorporating a number of interrelating levels, macro and micro, [that] an understanding of the complex processes taking place can be understood and the diversity of differences between nation-states can be highlighted".[98] Correspondingly, this thesis recognises that Australia, India and Singapore have unique cultural, social, political, economic and historical influences that may have led to differing policy outcomes. There may also be unique challenges faced by Australian, Indian and Singaporean women that have resulted in policies and programs that differ greatly from the other case studies. A comparative policy approach enables this thesis to further explore these differing

[96] Simons, *Case Study Research in Practice*, 164.
[97] Alexander George and Andrew Bennett, *Case Studies and Theory Development in the Social Sciences* (Cambridge: MIT Press, 2004), 19.
[98] Nonie Harris, "Comparative, Feminist, and Qualitative: An Uncommon Perspective on Cross-National Social Policy Research", *International Journal of Qualitative Methods* 6, no. 1 (1 March 2007): 28, https://doi.org/10.1177/160940690700600103.

influences, while also identifying some shared ones ranging from the influence of gendered stereotypes (albeit country-specific ones) to the influence of versions of neoliberal ideology.

However, this thesis has been particularly influenced by the FCP approach because it "illuminates areas often hidden from view and indicates differential impacts between men and women."[99] Utilising feminist analyses therefore strengthens a standard comparative policy study methodological approach which seeks to understand the processes of policymaking, implementation and evaluation. Feminist insights can also usefully inform comparative policy approaches which seek to examine the reasons why governments choose different ways of addressing issues or even why they may not seek to resolve them at all.[100] Consequently, this thesis will assess how influences can shape government policies for girls and women interested in STEM education and occupations. The analysis will also focus on how governments implement evaluation mechanisms and whether programs adequately address issues examined in Chapters Three, Four and Five.

1.2.5 Why a Comparative Analysis of Australia, India and Singapore?

As indicated above, a key reason India and Singapore were chosen as case studies is because research reveals that Indian and Singaporean women have higher rates of participation in STEM than many other countries including Australia. An estimated 69% of Indian young women aged between 15 and 19 years study STEM, while 63% are interested in a STEM related career whilst women account for 41% of the tech workforce in Singapore.[101] This figure may be even higher depending upon the accuracy of

[99] Gottfried and Reese, "Gender, Policy, Politics, and Work", 6.
[100] Engeli, and Allison, "Conceptual and Methodological Challenges", 2-3.
[101] Ministry of Communications and Information "Transcript of Speech by Ms Rahayu Mahzam, Parliamentary Secretary, Ministry of Communications and Information, in Response to Motion on Empowering Women".

figures.[102] As raised earlier in this chapter, some figures may include women employed in STEM industries but who are working in non-technical jobs within those companies. Nonetheless, given these significant differences with regards to women's representation in STEM, an examination of India and Singapore provides an opportunity to contribute to the wider literature which will be highlighted in the below sections.

Some researchers contend that a comparative analysis approach should predominately feature countries that have common features or similarities.[103] This combined with Euro and Americentrism has meant that a large number of comparative studies are predominately focused on western states.[104] Few comparative studies examine countries in the Asian region. Notably, India and Singapore differ greatly when considering their unique cultural, social, political and economic factors. This thesis argues that comparing Australian, Indian and Singaporean case studies will advance our understanding of how policymakers approach the issue of women's underrepresentation in STEM.

Fred Dallmayr suggests that comparative work that is limited to countries that are 'western' can lead to deep-seated biases or generalisations.[105] The exclusion of countries such as India and Singapore from comparative policy approaches can help construct the problematic idea that certain ideas and concepts which apply to western states are universal. At the time of Dallmayr's publication, feminist scholarship was limited in its

[102] ET Bureau, "69% of Indian Girls Pick STEM Courses: Mastercard Survey", *The Economic Times,* February 15, 2017, http://tech.economictimes.indiatimes.com/news/people/69-of-indian-girls-pick-stem-mastercard-survey/57158194.
Singapore Ministry of Manpower, "Oral Answer to PQ on Emerging Trends for Female Professionals".
[103] Roger Pierce, *Research Methods in Politics - A Practical Guide* (Los Angeles: SAGE Publications, 2008), 51.
[104] Isabelle Engeli, Christine Rothmayr Allison, and Éric Montpetit, "Beyond the Usual Suspects: New Research Themes in Comparative Public Policy", *Journal of Comparative Policy Analysis: Research and Practice* 20, no. 1 (January 2018): 118, https://doi.org/10.1080/13876988.2017.1413869.
[105] Fred Dallmayr, "Beyond Monologue: For a Comparative Political Theory", *Perspectives on Politics* 2, no. 2 (2004): 249, 254.

scope because it was monopolised to a large extent by western scholars. The feminist movement did not sufficiently encourage women to consider the viewpoint of women from marginalised or racially diverse groups. This may have contributed to limited understandings of the issues impacting on women from diverse backgrounds. Though it should be noted that there are now more feminist scholars working to increase the knowledge of gender power relations in diverse countries including, in the field of International Political Economy.[106] Similarly, a comparative policy approach that does not examine countries from the Asian region can potentially generalise concepts and incorrectly determine that they apply to other more diverse countries. It may also limit how researchers and policymakers address issues affecting women in STEM. Thus, a comparative analysis approach which incorporates the comparison of diverse cultural countries can enable it to move towards a more genuine universalism. Dallmayr defines genuine universalism as taking into account the experiences and knowledge of all cultures.[107] Genuine universalism does not seek to monopolise or assume that the experiences and knowledge of one country extend to another. Genuine universalism aims to ensure that knowledge in comparative political approaches is reflective of the world.

A comparative policy study approach that engages with countries from Asia can also generate more inclusive dialogue within the wider academic debate and moreover "yield in truth-claims that have greater validity than claims rooted exclusively in a single tradition."[108] It may also contribute to the development and implementation of better policies.[109] Thus, this thesis seeks to fill in gaps within the wider academic literature by

[106] See Juanita Elias and Adrienne Roberts, *Handbook on the International Political Economy of Gender* (Cheltenham: Edward Elgar Publishing Limited, 2018).
[107] Dallmayr, "Beyond Monologue: For a Comparative Political Theory", 253, 254.
[108] Melissa S. Williams and Mark E. Warren, "A Democratic Case for Comparative Political Theory", *Political Theory* 42, no. 1 (1 February 2014): 33, https://doi.org/10.1177/0090591713507934.
[109] Engeli, Allison, and Montpetit, "Beyond the Usual Suspects", 128.

exploring how Indian and Singaporean governments have sought to increase the rates of women in STEM.

In addition to the above, the thesis has selected India and Singapore as case study comparisons to Australia because both have established close STEM trade ties with Australia. India and Australia share a 'Comprehensive Strategic Partnership' which has seen these three states share knowledge in STEM including in areas such as quantum computing, artificial intelligence, mining (which is increasingly technology intensive) and space science.[110] Under this partnership, Australia and India have also agreed to work together in areas of the digital economy, cyber security as well as emerging technologies.[111] In 2022, Australia and India also celebrated 15 years of the Australia-India Strategic Research Fund which supports scientists and innovators to collaborate on research in strategically prioritised focus areas including agriculture, renewable energy and nanotechnology.[112] Similarly in 2020, Australia and Singapore signed a Digital Economy Agreement. The agreement has been cited as a digital bridge that features modern and upgraded rules to free up data flows and increase the compatibility for online trade.[113] The Digital Economy Agreement signals a series of "[Memorandum of Understandings] on areas including data innovation, artificial intelligence, e-invoicing, e-certification for agricultural exports and imports, trade facilitation, personal data

[110] "Remarks, Bengaluru Tech Summit", Prime Minister of Australia, accessed 26 November 2021, https://www.pm.gov.au/media/remarks-bengaluru-tech-summit.
[111] "Joint Statement on a Comprehensive Strategic Partnership Between Republic of India and Australia", Department of Foreign Affairs and Trade, accessed 26 November 2021, https://www.dfat.gov.au/geo/india/joint-statement-comprehensive-strategic-partnership-between-republic-india-and-australia.
[112] "Fifteen Years of the Australia-India Strategic Research Fund", Department of Industry, Science and Resources, accessed 12 February 2023, https://www.industry.gov.au/news/fifteen-years-australia-india-strategic-research-fund.
[113] "Virtual Speech – Singapore FinTech Festival", Prime Minister of Australia, accessed 26 November 2021, https://www.pm.gov.au/media/virtual-speech-singapore-fintech-festival.

protection and digital identity."[114] It is clear that such close ties will continue beyond the period focused on in this thesis. In October 2022, Prime Minister Albanese and Singaporean Prime Minister Lee Hsien Loong reaffirmed Australia and Singapore's cooperation in science and innovation and acknowledged the Master Research Collaboration Agreement which enables Singaporean agency A*STAR and CSIRO to collaborate on STEM areas).[115] Therefore, given these close and relevant partnerships as well as the shared interest in STEM and particularly, technological areas, a comparative focus on Australia, India and Singapore will provide useful insights into policies, programs and initiatives designed to encourage women in STEM. Noting the above, it is also noteworthy to add that Australian, Indian and Singaporean policies and programs for women in STEM signals that governments and policymakers have identified that the underrepresentation of women in STEM is a major issue, given the role that STEM will play in future strategic and economic developments.

There were also considerations around language and the accessibility of government and non-government information. Initial scoping uncovered that Australian, Indian and Singaporean governments published information and documents in the English language. Early research about current policies and programs for Australian, Indian and Singaporean women found that most are publicly available on government websites. In terms of accessibility, the researcher identified that Australian, Indian and Singaporean governments archived some past official documents and policies on their publicly available websites. This meant that the thesis could gain greater insight into historical

[114] "Australia-Singapore Digital Economy Agreement", Department of Foreign Affairs and Trade, accessed 26 November 2021, https://www.dfat.gov.au/trade/services-and-digital-trade/australia-and-singapore-digital-economy-agreement.
[115] "Press Conference – Parliament House, Canberra Transcript, 18 October 2022, Prime Minister, Prime Minister of Singapore", Prime Minister of Australia, accessed 22 January 2023, https://www.pm.gov.au/media/press-conference-parliament-house-canberra-7.

policy discussions around women in STEM as well as reveal how governments have defined or understood a problem or issue.[116] As acknowledged by Isabelle Engeli and Christine Allison, the digital age has made information more accessible to researchers.[117]

Thus, a comparative policy approach that examines Australia, India and Singapore will enable a deeper exploration of a wider range of policies and programs related to women in STEM. It will also further our understanding of Indian and Singaporean policies and programs that have developed beneficial policies and programs which have addressed issues that have not been thoroughly explored by Australian policymakers. It will also potentially be a "starting point for consciously seeking and building opportunities to enlarge the spectrum of countries covered (in comparative study approaches) and to strengthen … policy-relevant knowledge" that nurtures women's participation in STEM.[118]

1.2.6 Non-Government Organisation Sources

The thesis also accessed material from relevant non-government organisations who provided additional information or featured information that was sometimes critical of government policies and initiatives. For example, the thesis examined websites from organisations such as the Singaporean advocacy group, AWARE, to assist with understanding the historical, political and social factors that influenced women's participation in STEM. Organisations such as AWARE conduct research on issues relating to gender equality that can offer insight into otherwise undocumented challenges

[116] Grant, "Historical and Official Documents: Moving Beyond Simple Interpretations", 61.
[117] Isabelle Engeli, and Christine Rothmayr Allison, "Conceptual and Methodological Challenges in Comparative Public Policy", in *Comparative Policy Studies: Conceptual and Methodological Challenges*, ed. Isabelle Engeli, and Christine Rothmayr Allison (London: Palgrave Macmillan UK, 2014), 3.
[118] Engeli, Allison, and Montpetit, "Beyond the Usual Suspects", 129.

faced by women. While the researcher acknowledges that information from such organisations can also be problematic or pursuing particular agendas, she notes that AWARE is a relatively reputable source with some Singaporean academics referring to AWARE in their work.[119]

1.2.7 Other Additional Considerations

This research project chose not to conduct interviews because a major focus of this project is on policy framing. As such, analysing government documents was deemed to be an appropriate and viable research method. For instance, existing public records, and statements made by key politicians can explain their governments' policies, revealing relevant discursive policy framing in the process. Moreover, the researcher encountered difficulties with obtaining an Indian visa. Given this, the researcher sought to apply a consistent methodology across the three case studies. In addition, both Singapore and India are countries with authoritarian tendencies that could impact some respondents' willingness to provide a full and frank analysis of government policies in interviews. In recent times, Indian authorities have targeted journalists for their criticism of government policies and practices.[120] Singapore's Protection from Online Falsehoods and Manipulation Act grants ministers the ability to take down or correct media pieces.[121] For all these reasons, as well as considerations of scope and feasibility in the timeframes allowed for a PhD thesis that was already analysing a complex policy area across three

[119] Yasemin Besen-Cassino and Dan Cassino, "5. Literature Reviews", in *Social Research Methods by Example: Applications in the Modern World*, (New York: Routledge, 2018), 100-101.
[120] Human Rights Watch, "India Media Freedom Under Threat", *Human Rights Watch*, May 3, 2022, https://www.hrw.org/news/2022/05/03/india-media-freedom-under-threat.
[121] Annabelle Liang, "'Hard Choices' for Singapore Media After Controversial Law Passed", *Aljazeera*, October 13, 2021, https://www.aljazeera.com/news/2021/10/13/singapore-media-face-hard-choices-after-new-law-passed.

countries, it was decided not to undertake interviews, especially given the substantial amount of primary source material that is publicly available.

1.3 Thesis Structure

Chapter One has introduced the thesis, theoretical framework and methodology of the study.

Chapter Two provides essential background on the challenges faced by women in STEM when they attempt to pursue and advance in STEM education and employment, as identified by the wider feminist academic literature. Much of the literature also analyses how cultural and societal influences continue to influence the type of study and work that is deemed acceptable for girls and women. The chapter will utilise discursive policy framing to articulate how social and cultural influences have contributed to flawed policies and initiatives for women in STEM. While subsequent chapters will draw from Chapter Two, especially in terms of identifying barriers to women's participation in STEM that have not been adequately addressed in policy programs, there are differences which will be explored.

Chapter Three will feature the thesis' first comparative study, Australia. The chapter will explore how barriers including gender discrimination, sexual harassment and bullying deter Australian women from pursuing or maintaining STEM education and occupations by drawing from broader feminist theory. Chapter Three will also examine discourse from past governments of various political persuasions to assess how the underrepresentation of women in STEM has been discursively framed. By analysing discursive policy framing, the thesis will identify forms of framing which have contributed to flawed policies and initiatives. For instance, it will be found that neoliberal

ideological framing has been prevalent and led to policies and initiatives at times undervaluing women's unpaid labour and the need to address specific challenges that women face. The chapter will analyse discourse including federal policies, programs and initiatives that aim to increase the participation rates of girls and women in science. It will also identify and critique approaches, programs and initiatives for girls and women in STEM.

Chapter Four examines the second comparative study, India and will illustrate the diverse social, cultural, familial, economic and political barriers that impact on a woman's decision to undertake a STEM education or career by examining the work of Indian feminist scholars and researchers. Utilising discursive policy framing in this chapter will reveal how the Indian government under Modi has been influenced by aspects of Hindu nationalism and neoliberalism. Subsequently, policies and initiatives for women in STEM have been framed to reflect these influences and as such, may fail to address significant structural disadvantages. This chapter will examine discourse including Indian federal policies, initiatives and programs for women in STEM to understand how they have been framed and the extent to which, they assist women in STEM.

Chapter Five assesses the third comparative study, Singapore and illustrates how past and present Singaporean governments have been contradictory in their attempts to encourage girls and women to undertake STEM education and careers by drawing on the broader work of feminist scholars and sociologists. The chapter will also discuss how Singaporean politicians and policymakers have been influenced by neoliberalism and discursively framed the idea that policymaking is 'pragmatic'. Discursive policy framing will also identify forms of framing that impact policies and programs for women in STEM, including how Singaporean politicians have framed women's roles. Discursive

policy framing analysis will then be used to articulate how policies and programs often neglect to address challenges women face as they attempt to fulfil familial and national expectations. Chapter Five will analyse discourse including policies, programs and initiatives of the current government that have the potential to benefit women in STEM. It will also highlight how the Singaporean government has discursively framed policies to reflect their ideas around meritocracy in ways that can also disadvantage some women. The influence of neoliberalism on aspects of Singaporean government policy will also be addressed.

Chapter Six of this thesis will illustrate how Australian, Indian and Singaporean governments have been influenced by neoliberalism and adopted a market-orientated approach to gender equality. It will do this by assessing discourse such as government policies and initiatives through a gendered lens. Using discursive policy framing analysis will also reveal how Australian and Indian governments have framed policies and initiatives to reflect neoliberal ideology which promotes the idea of women empowering themselves. As a result, Australian and Indian policies and initiatives for women entrepreneurs often fail to address prevalent issues which impact the extent to which women can succeed. Gendered discursive policy framing analysis will also explore how the Singaporean government has framed entrepreneurial programs to reflect ideas of meritocracy and gender-blindness. This has meant that programs may not wholly benefit working Singaporean mothers. An additional component of this chapter will assess how definitions of STEM do not account for some women, particularly those with little to no STEM skills who use technological tools to advance their understandings of STEM concepts, activities and knowledge.

Lastly, the Conclusion will summarise the analysis and arguments made throughout the thesis. In particular, the chapter will argue that an Australian, Indian and Singaporean government's policy framing of women's participation in STEM has been influenced by social, historical, cultural, political and economic factors. These factors have impacted on the participation rates of women in STEM education and occupations. The Conclusion will also argue that policymakers and politicians from the three countries have been influenced by neoliberal ideology which has often neglected the importance of women's unpaid labour and its role in social reproduction. The Conclusion will highlight the approaches taken by Australian, Indian and Singaporean governments as well as identify the flaws in programs as made apparent by the use of discursive policy framing analysis. The Conclusion will also seek to address the key research questions and in particular, how the examined policies and programs can be strengthened and improved. The chapter will also consider how the respective countries can learn from one another. The Conclusion will also provide suggestions for additional policies and programs that governments could implement to further encourage girls and women to pursue STEM.

The next chapter will now examine the wider academic literature with regards to the key issues faced by women in STEM.

Chapter 2: An Overview of Barriers Affecting Women in STEM

2.1 Introduction

This chapter provides essential background for the thesis as a whole by examining the relevant literature on key challenges faced by women when they seek to pursue STEM education and employment. It draws both on literature specifically on women in STEM as well as broader feminist theory to argue that STEM is a particularly problematic area of study and employment for women. Notably, the thesis will examine barriers that are more specific to women in STEM because as noted in Chapter One, women's underrepresentation in STEM is a concern for governments, especially given the role that STEM will play in future economic and strategic developments. However, the thesis will also draw on some relevant broader literature on the factors impacting women's labour force participation that also impact on women in STEM. Such literature also assists in establishing the broader international relevance of this thesis. Additional background material relevant to the specific case studies will be given at the beginning of the chapter dealing with each country. As outlined in Chapter One, this thesis will argue that Australian, Indian and Singaporean governments' policy framing of women's participation in STEM has been influenced by particular social, cultural, economic and historic factors that have had implications for women in STEM. More specifically, subsequent chapters will argue that government gender equality policies that have sought to improve the position of women in STEM have often had discursive framing flaws related to an inadequate understanding of, and unwillingness to address, the barriers that exist. Some of the challenges explored in this chapter include inadequate policy models

such as the leaky pipeline, the struggle to balance multiple responsibilities, institutional barriers as well as social and cultural factors.

This chapter will draw on an extensive amount of international literature that goes beyond the specific countries focused on in this thesis. Examples from the broader international literature can provide useful background evidence of the challenges faced by women in STEM as well as demonstrate the broader international relevance of studying issues related to women and STEM. Consequently, the thesis will refer to literature from Japan, Kenya, Malaysia and regions of the Middle East. However, while the literature can provide some useful insights into the barriers women face, it is also the case that much of that literature originates from the United States (US). This is a concern because it means that US concepts and knowledge about women in STEM have been potentially applied to states which are politically, economically, culturally and socially different. Subsequent chapters will therefore draw on work from Australian, Indian and Singaporean researchers to examine the cultural, social and political contexts of Australia, India and Singapore whilst, also providing a critique of policies and initiatives designed to increase the participation rates of women in STEM by using a gendered discursive policy framing analysis.

2.2 Women and STEM Education Pathways

The World Economic Forum contends that the rate of women enrolling in tertiary education now surpasses that of men. However, women continue to be underrepresented in STEM disciplines. Only 16% of women students worldwide choose to pursue a STEM

degree.[1] The table below outlines the enrolment rates of Australian, Indian and Singaporean women in university STEM courses.

STEM Enrolments (Undergraduate)[2]					
Country	**Gender**	**Agriculture, Environmental and Related Studies**	**Engineering**	**Information Technology**	**Natural and Physical Sciences**
Australia[3] *(2021 data)*	Women	7720 *Completions 1348*	10,848 *Completions 1456*	7367 *Completions 1070*	49,911 *Completions 10,233*
	Men	5278 *Completions 925*	48,389 *Completions 7155*	32,516 *Completions 4918*	44,420 *Completions 8569*
India[4] *(2020-2021 data)*	Women	86,860	1,006,100	63,036	2,505,224[5]
	Men	203,536	2,475,549	141,606	2,312,602
Singapore[6] *(2021 data)*	Women	N/A	5254	3027	3912
	Men[7]	N/A	13,112	7192	3159

[1] World Economic Forum, *The Global Gender Gap Report 2016* (Cologny/Geneva, 2016), 28-55, https://www3.weforum.org/docs/GGGR16/WEF_Global_Gender_Gap_Report_2016.pdf.
[2] Please note that the statistics are drawn from three different reports and databases (STEM Equity Monitor) which may have differing methodologies and definitions.
[3] "STEM Equity Monitor – University Enrolment and Completion in STEM and Other Fields", *Department of Industry, Science and Resources*, accessed August 28, 2023, https://www.industry.gov.au/publications/stem-equity-monitor/higher-education-data/university-enrolment-and-completion-stem-and-other-fields.
[4] Government of India – Ministry of Education, *All India Survey on Higher Education 2020-21* (New Delhi, 2023), 128-129, https://aishe.gov.in/aishe/gotoAisheReports.
[5] The All India Survey 2020-21 indicates that it groups sub-streams of science disciplines. As such, the numbers of women enrolled in science include those undertaking natural and physical sciences such as mathematics, chemistry, physics, etc.
[6] Ministry of Education – Singapore, *Education Statistics Digest 2022* (Singapore, October 2022), 21, https://www.moe.gov.sg/-/media/files/about-us/education-statistics-digest-2022.pdf.
[7] Singapore's Education Statistics Digest 2022 includes total enrolment rates and women's enrolment rates. In order to get a figure on men's enrolment rates, the total enrolment rate has been subtracted by the women's enrolment rates.

The World Economic Forum perceives women's low STEM participation rate to be a key emerging issue given that technological advances have increased the demand for STEM professionals. Nilanjana Dasgupta and Jane Stout contend that barriers affecting women in STEM tertiary education include hostile social environments and the lack of role models and mentors.[8] These factors lead to feelings of isolation and insecurity among women STEM university students. Other identifiable factors include institutional barriers. A study examining three Kenyan institutions uncovered that pregnant women students are subjected to penalties such as the loss of on-campus boarding privileges which prevents them from completing on-campus practicals and laboratory work. Additionally, the university institutions do not have childcare programs. These institutional inadequacies have impacted the number of Kenyan women who choose to pursue STEM qualifications. In addition, 58% of Kenyan women students believe they will not be successful in a STEM workplace because of dominant and gendered stereotypes associated with STEM careers. [9] This issue is also prevalent in western states as the section below will highlight.[10]

Women's low participation in STEM education can also be attributed to gendered beliefs that maintain that there are biological differences between men and women. In 2005, former-Harvard University President Lawrence Summers presented a conference on women and marginalised groups in STEM at the National Bureau of Economic Research.[11] Summers suggested that boys outperformed girls in science and maths

[8] Nilanjana Dasgupta and Jane G. Stout, "Girls and Women in Science, Technology, Engineering, and Mathematics: STEMing the Tide and Broadening Participation in STEM Careers", *Policy Insights from the Behavioural and Brain Sciences* 1, no. 1 (1 October 2014): 24, https://doi.org/10.1177/2372732214549471.
[9] Mbirianjau, "Why are Fewer Kenyan Women"
[10] Merryn McKinnon, "How to Keep More Women in Science, Technology, Engineering and Mathematics (STEM), *The Conversation*, July 13, 2016, http://theconversation.com/how-to-keep-more-women-in-science-technology-engineering-and-mathematics-stem-61664.
[11] Wood, Jonathan, "A Woman's Place", *Materials Today* 8, no. 3 (1 March 2005): 4, https://doi.org/10.1016/S1369-7021(05)00719-4.

because of innate genetic differences. Summers' beliefs illustrate that there are implications with how some researchers explain the low participation rates of women in STEM. These researchers contend that the introduction of feminist thought, affirmative action and equal access to education should have re-addressed the cultural and social challenges that affect women's participation in STEM.[12] Women's continued underrepresentation in STEM is perceived to be evidence that there are biological differences between the two genders. Ruben C. Gur and Raquel E. Gur suggest that men and women may have differing gender-linked processing styles.[13] Similarly, Simon Baron-Cohen states that women are genetically predisposed to empathy while males are genetically hard-wired for understanding and building systems.[14] These studies reinforce gendered beliefs that suggest that women are best suited to degrees that require their supposed biologically obtained attributes rather than STEM education. These studies refuse to acknowledge that social, cultural and institutional barriers have played a large role in deterring women from pursuing STEM qualifications.[15] However, recent studies by feminist scholars suggest that empathy is not solely a womanly trait. Women express empathy more because of social experience and cultural context. Summarised by Andrea Lobb, the distribution of empathy "becomes a question for politics and ethics to determine, rather than something automatically allocated (to women rather than men) by the 'invisible hand' of nature or evolution."[16] Yet, despite work from feminist scholars,

[12] Gerlind Wallon, "Aptitude or Attitude?" *EMBO Reports* 6, no. 5 (1 May 2005): 400, https://doi.org/10.1038/sj.embor.7400414.
[13] Wendy M. Williams and Stephen J. Ceci, "Introduction: Striving for Perspective in the Debate on Women in Science", in *Why Aren't More Women in Science?* ed. Wendy M. Williams and Stephen J. Ceci (Washington: American Psychological Association, 2007), 8.
[14] Simon Baron-Cohen, "The Essential Difference: The Male and Female Brain", *Phi Kappa Phi Forum* 85, no. 1 (Winter/Spring 2005): 23-26, http://proxy.library.adelaide.edu.au/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=16574492&site=ehost-live&scope=site.
[15] Alice H Eagly, "Has the Psychology of Women Stopped Playing Handmaiden to Social Values?", *Feminism & Psychology* 26, no. 3 (1 August 2016): 282-283, https://doi.org/10.1177/0959353516636150.
[16] Andrea Lobb, "The Agony and the Empathy: The Ambivalence of Empathy in Feminist Psychology", *Feminism & Psychology* 23, no. 4 (1 November 2013): 432, https://doi.org/10.1177/0959353513497556.

the belief that women are not intellectually capable of undertaking STEM qualifications due to supposed biological differences continues to influence some academics and institutions. Moreover, the gendered beliefs have also influenced what types of STEM qualifications women choose. Women in STEM account for approximately, 75% of all health-related occupations in the US.[17] Correspondingly, areas of STEM dominated by women in the UK include veterinary science, biological sciences as well as medicine and dentistry.[18] These STEM disciplines require communication and caring skills which are believed to be more common in women due to perceived biological differences.[19] Sections below will demonstrate how these gendered beliefs and norms can have implications for women in STEM occupations.

Nonetheless, tests such as the Programme for International Student Assessment have demonstrated that there is almost no gap in the scores between boys' and girls' science tests.[20] However, girls are more likely to suffer from test-related anxiety.[21] The fact that girls are less confident in tests could be attributed to social and cultural norms, behaviours and practices.[22] For instance, "elementary school teachers, who are likely to be women, are often themselves anxious about math. Research shows that they transmit this message, which girls absorb more."[23] Moreover, attempts to encourage girls to pursue STEM by

[17] "Women and Men in STEM Often at Odds Over Workplace Equity", Pew Research Center, January 9, 2018, http://www.pewsocialtrends.org/2018/01/09/women-and-men-in-stem-often-at-odds-over-workplace-equity/.
[18] Alison McGuire, "Females Are Studying STEM Degrees Just as Much as Males, Finally!", *Irish Tech News*, June 27, 2018, https://irishtechnews.ie/females-are-studying-stem-degrees-just-as-much-as-males-finally/.
[19] Mary Elizabeth Williams, "Men Aren't Being Encouraged to Take Caring Jobs — and That's Hurting Everyone", *Salon*, March 28, 2021, https://www.salon.com/2021/03/28/women-are-being-encouraged-to-go-into-stem-fields-why-arent-we-pushing-for-more-men-in-heed-jobs/.
[20] Jenny Anderson, "To See More Women in Science, Deal with Test-Taking Anxiety in Girls", *Quartz*, October 27, 2018, https://qz.com/1109075/the-lack-of-women-in-science-is-down-to-test-taking-anxiety-in-girls/.
[21] "Exam Anxiety Could Be Holding Women Back in the Sciences", World Economic Forum, accessed November 22, 2018, https://www.weforum.org/agenda/2017/11/want-to-keep-more-women-in-science-theres-a-simple-solution/.
[22] Ben A. Barres, "Does Gender Matter?" *Nature* 442 (12 July 2006): 135, https://doi.org/10.1038/442133a.
[23] Anderson, "To See More Women in Science".

feminising aspects of STEM learning have not been fruitful.[24] Toy companies such as LEGO are attempting to further engage girls in STEM activities by increasing the amount of women minifigures in STEM professions.[25] Yet, a 2021 LEGO report revealed that parents of children continue to perceive of STEM professionals as men.[26] Parents are also significantly more likely to encourage boys to engage in program games and coding. This has implications for girls given that a lack of early STEM learning engagement can contribute to lower levels of STEM learning and consequently, lead them to forgo STEM subjects. Lora Park's et al., study also illustrates that women could distance themselves from STEM because "pursuing intelligence goals in masculine domains such as STEM conflicts with pursuing romantic goals associated with traditional romantic scripts and gender norms."[27] In certain cultural environments, securing a marriage partner is considered to be more important that undertaking a tertiary qualification. Thus, a woman may find herself trying to untangle and navigate complex gendered norms, beliefs and practices that maintain that a STEM education is of less value than romantic goals.

2.3 Women in the STEM Workplace

Notably, there is a wide range of literature that examines how women's employment participation has been impacted by a number of barriers, including gendered norms and practices that affect pay, hiring processes and career progression.[28] For instance, research

[24] See Audrey Iffert-Saleem, "Why Lipstick and Nail Files Won't Draw Women Into Science", *Slate Magazine*, March 21, 2014, https://slate.com/technology/2014/03/science-its-a-girl-thing-and-other-flawed-attempts-to-bring-women-into-stem.html.
[25] Maia Weinstock, "LEGO Adds More Women in Science to Its Lineup", *Scientific American*, June 24, 2015, https://blogs.scientificamerican.com/voices/lego-adds-more-women-in-science-to-its-lineup/.
[26] "Girls Are More Ready to Overcome Gender Norms but Society Continues to Enforce Biases that Hamper Their Creative Potential", LEGO, accessed November 15, 2021, https://www.lego.com/en-us/aboutus/news/2021/september/lego-ready-for-girls-campaign/.
[27] Lora E. Park et al.., "Effects of Everyday Romantic Goal Pursuit on Women's Attitudes Toward Math and Science", *Personality and Social Psychology Bulletin* 37, no. 9 (1 September 2011): 1259, https://doi.org/10.1177/0146167211408436.
[28] Paola Belingheri, Filippo Chiarello, Andrea Fronzetti Colladon and Paola Rovelli, "Twenty Years of Gender Equality Research: A Scoping Review Based on a New Semantic Indicator", *PLOS ONE* 16, no. 9 (21 September 2021): 1-2, https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0256474.

has found that women are often held to stricter standards during promotions with women in line management positions especially vulnerable to gendered biasness.[29] Key findings from the 50/50 by 2023 Foundation indicate that more than one in three men in Australia are likely to believe that "it is important to maintain traditional gender roles so that families function well and children are properly supported".[30] This may have contributed to the fact that only 22.3% of Australian women are CEOs or the head of a business.[31] Research also suggests that most women globally are employed in less secure, often part-time forms of work as they attempt to fit paid work around unpaid childcare, elder care and other caring responsibilities.[32] Data from the Australian Government's Workplace Gender Equality Agency suggests that over the 2021-22 reporting period an estimated 709,206 women were employed part-time whilst 616,997 were employed as casual staff.[33] In contrast, 240,763 men were employed part-time whilst 476,402 were employed as casual staff. Evidence also suggests that women undertake twice as much unpaid domestic work as their male counterparts.[34] The COVID-19 pandemic revealed and accentuated many longstanding gender inequalities such as the disproportionate amount of unpaid labour that women undertake which became more visible as services were forced to close.[35]

[29] Karen Lyness and Madeline Heilman, "When Fit is Fundamental: Performance Evaluations and Promotions of Upper-Level Female and Male Managers", *Journal of Applied Psychology* 91, no. 4 (2006): 784, doi:10.1037/0021-9010.91.4.777.
[30] The University of Canberra, "From Girls to Men: Social Attitudes to Gender Equality in Australia – Survey Snapshot", *50/50 by 2030 Foundation*, 2018, www.broadagenda.com.au/wp-content/uploads/attachments/From-Girls-to-Men.pdf.
[31] "Gender Equality in the Workplace", Workplace Gender Equality Agency, accessed 13 August 2023, https://www.wgea.gov.au/data-statistics/data-explorer.
[32] Meraiah Foley and Rae Cooper, "Workplace Gender Equality in the Post-Pandemic Era: Where to Next?", *Journal of Industrial Relations* 63, no.4 (2021): 467, https://journals.sagepub.com/doi/epub/10.1177/00221856211035173.
[33] "Gender Equality in the Workplace", Workplace Gender Equality Agency.
[34] Foley and Cooper, "Workplace Gender Equality in the Post-Pandemic Era", 467.
[35] Foley and Cooper, "Workplace Gender Equality in the Post-Pandemic Era", 446.

Whilst 179 countries have taken some approach to address workplace gender discrimination, an estimated 50 have not specifically prohibited sexual harassment in the workplace and 89 have failed to prohibit behaviour which creates a hostile work environment.[36] There are also few mechanisms in place to support women in all areas of employment, including during hiring and promotion.[37] This, in turn, has meant that norms and expectations that maintain that women are largely responsible for the home continue to remain unchecked and sustained. A 2023 study examining the perception of gender equality from the Global Institute for Women's Leadership found that 74% of respondents in India are likely to think that enough has been done to give women equal rights.[38] Conversely 48% of Singaporean respondents and 51% of Australian respondents also think the same.[39] Nonetheless, academics such as Jody Heymann, Aleta Sprague and Amy Raub contend that the creation and framing of laws and policies such as parental leave and childcare provision have the ability to shape ideas around gender equality.[40]

However, care work and women's role in social reproduction has been often neglected by policymakers despite institutions and governments attributing global economic growth to women's labour force participation.[41] Elizabeth Hill, Michele Ford and Marian Baird explain that many women in the Asia-Pacific are held responsible for reproductive labour, unpaid care and domestic work with little state support for care work.[42] In many Asian-Pacific countries, women are expected to be the primary carers of children and

[36] Jody Heymann, Aleta Sprague and Amy Raub, "10. Achieving Gender Equality in the Economy in Our Lifetimes". In *Equality Within Our Lifetimes*, 273-274. Oakland: University of California Press, 2023.
[37] Heymann, Sprague and Raub, "10. Achieving Gender Equality in the Economy in Our Lifetimes", 273.
[38] "International Women's Day: Global Opinion Remains Committed to Gender Equality, but Half Now Believe it is Coming at the Expense of Men", Ipsos and the Global Institute for Women's Leadership, accessed 17 September 2023, https://www.ipsos.com/en/international-womens-day-global-opinion-remains-committed-gender-equality-half-now-believe-it. PDF available on website, page 11.
[39] Ipsos and Kings College London, "International Women's Day".
[40] Heymann, Sprague and Raub, "10. Achieving Gender Equality in the Economy in Our Lifetimes", 277.
[41] Elixabeth Hill, Michele Ford and Marian Baird, "Work/Care Regimes in the Asia-Pacific". In *Women, Work and Care in the Asia Pacific*, 1-2. London: Routledge, 2017.
[42] Hill, Ford and Baird, "Work/Care Regimes in the Asia-Pacific", 9.

elderly parents. As such, in countries including Japan, South Korea, Timor-Leste and Papua New Guinea, there is no support for a care workforce, formal or informal. Similarly, in Singapore and Malaysia, there is a lack of a formal care infrastructure because governments have preferred an informal care workforce.[43] Consequently, the lack of care policies and programs has meant that many women have to find ways to manage work and care loads such as reducing hours of paid work, and accepting lower levels of responsibility and limited career paths.[44] In regions such as Singapore, China and India, upper class women can outsource some forms of social reproduction and care work to paid domestic workers. Chapter Five will explore this more in its examination of the Foreign Maid Levy Relief. Noting that domestic labour sector is highly feminised, the outsourcing of social reproduction, however, continues to maintain gendered ideas that women are primarily responsible for unpaid care work and moreover, that reproductive and care labour can be taken up "in a commodified form by another woman of lesser economic and social means".[45] Drawing back to Bakker's work, this continues to see the responsibility of systemic problems being placed on the shoulders of women rather than governments thereby aligned to a neoliberal ideal.[46] At the same time, women's labour is often perceived as not essential or important to public policy. As subsequent chapters of this thesis will argue, this has contributed to policy and program flaws that do not address barriers related to women's employment.

As acknowledged above, the chapter will outline barriers that impact how women in STEM in particular, are able to pursue and succeed in STEM occupations. Key reasons for focusing particularly on women in STEM have been outlined in the previous chapter

[43] Hill, Ford and Baird, "Work/Care Regimes in the Asia-Pacific", 13.
[44] Hill, Ford and Baird, "Work/Care Regimes in the Asia-Pacific", 8-9.
[45] Hill, Ford and Baird, "Work/Care Regimes in the Asia-Pacific", 10.
[46] Bakker, "Social Reproduction and the Constitution of a Gendered Political Economy", 553.

which identified women's underrepresentation in STEM as an issue of policy concern for the Australian, Singaporean and Indian governments. Furthermore, data indicates that fewer women in STEM are pursuing or reaching leadership positions when compared to women in many non-STEM occupations. A report from Australia's Office of the Chief Scientist suggests that only 7% of women with VET and qualifications, and 22% of women with university qualifications hold manager positions.[47] In contrast, 43% of women with non-STEM VET qualifications and 48% of women with non-STEM university qualifications are in manager positions. This disparity suggests that the barriers affecting a woman's ability to pursue and succeed in a STEM occupation are potentially more harmful those impacting upon women in many non-STEM industries. For these reasons and ones articulated in previous chapters, the thesis will explore literature impacting on issues that are specific to women in STEM in subsequent chapters and in the section below. However, relevant literature that also impacts women across all industries will be utilised throughout the thesis.

While there has been progress with more women undertaking STEM courses in certain countries, the academic literature suggests that there has been insufficient change in the representation of women in STEM occupations. Women in STEM workplaces face a number of economic and social inequalities. Gender is considered to be an impediment rather than an advantage. Women are also more likely to face discrimination and sexual harassment in the workplace. Approximately 50% of women working in STEM positions have experienced discrimination in the workplace. This is in contrast to 41% of women who work in non-STEM positions.[48] The #Metoo Movement has led to governments and

[47] Office of the Chief Scientist, *Australia's STEM Workforce: Science, Technology, Engineering and Mathematics*, 222.
[48] "Women and Men in STEM", Pew Research Center.

institutions such as the National Science Foundation introducing measures to ensure that research institutions and universities report cases of harassment especially, if the scientist involved is receiving funding from the foundation. [49] Other agencies such as the Food and Drug Administration and the National Institutes of Health have been slow to change workplace policies regarding sexual harassment.[50] STEM departments and universities are often slow to enact policy change because of the financial repercussions of terminating well-known STEM academics.[51] As such, the #Metoo Movement has not been entirely successful in enacting immediate policy change for working women in STEM.

Studies also establish that some women in STEM are more likely to encounter workplace inequities than others. The Pew Research Centre notes that there are three types of groups that encounter increased employment challenges. The first group consists of women who are employed in STEM occupations where men outnumber women employees. The second group comprises of women in STEM who have postgraduate degrees. The third group includes women who are employed in computer jobs. Women's representation in computer occupations has decreased from 32% in 1990 to 25% in 2018.[52] Computer occupations consist of positions including computer scientists, systems analysts, software developers, information systems managers and programmers. The decrease in rates of women in these positions is a concern because STEM computer occupations have seen

[49] Shawna Williams, "The Year in #MeToo", *The Scientist Magazine,* December 27, 2018, https://www.the-scientist.com/news-opinion/the-year-in--metoo-65244.
"NSF Announces New Measures to Protect Research Community from Harassment", National Science Foundation, accessed February 2019, https://nsf.gov/news/news_summ.jsp?cntn_id=296610&org=NSF&from=news.
[50] Kyle Plantz, "The #MeToo Movement Shook up Workplace Policies in Science", *Science News,* December 20, 2018, https://www.sciencenews.org/article/metoo-movement-workplace-policies-science-2018-yir.
[51] Plantz, "The #MeToo Movement".
[52] "Women and Men in STEM", Pew Research Center.

the most career growth in recent decades. Women have the potential to earn more and increase their employability if they transition into computer occupations. However, discriminatory practices prevent women from being hired in certain STEM occupations.[53] Jenny Gristock explains that women researchers are possibly dissuaded from obtaining careers in STEM because of a clear bias towards male researchers.[54] Being able to access laboratories as well as processes that include hiring and grant allocation are overwhelmingly judged by male executives who may prioritise male researchers. When women transition into STEM employment, factors including, competing for funding and grants also influence how far they excel.[55] It is evident then, why most women are deterred from pursuing certain STEM occupations particularly, in disciplines where there is a significant overrepresentation of men.

A further challenge impacting women in STEM workplaces is the prominence of dynamic and conflicting constructions of gender and race maintained by male-dominated STEM industries. These constructions of gender and race suggest that technological companies are developing complex workplace hierarchies that prioritise women from particular groups over marginalised groups such as African Americans and Hispanic women. In the US, Asian women are overrepresented in STEM workplaces and across all STEM occupational groups.[56] Notably, Asian women employees are paid more than American, African American and Hispanic women. Yet, there are differences between the amount paid to Asian men and women. Men earn approximately $96,311 while

[53] Stephen J. Ceci, Wendy M. Williams, and Richard F. Thompson, "Understanding Current Causes of Women's Underrepresentation in Science", *Proceedings of the National Academy of Sciences of the United States of America* 108, no. 8 (2011): 3160, https://www.jstor.org/stable/41060898.
[54] Jenny Gristock, "Why Aren't There More Women in Science? The Industry Structure Is Sexist", *The Guardian*, May 31, 2016, https://www.theguardian.com/commentisfree/2016/may/31/women-science-industry-structure-sexist-courses-careers.
[55] Marc J. Lerchenmueller and Olav Sorenson, "The Gender Gap in Early Career Transitions in the Life Sciences", *Research Policy* 47, no. 6 (1 July 2018): 1008, https://doi.org/10.1016/j.respol.2018.02.009.
[56] "Women and Men in STEM", Pew Research Center. PDF available on webpage, page 8.

women earn $81,011.[57] This indicates that gendered practices such as the pay gap continue to impact women in STEM. Nevertheless, Asian women may have technical specialisations that are not overly studied by women in western countries. However, STEM companies could also be seeking to exploit socially constructed ideas that exist in Asian communities. These ideas associate a typical Asian student as committed, diligent, competitive, passionate, focused and ambitious.[58] Consequently, these beliefs may explain why Asian women in STEM are more likely to be paid more than women from other racial and ethnic groups.

Recent studies have also illustrated how women employed in STEM occupations and from marginalised communities are expected to adhere to behavioural norms that are based on culturally gendered ideas and beliefs. Asian-American women have reported that attempts to be assertive result in discriminatory remarks. Being assertive does not conform to stereotypical perceptions that associate Asian women as "passive, feminine 'China Doll(s)'.[59] Latina women in STEM who behave assertively are perceived to be angry or emotional while African Americans are allowed to behave in 'dominant ways' as long as they are not seen as 'angry black women'. Asian Americans (40.9%), Caucasian (35.9%) and Latina (28.1%) women scientists are also expected to play traditionally feminine roles.[60] These roles include office housework, emotional work and work undertaken by administrative staff. Women in STEM workplaces are expected to

[57] "Women and Men in STEM", Pew Research Center. PDF available on webpage, page 9.
[58] Dave Breitenstein, "Asian Students Carry High Expectations for Success", *USA Today*, August 4, 2013, https://www.usatoday.com/story/news/nation/2013/08/04/asian-students-carry-high-expectations-for-success/2615483/.
[59] Brigid Schulte, "Black and Latina Women Scientists Sometimes Mistaken for Janitors", *Washington Post*, February 6, 2015, https://www.washingtonpost.com/news/local/wp/2015/02/06/black-and-latina-women-scientists-sometimes-mistaken-for-janitors/.
[60] Joan C. Williams, Katherine W. Phillips and Erika V. Hall, "Double Jeopardy? Gender Bias Against Women in Science", The Center for WorkLife Law, 2014, https://worklifelaw.org/publication/double-jeopardy-gender-bias-against-women-of-color-in-science/. PDF available on website, 6, 24.

'take care' while men 'take charge.' Power imbalances keep working women in 'second place.'[61] These findings have implications for women.[62] It suggests that policies around women's participation in STEM have not accounted for the experiences of women from diverse cultural communities. Socially embedded norms, practices, and beliefs have the potential to significantly influence women to behave in a certain way in the STEM workplace. This has contributed to imagery that associates African American and Latina women as janitors rather than scientists.[63] All of the prescribed factors can contribute to feelings of isolation and competition as women in STEM strive to prove that they are not cultural tokens or employed out of affirmative action policies. As such, it is clear that conceptions of race and gender are deeply intertwined, and women in STEM from culturally diverse communities may face barriers not yet uncovered by the broader academic literature.

Women in the STEM workforce are also impacted by changes that occur when political governments decide to implement or minimise policies that impact them directly. Utilising gendered discursive policy analysis, Chapters Three, Four and Five of this thesis will explore this further within the Australian, Indian and Singaporean context. In March of 2017, US President Trump signed an executive order that revoked the 2014 Fair Pay and Safe Workplaces order.[64] The need for the order arose when a 2010 US Government Accountability Office investigation found that companies with severe labour and civil rights violations were still being awarded millions of dollars in federal contracts. The

[61] Patricia Bryans, Helen Fraser, and Paul-Alan Armstrong, "Workplace: Women's Place?", in *Re-Reading Spare Rib,* ed. Angela Smith (Cham: Palgrave Macmillan, 2017), 100, https://link.springer.com/book/10.1007%2F978-3-319-49310-7.
[62] Williams, Phillips, and Hall, "Double Jeopardy?" 24.
[63] Schulte, "Black and Latina Women Scientists".
[64] Mary Emily O'Hara, "Trump Pulls Back Obama-Era Protections for Women in the Workplace", *NBC News*, April 4, 2017, https://www.nbcnews.com/news/us-news/trump-pulls-back-obama-era-protections-women-workers-n741041.

main purpose of the order was to ensure that companies with federal contracts would adhere to 14 labour and civil rights laws.[65] The order included two rules that directly impact women in the workplace. The first rule included paycheque transparency. The second rule ensured that companies must not enforce forced arbitration clauses in cases of sexual assault or sexual harassment.[66] Arbitration clauses could only be made with the consent of the affected employees and/or contractors.

The first rule concerns women in STEM because the current US STEM industry pay gap is 16%. This increased from 2009 when the US STEM industry pay gap was 14%.[67] The loss of the paycheque transparency rule means that companies are no longer required to produce data or submit information that indicates whether they have underpaid working women. The transparency measure assisted government agencies such as US Department of Labor in determining whether violations had occurred.[68] Women in STEM can be prevented from collectively challenging workplaces over wage disparities as a condition of their employment. The 2014 Fair Pay and Safe Workplaces order was one of the key measures that provided some legal mechanism by which they could argue for fair treatment. Without policy measures, women in STEM may face increased hurdles when they attempt to challenge STEM companies. Women may need to pay for costly legal representation. The process can be long and lead to further economic issues. Individual cases may not receive the same amount of public attention that is given to collective cases. Some US judges are known for favouring companies over protecting the rights of

[65] Mary Emily O'Hara, "Trump Pulls Back Obama-Era Protections for Women in the Workplace".
[66] "Executive Order – Fair Pay and Safe Workplaces", The White House: Office of the Press Secretary, accessed November 13, 2018, https://obamawhitehouse.archives.gov/the-press-office/2014/07/31/executive-order-fair-pay-and-safe-workplaces.
[67] "Women in STEM: 2017 Update", US Department of Commerce, accessed November 2018, https://www.commerce.gov/news/fact-sheets/2017/11/women-stem-2017-update.
[68] O'Hara, "Trump Pulls Back".

individual employees.[69] This highlights that federal agencies working with enacted policies that have accountability functions are vital in ensuring that cases of gendered wage inequalities are assessed. Companies such as Google have the ability to silence women and protect accused individuals. Regulatory oversight is, however, dependent on government policies.

The loss of the second rule is significantly important to women in STEM because many technology firms have mandatory arbitration clauses in their employee contracts. Forced arbitration ensures that workplace disputes are kept out of the traditional US court system and away from public scrutiny.[70] Workplace disputes are decided by arbitrators with claims made confidential. This is problematic as harassers can transition into other employment positions without companies being aware of their misconduct. Forced arbitration is widespread and a dominant practice. In 2018, the New York Times uncovered that Andy Rubin, an Android co-founder had received a $90 million exit package following an investigation concluding that he had engaged in sexual misconduct.[71] Two other executives from Google were also accused of sexual misconduct. Both were paid millions despite no legal obligation for Google to do so. Forced arbitration meant that the affected women could not have their claims determined by US courts nor could they speak out. The case demonstrates that STEM companies are likely to prioritise their economic needs over ensuring that women are able to voice concerns. In a sense, women impacted by discriminatory behaviour, practices and/or

[69] Stephanie Russell-Kraft, "Will the Supreme Court Prevent Employees From Bringing Workplace Grievances Collecting?" *The Nation*, October 3, 2017, https://www.thenation.com/article/will-the-supreme-court-prevent-employees-from-bringing-workplace-grievances-collectively/.
[70] Daisuke Wakabayashi and Jessica Silver-Greenberg, "Facebook to Drop Forced Arbitration in Harassment Cases", *The New York Times*, November, 10 2018, https://www.nytimes.com/2018/11/09/technology/facebook-arbitration-harassment.html.
[71] Daisuke Wakabayashi and Katie Benner, "How Google Protected Andy Rubin, the "Father of Android"", *The New York Times*, October, 25 2018, https://www.nytimes.com/2018/10/25/technology/google-sexual-harassment-andy-rubin.html.

norms are perceived as a threat to a STEM company's reputation and image. As this case study demonstrates, political changes to policies have the potential to exacerbate existing issues within STEM industries that affect women.[72] A lack of regulatory oversight means that women will continue to feel the effects of pay disparity and moreover, suffer from normalised norms and practices that prevent them challenging gendered behaviour. Consequently, a lack of regulatory oversight means that accountability agencies are unable to gather detailed information regarding women's experiences in STEM workplaces. The inadequate amount of data available to policymakers is a serious concern because it means that they are unable to effectively update the pipeline model which will be explored further.

2.4 The Leaky Pipeline Model

Established by the US National Science Foundation in the 1970s, the leaky pipeline model has been used extensively by policymakers, universities and research institutes in a number of countries to determine the extent that women are able to pass through milestones of a STEM career.[73] The leaky pipeline is associated with the idea that at certain stages of a STEM career, there are leakages of women. The pipeline model enables researchers to determine the types of individuals who are affected and where the leaking is most severe.[74] Researchers have attributed the two biggest reasons of leakages to marriage and childbirth.[75] However, Matthew Cannady et al. notes that the pipeline model fails to illustrate other variables that influence women in STEM to leave.[76] Policymakers utilising the leaky pipeline model may also be neglecting issues that affect

[72] Adi Robertson, "Google Announces New Sexual Assault and Harassment Policies after Mass Protest", *The Verge*, November 8, 2018, https://www.theverge.com/2018/11/8/18075780/google-sexual-assault-harassment-policy-sundar-pichai-walkout-changes.
[73] Metcalf, "Stuck in the Pipeline", 39.
[74] Cannady, Greenwald and Harris, "Problematizing the STEM Pipeline", 444.
[75] Goulden, Mason and Frasch, "Keeping Women in the Science Pipeline", 141.
[76] Cannady, Greenwald and Harris, "Problematizing the STEM Pipeline", 444.

particular groups of women. Policymakers may not have been implementing suitable policies or initiatives to resolve barriers that are not explained by the model. As such, the model possesses a number of flaws which will be discussed below.

The pipeline model is unable to account for diverse career paths, exits and re-entries. The model is linear in nature and does not consider women who digress from the established path. Heather Metcalf cites that women who pursue graduate degrees in mathematics and then pursue education occupations are unfairly regarded as having left the pipeline.[77] It is assumed that they no longer engage in STEM or apply their STEM knowledge to their occupation. Similarly, Jill Marshall notes that the pipeline does not factor in the multiple pathways and entry points that women students pass through. Additionally, the pipeline models designed by research institutions may not include the wide range of career alternatives that are available to women with STEM qualifications. Pipelines that assess women in STEM disciplines often neglect the fact that women may incorporate a vast amount of multidisciplinary skills, practices and concepts of a STEM subject throughout their career.[78] The pipeline model also assumes that STEM disciplinary knowledge is only transferable to the respective disciplinary career. This results in data from the model being incorrect. Consequently, the pipeline tends to homogenize and oversimplify the complex pathways that are available to STEM graduates. This has the potential to misrepresent women who choose pathways that still utilise certain STEM skills, knowledge and practices.

Additionally, the pipeline model functions under assumptions that help to conceptualise what a traditional STEM occupation consists of. These assumptions are unhelpful

[77] Metcalf, "Stuck in the Pipeline", 9.
[78] Marshall, "Escape from the Pipeline" 23.

because STEM knowledge has become increasingly multidisciplinary and the pipeline can no longer describe current gendered differences that have arisen out of new social and cultural conditions.[79] The pipeline model also assumes that the end point of a STEM career is a leadership position and that a positive outcome is a woman in STEM who successfully completes all career milestones within a determined timeframe.[80] This is unrealistic because women may have other objectives in life or choose other diverse career paths. The pipeline thus associates women who pursue complex career trajectories as having leaked out of the pipeline. Elizabeth Garbee notes "inherent in this metaphor is the negative connotation associated with the language of 'leaks,' evoking images of dysfunctional faucets."[81] Subsequently, the pipeline model rejects the notion that women who have STEM knowledge yet, choose to pursue alternative career paths do contribute the wider STEM community and does not provide knowledge about why women may choose an alternative STEM pathway over a traditional one.[82] Women who choose to divert from the pipeline model are perceived as passive and unsuccessful individuals who have been affected by social, cultural and institutional barriers. Marshall notes that women students who leak out from the pipeline are considered to be "waste products with the poor fortune of encountering a crack in the pipeline."[83] Critics have also noted that the model does not sufficiently examine barriers affecting the participation rates of

[79] David I. Miller and Jonathan Wai, "The Bachelor's to Ph.D. STEM Pipeline No Longer Leaks More Women than Men: A 30-Year Analysis", *Frontiers in Psychology* 6 (2015): 6, https://doi.org/10.3389/fpsyg.2015.00037.
[80] Alice Pawley and Jordana Hoegh, "Exploding Pipelines: Mythological Metaphors Structuring Diversity-Oriented Engineering Education Research Agendas", *2011 ASEE Annual Conference & Exposition* (June 26, 2011): 5, https://peer.asee.org/exploding-pipelines-mythological-metaphors-structuring-diversity-oriented-engineering-education-research-agendas.
[81] Elizabeth Garbee, "The Problem With the "Pipeline" Metaphor in STEM Education", *Slate Magazine*, October 20, 2017, https://slate.com/technology/2017/10/the-problem-with-the-pipeline-metaphor-in-stem-education.html.
[82] Miller and Wai, "The Bachelor's to PhD", 8.
[83] Marshall, "Escape from the Pipeline", 20.

women from different racial or socio-economic backgrounds.[84] This can impact the types of policies that are available to women from disadvantaged areas and communities.[85] Unaddressed flaws within the pipeline model mean that policymakers are applying a simplistic and inadequate approach to a deeply multifaceted issue.[86]

Due to the discussed flaws, the pipeline model is not an effective tool for policy makers. The next sections of this chapter will illustrate how women in STEM have struggled to balance competing roles.

2.5 Balancing Work and Family

Researchers have illustrated that the most pressing challenge for women in STEM is balancing familial and career responsibilities. While the proportion of men and women in the workforce is relatively even, women play a larger role in childrearing and domestic duties.[87] The COVID-19 pandemic exacerbated many of the challenges faced by women in STEM employment with many taking a larger proportion of childrearing and household duties whilst working from home.[88] Linda Duxbury and Christopher Higgins illustrate that women have fewer avenues available than men for achieving control over competing role demands. Professional career women are "expected to be committed to

[84] Louise Soe and Elaine Yakura, "What's Wrong with the Pipeline? Assumptions about Gender and Culture in IT Work", *Women's Studies* 37, no.3 (April 2008): 177, https://doi.org/10.1080/00497870801917028.
Juan David Romero, "Study Urges a Movement Away From Traditional STEM Pipelines to Embrace Diversity of STEM Educational Pathways", *American Association for the Advancement of Science*, January 29, 2016. https://www.aaas.org/news/study-urges-movement-away-traditional-stem-pipelines-embrace-diversity-stem-educational.
[85] Metcalf, "Stuck in the Pipeline", 12.
[86] Cannady, Greenwald and Harris, "Problematizing the STEM Pipeline, 445.
[87]Tonya K. Frevert, Satoris S. Culbertson, and Ann H. Huffman, "Exploring the Double Jeopardy Effect: The Importance of Gender and Race in Work–Family Research", in *Gender and the Work-Family Experience: An Intersection of Two Domains*, ed. Maura J. Mills (Cham: Springer International Publishing, 2015), 60, https://doi.org/10.1007/978-3-319-08891-4_4.
[88] Monique Frize et al., "The Impact of COVID-19 Pandemic on Gender-Related Work from Home in STEM Fields—Report of the WiMPBME Task Group", *Gender, Work & Organization* 28, no. S2 (2021): 391, https://doi.org/10.1111/gwao.12690.

their work ‘just like men’ at the same time that they are normatively required to give priority to their family roles.” [89] This idea is arguably already normalised within certain western societies which have not seen major progress with regards to the redistribution of domestic responsibilities between men and women. Greater amounts of women, including women in STEM are leaving their occupation or taking career breaks because of an inability to cope with dual responsibilities. Women physicians report feelings of fatigue more so than their male counterparts. Advances in digital technology have increased work demands. With the convenience and prominence of electronic medical records, internet access and mobile applications, individuals have a greater degree of access to physicians.[90] This instant access, however, has some consequences for physicians. Women physicians are often forced to worker longer hours while also fulfilling their familial duties. This precarious juggling often means that many women physicians choose not to pursue leadership opportunities or aspire to promotions and tenures thereby contributing to an underrepresentation of women physicians in leadership positions.

Most women in STEM have also been impacted by workplaces that have been slow to implement family friendly organisational policies. Within academic fields, women in STEM have turned to STEM teaching positions rather than research-based careers out of the belief that they are more family friendly. This has far-reaching consequences as illustrated by Caroline Criado Perez whose work examines how a lack of women representation in STEM research positions has resulted in technological tools that

[89] Linda Elizabeth Duxbury and Christopher Alan Higgins, "Gender Differences in Work-Family Conflict", *Journal of Applied Psychology* 76, no. 1 (February 1991): 71, http://proxy.library.adelaide.edu.au/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=9103180584&site=ehost-live&scope=site.

[90] Lisa Cassidy-Vu, Keli Beck, and Justin B. Moore, "Burnout in Female Faculty Members: A Statistic or an Opportunity?", *Journal of Primary Care & Community Health* 8, no. 2 (1 April 2017): 97-98, https://doi.org/10.1177/2150131916669191.

replicate gendered biasness.[91] Only 36% of women perceived research-intensive careers as family friendly. One interviewee highlighted that:

> Research demands too much time away from my family. Also, as a woman, I don't feel as if the current academic environments are any more supportive of women with families.[92]

While there are existing family responsive policies which include modified duties, flexible working times and part-time work, US federal agencies and research universities do not coordinate their efforts to support women in STEM. Federal funding is directed to universities who are responsible for allocating funds into their local policies and programs, however, there is little guidance from federal agencies over how family policies should operate. Basic baseline policies established by US universities surrounding maternity leave and parental leave are inconsistent and universities can place limits on the number of women who can apply. Most research universities do not offer maternity leave to graduate students, postdoctoral scholars and academic researchers.[93] The lack of family friendly policies has further implications which will be explored below.

A lack of family friendly policies within STEM organisations and research institutions can prevent women from advancing in STEM environments which are highly competitive.[94] Women in STEM can struggle to strive in STEM fields that demand constant results and are dependent on research grants. Moreover, women in STEM are required to develop and maintain an academic profile through attending and presenting at academic conferences. Attending conferences is "essential, particularly during the first

[91] Blueprint for Living, "Humans are Making Biased Algorithms".
[92] Goulden, Mason and Frasch, "Keeping Women in the Science Pipeline, 150.
[93] Goulden, Mason and Frasch, "Keeping Women in the Science Pipeline", 152-3.
[94] Rosser, "Using POWRE to Advance".78.

few years of career establishment, and this lack of availability could stymie the success of women in STEM fields."[95] A lack of family friendly policies means that women are often unable to travel or network because of child caring responsibilities. Older women academic staff in STEM also report that caretaking responsibilities transition from children to elderly parents.[96] Women with caretaking responsibilities may choose to take a career break because of the extra pressures associated with their career. Yet, this can negatively impact them as they are often perceived as less career minded than their male counterparts. This belief can lead to career stagnation as they are not chosen for promotions or denied opportunities to work on big projects.[97] It can also result in women losing their STEM occupations as the job security of male colleagues is prioritised more especially, in times of economic strife.[98] Given these implications, some women in STEM choose to leave their career entirely. Other women in STEM may turn to insecure and vulnerable employment, including part-time or casual work in order to balance work and family responsibilities. This, in turn, leads to structural implications. Women may work in an administrative capacity rather than a STEM one.[99] Many governing boards also require individuals to be employed on a full-time basis in order to be considered for a leadership position.[100] Therefore, a lack of viable workplace policies can undermine

[95] Jean, Payne and Thompson, "Women in STEM", 301.
[96] Sue V Rosser, *Academic Women in STEM Faculty: Views beyond a decade after POWRE* (Cham: Palgrave Macmillan, 2017), 107, https://doi.org/10.1007/978-3-319-48793-9_5.
[97] Frevert, Culbertson and Huffman, "Exploring the Double Jeopardy Effect", 60.
[98] Gillian Whitehouse and Michelle Brady, "Editorial: New Social Inequalities and the Future of Work", *Labour & Industry: A Journal of the Social and Economic Relations of Work* 29, no. 3 (3 July 2019): 238–42, https://doi.org/10.1080/10301763.2019.1679422.
[99] Pooran Wynarczyk and Chloe Renner, "The 'Gender Gap' in the Scientific Labour Market", in *International Investigation into 'Gender Inequality' in Science, Technology, Engineering and Mathematics (STEM)*, ed. Pooran Wynarczyk (Bradford: Emerald Publishing Limited, 2006), 50, http://ebookcentral.proquest.com/lib/adelaide/detail.action?docID=285511.
[100] Julia Segar, "Under-Representation of Women on Governing Bodies: Women General Practitioners on Clinical Commissioning Groups in England", *Journal of Health Services Research & Policy* 20, no. 4 (1 October 2015): 258, https://doi.org/10.1177/1355819614567912.

attempts to increase the participation rates of women in STEM and moreover, lead women to choose vulnerable and insecure work.

Due to a lack of viable family friendly measures, women in STEM continue to struggle with competing demands arising from childcare and work. A lack of policy and programs to aid women with familial responsibilities has meant that women are underrepresented in STEM positions that are focused on research and leadership. This thesis will now examine institutional barriers that contribute to the low representation of women in STEM.

2.6 Institutional Barriers

Feminist scholars regard institutional barriers as a significant barrier to women's participation in STEM. Institutional barriers can include unfair recruitment processes, gender discrimination, pay gaps, limited mentoring opportunities, a lack of flexible working arrangement options as well as cold socio-cultural environments. Academic institutions, organisations and businesses function under a set of rules and expectations. In many cases, these rules and expectations are clearly identifiable through the development policies and regulations. However, as Lalita Subrahmanyan notes, organisations are also capable of maintaining and encouraging rules and behaviour that are informal but are acknowledged as legitimate.[101] These informal rules and practices can maintain harmful gendered ideology that insists that women do not belong in STEM education and workplaces.

Institutional barriers have the ability to influence the participation rates of women who wish to pursue STEM in higher education. In 2018, Tokyo Medical University was

[101] Subrahmanyan, "Women Scientists", 36.

accused of deliberately marking down the scores of women applicants and increasing the marks of male students by 10 points with a computerised marking system automatically altering exam marks. The practice had been occurring for more than a decade. University officials cited that they wished to maintain the number of women students at 30%.[102] Officials operated under the belief that women tended to either take maternity leave or resign after marriage and/or after giving birth. A wider investigation uncovered that more Japanese universities may have manipulated results to favour male applicants. As this case demonstrates, Japanese women seeking to undertake STEM courses in universities could face discrimination in tests due to gendered institutional practices. In many instances, it is often hard to find evidence unless an external or accounting agency intervenes. This may account for why it took more than a decade for evidence to emerge. During this time, many women may have chosen to enter alternative disciplines based on the belief that they have not achieved a high result to succeed in STEM. Financial pressures may have also contributed to losses in women's representation in STEM given that students must pay to undertake entrance exams. It costs 60,000 yen or $720 to take one university exam. This decade's long practice has potentially helped construct a male dominated STEM industry. Subtle gender disparities also exist on a deeper level. In an ABC report, one Japanese applicant explained that textbooks used for exam preparation featured questions that asked discriminatory questions regarding marriage and life with children. The textbook's answer "I will work my whole life as a doctor even after I have

[102] Jake Sturmer, "Tokyo Medical University Apologises After Women Deliberately Marked Down to Limit Numbers", *ABC News,* August 8, 2018, https://www.abc.net.au/news/2018-08-08/tokyo-university-apologises-for-rigging-marks-to-exclude-women/10086924.

a baby and raise a child" reveals that education institutes are influenced by gendered ideology. [103]

Institutional barriers imposed by STEM companies and industries have also supported gender disparities and reinforced gendered ideas, norms and practices. In its investigation of Google, the US Department of Labor revealed ongoing and systemic compensation disparities between men and women.[104] Using a 2015 snapshot of salaries, the US Department of Labor hypothesised the pay disparity against women is extreme even within the norms and practices of tech industry standards.[105] Attempts to hold STEM businesses accountable for gendered and unequal practices is difficult. In January of 2017, the US Department of Labor had to file a suit in order to compel Google to submit salary documentation and data to determine if Google complied with equal opportunity laws.[106] Google initially agreed, however, it refused to provide detailed information regarding employees. This violation of contractual obligations with the federal government led to a lawsuit. Google explained that the requests made by the department are overbroad in scope and have the potential to reveal confidential data.[107] Lisa Barnett Sween, an attorney for Google, testified that the "request was an unconstitutional violation of the company's fourth amendment right to protection from unreasonable

[103] Jake Sturmer, "Japanese University Scandal Signals Broader Issue of Gender Inequality in Japan", *ABC News*, November 9, 2018, https://www.abc.net.au/news/2018-11-09/gender-bias-at-tokyo-medical-university-not-isolated-case/10478764.
[104] Sam Levin, "Google Accused of 'Extreme' Gender Pay Discrimination by US Labor Department", *The Guardian*, April 7, 2017, http://www.theguardian.com/technology/2017/apr/07/google-pay-disparities-women-labor-department-lawsuit.
[105] Jessica Schladebeck, "U.S. Department of Labor Accuses Google of 'Extreme' Gender Pay Discrimination", *New York Daily News*, April 8, 2018, http://www.nydailynews.com/news/national/google-accused-extreme-gender-pay-discrimination-article-1.3033235.
[106] Levin, "Google Accused of 'Extreme Gender Pay".
[107] Megan Rose Dickey, "The U.S. Department of Labor Is Suing Google for Compensation Data", *TechCrunch*, January 6, 2017, http://social.techcrunch.com/2017/01/05/the-u-s-department-of-labor-is-suing-google-for-compensation-data/.

searches."[108] This amendment has also been extended to contracted employees and companies.[109] Google has maintained that it provides all workers with equal pay across races in the United States.[110] As this example demonstrates, women in STEM and regulatory agencies have little means of accessing information related to gender pay inequities due to a lack of legislation. Moreover, technology companies such as Google have established legal mechanisms that make it hard for women employees to determine whether gendered and unequal practices have occurred.

A further disparaging trend is that Google is not the only technology company to face legal action from the US Department of Labor over its institutional practices that disadvantage women employees. In September 2016, major data analytics company, Palantir was accused of discriminating against Asian job applicants in recruitment practices. Palantir has been awarded more than $340 million in federal contracts.[111] Its clients range from US intelligence agencies to local governments. The US department of Labor claims that unfair recruitment processes have occurred since 2010. This has implications for women who belong to diverse cultural and ethnic communities. In 2017, Palantir agreed to pay $1.7 million to the US Department of Labor, however, it refused to admit any wrongdoing.[112] As David Kravets accentuates, Palantir were more concerned that if it did not settle the allegations, future government contracts could be compromised.[113] As this example highlights, regulators such as the US Department of

[108] Levin, "Google Accused of 'Extreme Gender Pay".
[109] Sam Levin, "Accused of Underpaying Women, Google Says It's Too Expensive to Get Wage Data", *The Guardian*, May, 26 2017, https://www.theguardian.com/technology/2017/may/26/google-gender-discrimination-case-salary-records.
[110] Levin, "Google Accused of 'Extreme Gender Pay".
[111] Tim Higgins, "Palantir Sued Over Alleged Hiring Discrimination - Update", *Wall Street Journal*, September 27, 2016, https://www.wsj.com/articles/palantir-sued-over-alleged-hiring-discrimination-1474928585.
[112] David Kravets, "Palantir Settles US Charges That It Discriminated Against Asian Engineers", *Ars Technica*, April 26, 2017, https://arstechnica.com/tech-policy/2017/04/palantir-settles-us-charges-it-discriminated-against-asian-engineers/.
[113] Kravets, "Palantir Sued".

Labor are unable to tackle widespread practices and norms that disadvantage women in STEM. Regulators are unable to compel a company to change its practices or implement strategies to mitigate unfair and gendered practices. At the most, they are only able to persecute companies after a violation has been committed. STEM companies have been known to prioritise their economic wellbeing over the rights of their women employees. The process to enforce protections for employees is also undermined by the regulatory oversight process which can be time consuming and highly expensive. This may mean that women employees choose to leave their STEM position and seek alternative pathways that offer better cultural and economic advantages due to a lack of available or immediate alternatives from their STEM workplace as well as the fact that regulatory agencies are slow to resolve workplace issues.

Institutional barriers have also come in the form of internal policies that aim to silence individuals who criticise measures which maintain workplace discrimination practices towards women. For instance, confidentiality agreements are used as a tool to ensure that individuals do not speak out against wage discrimination. Sam Levin notes that confidentiality clauses are incredibly common in Silicon Valley.[114] While the purpose of the clauses is to protect trade secrets, the rules around any form of interaction with external actors are extremely complex. Women employees are unable to discuss or raise concerns about any type of workplace discrimination for fear of violating the clause even when discussions over unfair workplace practices are legally permitted. Google's exploitation of confidentiality clauses is concerning because it incites other technology companies to do the same. Google's status as a major player and cultural beacon means

[114] Sam Levin, "Google Employees Deterred from Reporting Discrimination, US Official Says", *The Guardian*, July 19, 2017, https://www.theguardian.com/technology/2017/jul/19/google-confidentiality-wage-gap-us-investigation.

that it is capable of influencing other companies to create internal policies that prevent employees and particularly, women from speaking out against the industry.[115] It is clear that internal policies such as confidentiality clauses have enabled technology companies to perpetuate workplace discrimination that affects women.

The US Department of Labor notes that inquiries into whether Google has unfairly paid its women employees are also hindered by internal workplace cultures and engrained attitudes surrounding employees who speak to external agencies about unfair pay processes. One former senior manager at Google explained that it "is built into the culture that it's shameful to leak" and moreover, "it builds a sense of paranoia… There is just a sense that leakers will be found and terminated."[116] This repercussion has proved to be an obstacle for regulatory agencies such as the US Department of Labor because:

> The entire enforcement mechanism of federal law is dependent on employees feeling free and able to talk ... [Therefore,] in a case like Google, where [the] preliminary analysis reveals systematic and sweeping discrimination in pay against women for nearly all job titles… something is going on and we need to find out what that is. Employees are the eyes and ears on the ground.[117]

By creating a workplace atmosphere of paranoia, Google has silenced employees from speaking about unjust policies, some of which disproportionately affect women. Google's workplace culture has also embraced the notion of a "culture of guys promoting guys" or in this case, 'guys protecting guys.'[118] Women impacted by illegal or unfair and gendered practices are less likely to find support with other employees. Therefore, this current tech

[115] Sam Levin, "Women Say They Quit Google Because Of Racial Discrimination: 'I Was Invisible'", *The Guardian*, August 18, 2017, https://www.theguardian.com/technology/2017/aug/18/women-google-memo-racism-sexism-discrimination-quit.
[116] Levin, "Google Employees Deterred from Reporting".
[117] Levin, "Google Employees Deterred from Reporting".
[118] Levin, "Women Say They Quit".

culture has and continues to be, capable of discouraging women from both entering and excelling in STEM career streams. By establishing a potentially exclusionary working environment that is kept in line by strict confidentiality clauses and gendered ideology, tech companies have undermined the efficiency of federal accounting agencies. Institutional and informal workplaces practices have gone unchallenged and prevented women in STEM from finding a viable means of countering unfair workplace procedures. As a result, it is apparent why many choose to their STEM careers early while future generations learning from their experiences choose not to pursue STEM.

2.7 Culture and Society

2.7.1 Social Constructions of STEM

Social influences have played a large role in maintaining that women have characteristics that make them less suitable for undertaking STEM education and careers. These ideas continue to impact girls and women in STEM, and moreover, contribute to gendered practices, norms and behaviours that impact women's engagement in STEM education and occupations as examined above. Social constructions have also reinforced the idea that STEM is a masculine area of study and work as sections below will explore.

One of the social constructions reinforced by the scientific world was that women were more intertwined with the natural world. Early western patriarchal societies found immediate connections with nature and the qualities that were fast becoming expectations for women.[119] The environment and women became devalued. Terms such as 'virgin earth,' 'fertile land' and 'barren earth' reinforced pervasive ideology that sought to

[119] Sarah Milner-Barry, "The Term 'Mother Nature' Reinforces the Idea That Both Women and Nature Should Be Subjugated", *Quartz*, December 2, 2015, https://qz.com/562833/the-term-mother-nature-reinforces-the-idea-that-both-women-and-nature-should-be-subjugated/.

emphasise that women and nature are exploitable commodities. The women and nature association has meant that women have been unfairly regarded as more emotional, less rational and weaker than their male counterparts. Male scientists are perceived to possess the means and power to know and control nature. In her study, Mary Barbercheck examined published issues ranging from January 1995 to December 1997 from the academic journal, *Science*. Barbercheck uncovered that the publication would present commercial images of women as a symbol of nature or as an object of study. In one image, fragments of a woman's body such as lips, eyes and hands are interspersed with the pictures of flowers and seashells and the word 'discovery' in displayed in a large font size. As Barbercheck remarks, the image suggests that similarly to nature, "women can be fragmented, reduced, understood, and controlled by science." [120] In a second image, Barbercheck examined an advertisement for a biotechnology company with the headline, 'Mapping the Human Genome.'[121] The image features a nude woman in a seductive pose. The woman is covered by an antique map of Africa. Much like the first image, the woman is represented as nature. The addition of the map of Africa, however, suggests that the woman is territory that can be dominated and exploited.

Feminist scholars such as Sherry Ortner and Catherine Roach contend that associating women with nature has other problematic implications. Ortner illustrates that if women are identified as nature then men are assumed to be closely associated with culture. Within this line of thinking, culture is connected with ideas surrounding knowledge and order. The social construction of women being closer to the natural world makes it easier for dominant groups to subordinate them, much like nature which is the target of a culture

[120] Barbercheck, "Mixed Messages", 128.
[121] Barbercheck, "Mixed Messages", 129.

that aims to subsume and transcend it.[122] Similarly, Roach, an eco-feminist explains that Mother Nature has long been perceived as fruitful and yielding for the benefit of humanity.[123] Similarly, women too are considered to be productive resources and are expected to place the needs of their husband and family ahead of themselves. Consequently, the idea that women are closely intertwined with nature is a dangerous belief as it perceives both women and nature to be legitimately exploitable.[124] Social constructions that associate women with nature also suggest that women are exploitable, can be controlled and are embedded with feminine qualities that encourage passiveness.

2.7.2 Science as a Masculine Area

Many scholars have illustrated how cultural and societal influences play a large part in gendering the norms, practices, and beliefs of the STEM environment. The 1960s and 1970s saw fewer than 1 in 100 children draw a woman when asked to draw a scientist. By 2010, 83% of boys and 30% of girls aged 6 drew male researchers.[125] Despite this change, researchers have found some alarming trends. By age 16, 98% of boys and 75% of girls perceive scientists to be predominantly male. This suggests the image of science as well as its orientation towards masculine ideology and dominance over nature remain ever-present.[126] Lucy Mbirianjau illustrates that most societies perceive women STEM students as intruding on a male area. Women students are regarded as outsiders, masculine and face rejection from the wider academic and industry circles.[127] The

[122] Sherry B. Ortner, "Is Female to Male as Nature Is to Culture?", *Feminist Studies* 1, no. 2 (1972): 12, https://doi.org/10.2307/3177638.
[123] Catherine M. Roach, *Mother/Nature: Popular Culture and Environmental Ethics,* (Bloomington: Indiana University Press, 2003), 34, http://ebookcentral.proquest.com/lib/adelaide/detail.action?docID=151940.
[124] Roach, "*Mother/Nature,* 39.
[125] Giorgia Guglielmi, "US Kids' Doodles of Scientists Reveal Changing Gender Stereotypes", *Nature,* March 20, 2018, https://www.nature.com/articles/d41586-018-03346-7.
[126] Barbercheck, "Mixed Messages", 127.
[127] Mbirianjau, "Why are Fewer Kenyan Women".

Clayman Institute for Gender Research has found that images which convey the idea that STEM is an area for "coding-obsessed, geeky guys contributes more powerfully to significant gender gaps in tech."[128] Silicon Valley, the main sphere from which major technological enterprises exist reinforces a toxic and masculine culture. This culture has been responsible for the development of the term, 'brogrammer.'[129] The term attaches the idea of a programmer to that of a stereotypical male fraternity-house salute. The term not only genders STEM careers, but rather, also signifies that male programmers belong to a dominant community. This has marginalised women in STEM who do not fit within the prescribed social characteristics. New and young male programmers have also begun to redraw the boundaries over the rules and expectations of women in STEM. During the 2012 South by Southwest Interactive Festival, Matt Van Horn, an executive at social media company, Path, "cautioned against 'gangbang' interviews' – screening prospective employees by committee – and made a crack about his fraternity's recruitment strategy, designed to 'attract the hottest girls' on campus."[130] Van Horn's remarks clearly directed at male students sought to reinforce gender disparities. His comments reveal that women continue to be seen as objects that can be exploited and commodified for material gain. This example is not the only case where tech companies have resorted to gendered practices and norms to attract new employees. Website, Scoot, advertised a Boston hackathon that promised massages, access to gyms and cupcakes. Yet, this was accompanied by the statement, "Need another beer? Let one of our friendly (female) event staff get that for you."[131] This statement clearly positions women as subservient to

[128] The Clayman Institute for Gender Research, "Alignment with Gender Stereotypes".
[129] Doug Gross, "In Tech, Some Bemoan the Rise of 'Brogrammer' Culture", *CNN*, May 7, 2012, https://www.cnn.com/2012/05/07/tech/web/brogrammers/index.html.
[130] Tasneem Raja, "'Gangbang Interviews' and 'Bikini Shots': Silicon Valley's Brogrammer Problem", *Mother Jones*, April 26, 2012, https://www.motherjones.com/media/2012/04/silicon-valley-brogrammer-culture-sexist-sxsw/.
[131] Gross, "In Tech".

their male counterpart. It also implies that women in technology companies may be forced into fulfilling roles that are culturally gendered.

2.7.3 Cultural Comparisons

Academic scholars are also exploring the diverse cultural and social variables that help to construct ideas around what constitutes as appropriate work for women and whether STEM careers comply with these ideas. Ulf Mellström's work has demonstrated that there are clear cultural and societal differences in how STEM careers are constructed for Malaysian women. Mellström notes that Malaysia provides an interesting comparison to western countries because a large percentage of women choose to undertake STEM courses comprising of computer science and IT. Notably, women are underrepresented in other STEM disciplines including engineering and technology.[132] Yet, at the School of Computer Science at Universiti Sains Malaysia, 65% of students are women, and 1990-91 statistics reveal that 51% of women were students in courses related to IT and computing. Mellström suggests that there a number of reasons why STEM computing courses are undertaken predominately by women. In order to move away from their colonial past, Malaysia's political culture has stressed the need for Malaysia to become a fully developed country.[133] Politicians have developed a narrative which associates development with technology and modernisation. Malaysia and specifically, the emerging middle classes perceive IT and technology to be power markers that signify individual and national empowerment. Subsequently, political and cultural factors have led to the belief that IT and computing are powerful indicators of individual and national empowerment. IT is also increasingly seen as an important indicator of global market

[132] *Malay Mail*, "Report: Lack of Women in STEM Due to Gender Stereotypes", *Malay Mail*, July 23, 2017, https://www.malaymail.com/s/1427029/report-lack-of-women-in-stem-due-to-gender-stereotypes.
[133] Mellström, "The Intersection of Gender, Race and Cultural Boundaries", 894.

competitiveness.[134] Similarly, the United Nations Educational, Scientific and Cultural Organisation contends that Malaysian families are supportive of daughters who wish to enter IT and computing pathways.[135] IT and computing are widely regarded as prestigious and belong to highly remunerated industry. All of these factors enable some women and their families to enjoy the rewards of social and economic mobility.

While this illustrates why individuals are drawn to IT and computing education pathways and careers, it does not explain fully why women dominate this industry of STEM. As such, Mellström proposes that answers may lie in the fact that practices, space and ideas related with IT and computer science have been gendered by local gender discourses. In Malaysia, there are close spatial associations between women and indoor spaces as well as men and outdoor areas. Outdoor jobs and hardware network jobs are considered to be a masculine field because such positions require more mobility, involve more outdoor exposure and are physical in nature. These requirements are considered to be less suited for Malaysian women. Gendering spatial spaces within STEM disciplines "helps men to create spaces of their own and to keep women circumscribed by a situated body politics with its plethora of rules of what certain women can or cannot do."[136] By choosing to enter the computing and IT stream, women are associated with the belief that they are a part of a national movement that values technology and modernity and they are thus, both empowered on an individual level and at nationalistic level. Yet, cultural influences that symbolically associate indoor spaces with women reveal that deeply engrained beliefs about women's expectations continue to play a role in determining what STEM discipline

[134] See Juanita Elias, "The Gender Politics of Economic Competitiveness in Malaysia's Transition to a Knowledge Economy", *The Pacific Review*, 24, no. 5 (December 2011): 530, https://www-tandfonline-com.proxy.library.adelaide.edu.au/doi/full/10.1080/09512748.2011.596564?scroll=top&needAccess=true
[135] "Women Still a Minority in Engineering and Computer Science", UNESCO, February 9, 2017, http://www.unesco.org/new/en/media-services/single-view/news/women_still_a_minority_in_engineering_and_computer_science/.
[136] Mellström, "The Intersection of Gender, Race and Cultural Boundaries", 894.

Malaysian women gravitate towards. Furthermore, as Juanita Elias notes, "an increased emphasis on women's role as productive knowledge workers potentially conflicts with government policies that emphasise wives' and mothers' responsibilities in supporting productive and morally upstanding and, increasingly, Islamic citizens".[137] As will be seen later in this thesis, issues of motherhood have also arisen in the Singaporean context.

In comparison to other western countries, the Middle East has also seen more women engage with STEM. More than 50% of Middle Eastern women have graduated from STEM courses. In Iran, this figure is higher with almost 70% of university STEM graduates women. Oman, Saudi Arabia and the United Arab Emirates follow with 60% of science graduates women.[138] Claudine Schmuck notes that this change has occurred rapidly over a period of 10 years and that there is no gap between girls and boys with regards to the confidence and skills in science. The only discipline that has a gender gap is mathematics. The Middle East is, therefore, one region where the level of women undertaking engineering and computing courses is significantly higher than in comparison to other countries.[139] This increased engagement with STEM is notable given that prevailing cultural beliefs continue to impact women's participation in STEM workplaces. For instance, in Egypt, only 31% of men believe that women should have equal rights to employment. Severe forms of social, cultural and economic discrimination may be the reason most women's participation in STEM has not transitioned into growth in STEM employment.[140] Despite this, Schmuck contends that the rising growth in

[137] Elias, "The Gender Politics of Economic Competitiveness", 547.
[138] Annalisa Merelli, "The West Is Way Behind Iran and Saudi Arabia When It Comes to Women in Science", *Quartz*, March 9, 2018, https://qz.com/1223067/iran-and-saudi-arabia-lead-when-it-comes-to-women-in-science/.
[139] Claudine Schmuck, *Women in STEM Disciplines* (Cham: Springer International Publishing, 2017), 16, http://link.springer.com/chapter/10.1007/978-3-319-41658-8_1.
[140] Kate Lyons, "Majority of Men in Middle East Survey Believe a Woman's Place Is in the Home", *The Guardian*, May 2, 2017, https://www.theguardian.com/global-development/2017/may/02/majority-of-men-in-middle-east-north-africa-survey-believe-a-womans-place-is-in-the-home.

women's engagement with STEM is a clear indication that women in the Middle East are determined to overcome barriers and contribute to economic development.[141]

Researchers have attempted to understand how regions of the Middle East have been able to achieve greater gender parity in STEM. One factor is the implementation of gender equality measures that were incorporated into state constitutions following the 2011 Arab Spring uprisings.[142] In her article, Adela Suliman attributes the increased rates of women in STEM to a slow but changing cultural environment. Previously, women from Middle Eastern countries gained status with the birth and raising of children.[143] However, these social constructions are gradually shifting towards the idea that education and employment are indicators of status. In some regions, Muslim women have had a greater amount of success changing cultural attitudes about women in the workforce. They have been able to essentially pioneer their role and reject preconceived notions that associate femininity with indoor positions such as those from IT and technology.[144] Some Middle Eastern countries have also developed internal measures within their education system. In Tunisia and Jordan, students from all socio-economic communities undertake a national exam after high school. From the results of the scores, students are funnelled into set career tracks. Top performers are admitted into medical schools while second-tier performers are placed into engineering schools. Raja Ghozi, a Tunisian engineering professor, acknowledges that "a large percentage of girls aren't driven by passion for

[141] Schmuck, *Women in STEM Disciplines*, 18.
[142] *The Straits Times*, "Gender Discrimination Costs Middle East and North Africa Region $779 Billion a Year: OECD", *Straits Times*, October 11, 2017, https://www.straitstimes.com/world/europe/gender-discrimination-costs-middle-east-and-north-africa-region-779-billion-a-year-oecd.
[143] Adela Suliman, "Educated but Not at Work: Lack of Women in Middle East Workforce Hinders Growth", *Reuters*, October 17, 2017, https://www.reuters.com/article/us-population-mideast/educated-but-not-at-work-lack-of-women-in-middle-east-workforce-hinders-growth-idUSKBN1CM1AC.
[144] Merelli, "The West is Way Behind".

engineering but by performance."[145] While women students in STEM can change their discipline, most tend to stay in engineering courses because of parents who encourage them and increased employment prospects. This has raised somewhat of a dilemma, as critics of Tunisia's education system have argued that it is not flexible and discourages girls from pursuing subjects that they more readily identify with. Maria Charles, however, contends that girls in western states may not have free will either remarking that "if a woman pursues a career as a teacher, she's unlikely to see this choice as one of forced conformity to gender norms but rather think her aspirations reflect a unique mix of interest and ability."[146] Therefore, it is unlikely that she will challenge whether her choices and decisions are constrained by subtle social and cultural influences. Recent studies have validated Charles' point. Countries with higher levels of gender equality have fewer women studying STEM degrees because girls choose studies based on their preference.[147] In many cases, preferences are influenced by familial and societal factors that do not attribute STEM courses as an appropriate form of study or employment for girls whereas for boys, it is socially acceptable work because it reinforces their masculinity and is economically beneficial. This is in contrast, to poorer states which reinforce the belief that STEM is a pathway for social and economic mobility and therefore, suitable for women.

2.8 Conclusion

By drawing from a broad range of feminist and other scholarly work, this chapter has argued that women in STEM face numerous challenges, including cultural, political,

[145] Elizabeth Weingarten, "The STEM Paradox: Why Are Muslim-Majority Countries Producing So Many Female Engineers?" *Slate Magazine,* November 9, 2017, https://slate.com/human-interest/2017/11/the-stem-paradox-why-are-muslim-majority-countries-producing-so-many-female-engineers.html.
[146] Weingarten, "The STEM Paradox".
[147] "In Countries with Higher Gender Equality, Women Are Less Likely to Get STEM Degrees", World Economic Forum, accessed 3 December 2018, https://www.weforum.org/agenda/2018/02/does-gender-equality-result-in-fewer-female-stem-grads/.

institutional and economic ones that impact on how they can pursue and maintain a STEM education pathway or occupation. Additional material, relevant to the individual country case studies, will be given in the specific chapters on each country.

Gendered beliefs maintain that women's biological differences make them less suitable for STEM education and occupations. Moreover, policymakers utilising the leaky pipeline model are potentially neglecting to address issues affecting women from disadvantaged backgrounds. Women in STEM have also struggled to balance demands arising from the home and workplace. A lack of family friendly measures has also contributed to a lower number of women in STEM leadership positions. Institutional barriers have also impacted how women can challenge gendered pay inequities and unfair norms, practices and beliefs. Regulatory agencies have also struggled due to a lack of viable legislation that ensures that companies adhere to gender equality policies. This chapter has also illustrated that there are clear cultural differences with how countries construct STEM.

Subsequent chapters will now draw on this broader academic literature as well as work from Australian, Indian and Singaporean scholars to examine whether the examined Australian, Indian and Singaporean policies and programs adequately address the barriers affecting girls and women in STEM that have been identified in this chapter. In order to do so, the thesis will draw on the feminist comparative policy and discursive framing approaches outlined in the previous chapter.

Chapter 3: Australia

3.1 Introduction

As explained in the previous chapter, this thesis draws on a feminist comparative policy approach. This chapter begins the specific country case studies and will provide essential background regarding the historic and current position of women in STEM in Australia before proceeding to analyse relevant government policy, as per the central focus of this thesis, outlined in Chapter One. It will utilise the feminist analytical approaches outlined previously, including a gendered discursive policy framing analysis, to argue that Australian government policies addressing women's participation in STEM have been influenced by specific historic, social and political factors that have impacted the effectiveness of policies and programs for women in STEM. Governments of all political persuasions have been influenced by a neoliberal ideology which has failed to sufficiently recognise the importance of women's unpaid role in social reproduction. A neoliberal framing has also led to some policies and initiatives suggesting that women are largely responsible for their own economic and social mobility and that the government should not overly interfere in the economic market. As such, policies and programs for women in STEM have not been able to effectively respond to the barriers outlined in Chapter Two and in this chapter. Drawing on the work of Australian feminist scholars and the wider literature, this thesis will examine some of the challenges faced by women in STEM and illustrate how historical issues which affected women in STEM continue into the present day and need to be addressed by governments.

Subsequent sections of this chapter will examine gender equality policies with a particular focus on policies, programs and initiatives that are designed to increase the

participation rates of girls and women in STEM. The thesis will look at policy discourse, including political statements, press releases, official documents, reports, websites, policies, initiatives and other government material. It should be noted that this thesis does not examine policies and initiatives for women in STEM past February 2022. However, documents such as the 1995 discussion paper produced by the Women in Science, Engineering and Technology Group (WISET) have enabled this thesis to reflect upon the position of past federal governments attitudes towards women in STEM. The chapter will examine the policy positions of the Labor government under Paul Keating (1991-1996), the Liberal government headed by John Howard (1996-2007), the Labor governments under Kevin Rudd (2007-2010, 2013) and Julia Gillard (2010-2013) as well as the Coalition governments headed by Tony Abbott (2013-2015), Malcolm Turnbull (2015-2018) and Scott Morrison (2018-2022). The thesis will then move on to explore policies, programs and initiatives for girls and women in STEM that were developed by the Liberal government under Morrison. Analysis into government policies and initiatives will focus on whether they address the identified barriers that affect girls and women in STEM. The thesis will identify any ideological or economic contexts that have shaped or influenced policy framing with regards to women in STEM. This thesis will also determine whether there are policy flaws that undermine or impact the government's efforts to increase the participation rates of women in STEM.

3.2 The Historical Presence of Australian Women in STEM

This chapter will begin by providing historical information regarding Australian women in STEM in order to determine whether barriers that affected women in the past continue to do so. It is important to note that a historical assessment of Australia will illustrate the ways in which women's roles have been constructed and moreover, how social, cultural

and political factors continue to influence women's participation rates in the present day. It will also be important in assessing the ways that some disciplines within STEM have been constructed as appropriate work for Australian women. Notably, most historical information regarding women's involvement in STEM is limited as women's participation in technology and engineering is not well recorded. Despite this, Anne Sunter reveals that Australian women in the 1870s were able to obtain certificates in telegraphy.[1] From the 1960s, girls began to enrol in chemistry courses while others began graduating in Metallurgy and Engineering.

The nineteenth century in Australia did present women with opportunities to be educated in botany which as in Britain and the U.S. was seen as an appropriate field for women to be engaged in as botany was associated with "the cultural nexus between popular science and fashion encased in Enlightenment ideas of self-improvement and linked with prevailing beliefs about nature and God."[2] Women were able to create illustrations of Australian species' and thus, enhance knowledge about the new environment. This was an important part of colonisation because it was considered as crucial for survival.[3] Groups of women in Australia became sketchers, collectors, watercolourists, illustrators and botanical writers. They were able to interpret and convey their work to a generalist audience.[4] Louisa Atkinson regarded by scholars such as Claire Hooker as the first female Australian scientist, published her sketches in the *Sydney Morning Herald* under the column "A Voice from the Country" in 1859. Her work marked a change from male scientists who printed their findings in language deemed obscure, authoritative,

[1] Anne Beggs Sunter, "Rich Vein of Learning: An Historical Assessment of Ballarat's Role in Australian Engineering Education", *9th National Conference on Engineering Heritage: Proceedings*, (1998): 133, https://search.informit.org/doi/epdf/10.3316/informit.546616252043720.
[2] Moyal, "Invisible Participants", 176.
[3] Hooker, *Irresistible Forces,* 11.
[4] Moyal, "Invisible Participants", 176.

masculine and technical. Atkinson preferred to write in simple language that was conversational and feminine in tone. Atkinson's knowledge of botanical, geological and zoological sciences allowed readers to familiarise themselves with the names of new Australian species as well as gain insight about fauna. Atkinson's column would help to popularise science and she would be regarded as an authority figure on natural science.[5]

Atkinson's nature journalism, however, was limited by the social conventions of the time that meant that she was still required to adhere to cultural standards that deemed her 'the perfect lady.' According to Hooker, a 'true lady' not only exhibited refined tastes and manners but even if her parents allowed her access to scientific knowledge, she would always be "an amateur in the original sense of the word: one who worked for love and never for money."[6] Such standards prevented women like Atkinson from gaining the means to explore new geographical areas or pursue expensive scientific ventures. Atkinson's work was also construed by her friends as "motivated by national pride, not by profit."[7] Consequently, women engaged in science were perceived as popularisers rather than active researchers and were restricted in their ability to undertake paid work. Furthermore, Hooker notes, that women were excluded from belonging to most Australian scientific societies, which were modelled after the socially elitist British Royal Society and its engrained ideas surrounding the role of women.[8] As a consequence, Australian women were unable to receive regular or up-to-date information on scientific discoveries. Moreover, Jane Carey notes that whilst the first Australian universities were established in the 1850s, they did not have laboratories meaning that the ability to

[5] Hooker, *Irresistible Forces,* 19-20.
[6] Hooker, *Irresistible Forces,* 10.
[7] Hooker, *Irresistible Forces,* 20.
[8] Hooker, *Irresistible Forces,* 11.

undertake scientific research was severely restricted.[9] In order to pursue a career in science, an individual needed to undertake studies in Britain or to a lesser extent the United States. For many women, this would be a challenging endeavour given the gendered ideology, norms and practices of the time. Women, particularly those from scientific families, were also forced to adhere to social beliefs that reinforced their subordination and meant that contributions they made with male members of the family were largely ignored.[10] As such, Australian women much like their US counterparts, were confined to being 'silent assistants' or subordinates to male researchers.

As a result, Australian women engaged in science were often forced to reinforce their femininity and their contributions were often de-valued as that of a feminine hobby rather, than a notable contribution. Women were also constrained by social conventions that played a significant role in appropriating the extent that they could engage in scientific endeavours.[11] Science was deemed as gendered from the beginning of Australian colonial-settler society with research from Jane Carey highlighting that gendered ideology, practices and norms continued to deter women from participating in scientific disciplines such as physics, mathematics and engineering well into the 1940s and 1950s.[12] Further sections of this chapter will examine policy changes that occurred

[9] Jane Carey, "Taking to the Field: A History of Australian Women In Science", interview by Robyn Williams, *The Science Show,* ABC, June 3, 2023, audio, 9:43, https://www.abc.net.au/radionational/programs/scienceshow/taking-to-the-field-a-history-of-australian-women-in-science/102421216.
[10] Moyal, "Invisible Participants", 178.
[11] Sara Maroske, ""The Whole Great Continent as a Present": Nineteenth-Century Australian Women Workers in Science", in *On the Edge of Discovery - Australian Women in Science,* ed. Farley Kelly (Melbourne: The Text Publishing Company, 1993), 34.
[12] Carey, "Taking to the Field: A History of Australian Women In Science". See also Alice Gorman, "Prejudice, Poor Pay and the 'Urinary Leash': Naming and Claiming Australia's Forgotten Women Scientists", *The Conversation,* February 9, 2023, https://theconversation.com/prejudice-poor-pay-and-the-urinary-leash-naming-and-claiming-australias-forgotten-women-scientists-198407.

in the late nineteenth century, however, it should be noted that the early treatment of women engaged in science continued to influence women in later generations.

3.3 Australian Women in STEM

In Australia, women in STEM continue to face challenges with many discouraged because of institutional and social barriers which continue to enforce measures that see many underpaid and others disillusioned because of hostile working environments. There are also longstanding, deep-seated ideas that maintain that Australian women are primarily caregivers.[13] Consequently, employed Australian women make up 75.1% of part-time roles and 56.3% of casual roles.[14] In all industries and in all Australian states and territories, women are earning on average less than men with the national pay gap being 13% in 2023.[15] Recent studies have found that Australian girls perform just as well as boys in STEM subjects.[16] However, fewer girls in year 12 enrol in STEM subjects such as ICT, physics, advanced mathematics and design and technology.[17] Subsequently, Australian women comprise just 16% of Australia's STEM-skilled workforce.[18] STEM occupations including those from the hard sciences such as physics, engineering and IT have the lowest amounts of female participation.[19] This is also compounded by the fact

[13] Meredith Nash and Brendan Churchill, "Caring during COVID-19: A Gendered Analysis of Australian University Responses to Managing Remote Working and Caring Responsibilities", *Gender, Work & Organization* 27, no. 5 (2020): 836, https://doi.org/10.1111/gwao.12484.
[14] "New WGEA Data Shows Employer Action on Gender Equality Has Stalled", Workplace Gender Equality Agency (WGEA), accessed November 24, 2021, https://www.wgea.gov.au/newsroom/new-wgea-data-shows-employer-action-on-gender-equality-has-stalled.
[15] "Lowest Ever National Gender Pay Gap Good Result But Still More to Be Done", Workplace Gender Equality Agency, accessed 2 October 2023, https://www.wgea.gov.au/newsroom/gender_pay_gap_media_release_Aug_2023.
[16] *ABC News (AM),* "Girls Just as Good at STEM Subjects as Boys, Study Shows", September 26, 2018, https://www.abc.net.au/news/2018-09-26/girls-just-as-good-at-stem-subjects-unsw-study-shows/10307266.
[17] Department of Industry, Science and Resources, "Women in STEM Evaluation Final Report", 11.
[18] Australian Academy of Science, *Women in STEM Decadal Plan,* 3.
[19] Professionals Australia, *Women in STEM in Australia,* (Professionals Australia Women in STEM Position Paper, 2014), 5, http://www.professionalsaustralia.org.au/professional-women/wp-content/uploads/sites/48/2014/03/WOMEN_IN_STEM_v2.pdf.

that among the countries in the Asia Pacific region, Australia has the lowest percentage of girls enrolled in high school STEM subjects. This indicates that Australia could potentially suffer from STEM skill shortages and moreover, may lose a competitive advantage over rivals in the Asia Pacific region. Statistics from 2016 have found that only 27% choose STEM courses, while in comparison, girls' participation rates from China and India are at 76% and 69% respectively.[20] In Singapore, girls' participation rates in STEM are at 63%.[21] This is concerning particularly, because STEM industries have been regarded by political leaders such as Josh Frydenberg as "industries of the future."[22] The Australian Department of Industry, Science, Energy and Resources suggests that by 2030, Australian workers will spend 77% more time using science and mathematical skills.[23] A 2020 Digital Pulse report estimates that 156,000 technology workers will be required by 2025 in order to keep up with demand.[24] Moreover, an additional 388,000 technology workers are needed in order for Australia to demonstrate its international competitiveness.[25] These statistics reflect the fact that Australian women are potentially less equipped or prepared for future career positions that will require STEM skills and knowledge. It also means that the Australian workforce may find it harder to compete economically with countries who have a greater amount of participation in STEM disciplines. Studies undertaken by Australia's Chief Scientist have also illustrated that

[20] Australian Academy of Science, *Women in STEM Decadal Plan*, 4.
[21] "Low Confidence Limits Number of Girls Pursuing STEM Careers in Singapore: Inaugural MasterCard Study", MasterCard, accessed 5 August 2019, https://newsroom.mastercard.com/asia-pacific/press-releases/low-confidence-limits-number-of-girls-pursuing-stem-careers-in-singapore-inaugural-mastercard-study/.
[22] "Treasurer Josh Frydenberg's 2019 Budget Speech – in Full", *The Guardian*, April 2, 2019, https://www.theguardian.com/australia-news/2019/apr/02/treasurer-josh-frydenbergs-2019-budget-speech-in-full.
[23] "Young Australians Value STEM For The Future", Department of Industry, Science, Energy and Resources, March 7, 2019, https://www.industry.gov.au/news-media/science-news/young-australians-value-stem-for-the-future.
[24] "ACS Australia's Digital Pulse 2020", ACS, accessed November 2, 2020, https://www.acs.org.au/insightsandpublications/media-releases/acs-australia-s-digital-pulse-2020-.html.
[25] ACS, "ACS Australia's Digital Pulse".

females have a harder time obtaining employment in STEM in comparison to males. The unemployment rate for women with STEM university qualifications is 5.2%. In contrast, the male unemployment rate is 3.5%. For females who have obtained Vocational Education and Training (VET) qualifications in STEM, the unemployment rate is 6.3% while for males, the rate is 3.3%. Females have a higher rate of unemployment across each STEM discipline at the university level. Similarly, at the VET level, females face higher rates of unemployment with the exception of science and mathematical fields.[26] These figures suggest that there are economic implications for women who wish to undertake STEM employment with qualified STEM VET women graduates the most affected group. In addition, 2016 data revealed that more than 40% of science graduates are employed in industries such as labour, sales and administration.[27] These industries are less likely to use their STEM knowledge and have contributed to lower employment participation rates for women in STEM.

Women in STEM workplaces also earn approximately 23.7% less than their male counterparts. Female graduates in engineering (16.7%) and agricultural and environmental sciences (19.7%) have some of the largest gender pay gaps within STEM industries.[28] However, this figure is contested. Science & Technology Australia estimate the gender pay gap to be 16% for women in STEM.[29] Other groups such as Professions Australia note that the gender pay gap is the highest for females in IT industries.[30] Going

[26] Office of the Chief Scientist – Australian Government, *Australia's STEM Workforce* (Canberra, March 2016), 20, 23, https://www.chiefscientist.gov.au/2016/03/report-australias-stem-workforce/.
[27] Paul Karp, "Gender Gap Narrows but Push towards Science Has Lowered Wages", *The Guardian*, September 16, 2018, https://www.theguardian.com/australia-news/2018/sep/16/gender-gap-narrows-but-push-towards-science-has-lowered-wages.
[28] Australian Academy of Science, *Women in STEM Decadal Plan*, 4.
[29] "Science Gender Pay Gap Too Wide and Job Insecurity Persists: New Report", Science and Technology Australia, November 20, 2018, https://scienceandtechnologyaustralia.org.au/science-gender-pay-gap-too-wide-and-job-insecurity-persists-new-report/.
[30] Professionals Australia, *All Talk: Gap Between Policy and Practice A Key Obstacle to Gender Equity in STEM*, (Melbourne, 2018), 23, http://www.professionalsaustralia.org.au/professional-women/wp-content/uploads/sites/48/2018/08/2018-Women-in-STEM-Survey-Report_web.pdf.

further, Professions Australia maintains that companies with gender policies also have gender pay gaps and in some instances, women are paid $17,500 less than their male counterparts.[31] These findings suggest that STEM industries have a higher prevalence of pay inequalities between men and women than many other non-STEM industries. It also accentuates that women may choose careers and industries which have lower pay gaps and are more economically beneficial for them to pursue. These findings highlight the significant challenges for women who wish to pursue STEM at a career level. An additional point of consideration is that the COVID-19 has exacerbated some of the existing inequalities faced by women in STEM.[32] Correspondingly, Australia's then-Chief Scientist, Alan Finkel stated that Australian women academics and researchers have been disproportionately impacted by university job losses.[33] A majority of women researchers are employed on a casual and fix-term basis. In mathematics fields, 64% of all Australian women in academic positions are in casual positions.[34] Most Australian universities did not have standard or consistent guidelines on how employees could continue their work whilst managing familial demands during the pandemic.[35] These instances may pose long-term consequences for early women STEM researchers and deter many from continuing in STEM employment. This section will now explain some of the barriers that have contributed to the low rates of female participation in STEM.

[31] *SBS News*, "Women Leave STEM over Pay Gap, Study Finds", *SBS News*, September 23, 2018. https://www.sbs.com.au/news/women-leave-stem-over-pay-gap-study-finds.
[32] Lyn Craig and Brendan Churchill, 'Dual-Earner Parent Couples' Work and Care during COVID-19', *Gender, Work & Organization* 28, no. S1 (2021): 76-77, https://doi.org/10.1111/gwao.12497.
[33] "Impact of the Pandemic on Australia's Research Workforce", Australian Academy of Science, accessed November 24, 2021, https://www.science.org.au/covid19/research-workforce. PDF available on website, 1, 5.
[34] Terri MacDonald, "Women Are Bearing the Brunt of COVID Pain in Higher Ed", *Agenda* 28 (2020): 16–17, https://doi.org/10.3316/informit.407670796784610.
[35] Nash and Churchill, "Caring During COVID-19", 842.

As demonstrated above, Australian girls' and women's participation in STEM is low with many choosing not to pursue an education in STEM and those already educated in STEM facing higher chances of unemployment and gender pay gaps. The 2019 Women in STEM Decadal Plan announced in the 2018-19 Federal Budget and developed by the Australian Academy of Science and Australian Academy of Technology and Engineering uncovered that women in STEM face barriers at each stage of their career pipeline. Similarly to the concerns examined in Chapter Two, Australian women in early stages of the STEM career pipeline face challenges including flawed recruitment practices, an inability to juggle caring responsibilities with work duties, experiences of sexual harassment and discrimination as well as social prejudice.[36] For women in mid-career stages of their STEM role, challenges such as a lack of development opportunities, flexible working arrangements and a lack of mentors significantly influences women to leave their STEM profession. Concerningly, a 2018 Professions Australia report revealed that 33.8% of female respondents aged 25 to 35 intended to leave their STEM profession within the next 5 years.[37] As such, it is clear that Australian workplaces may struggle to retain working women in STEM professions if they are unable to address the above challenges.

While Australian STEM workplaces have encouraged women with familial responsibilities to enter into flexible working arrangements such as part-time and casual positions, there are serious implications. The Professions Australia report cited one respondent who clarified that while part-time options are helpful for women who balance familial responsibilities, "part-time employees are not seriously considered for

[36] Australian Academy of Science, *Women in STEM Decadal Plan,* 2.
[37] "Professionals Australia Releases Women in STEM Report", Professionals Australia, last modified August 30, 2018, http://www.professionalsaustralia.org.au/blog/professionals-australia-releases-women-stem-report. PDF available on webpage, 10.

developmental opportunities nor career progression/promotion."[38] In another example, one respondent described how a company offered demoting their female employees as a way of accommodating their familial and career responsibilities. This is a disconcerting factor because it means that Australian women are less likely to pursue leadership and decision-making roles within STEM workplaces. Limiting women's representation in STEM particularly, at senior levels has the potential to silence workplace gender equality policies that can aid women in STEM. It can be demonstrated then, that pervasive "gendered historic work patterns whereby females were concentrated in lower-paid roles with less responsibility working part-time, and males worked full-time in more senior roles with greater responsibility" have continued into the present day particularly, as some workplaces maintain the socially embedded belief that flexible working arrangements are more relevant for women with children.[39]

Australian women in STEM also struggle with barriers including gender discrimination, sexual harassment and bullying which are heightened due to inadequate reporting mechanisms and hostile working cultures.[40] Workplaces still engage in behaviour, norms and attitudes that help to instil the idea that STEM is not appropriate work for women. Workplace policies including those that offer flexible working arrangements are also flawed because they hinder women's career progression and reinforce the expectation that women are largely responsible for familial and carer duties. As a result, Australian women's participation and progress in STEM has been slow with one report concluding that if existing workplace practices continue and there are no significant changes made

[38] Professionals Australia, *The Slower Track: Women in the STEM Professions Survey Report,* (Melbourne, 2015), 20, http://www.professionalsaustralia.org.au/professional-women/wp-content/uploads/sites/48/2014/03/2015-Women-in-the-STEM-Professions-Survey-Report.pdf.
[39] Professionals Australia, "Professionals Australia Releases Women in STEM Report", 21. Professionals Australia, *The Slower Track,* 22.
[40] Australian Academy of Science, *Women in STEM Decadal Plan,* 20.

to the prevailing STEM workplace culture then the barriers that affect women in STEM will continue to persist.[41] The next section of this chapter will explore whether the Australian federal government under Coalition and Labor governments have attempted to address the issues surrounding girls and women in STEM.

3.4 Australian Federal Policies

Governments of all political persuasions have made commitments to increasing the participation rates of women in STEM. However, progress has been slow with many policies directed broadly at women's education and health. Many academics including Yollanda van Gellecum and Janeen Baxter note that since the mid-1980s and the 1990s, neoliberal ideology has been adopted as a key political philosophy that has influenced a vast amount of policy change within the Australian labour market.[42] Neoliberal political discourse began to associate empowerment as the exercise of individual preference or the acquisition of assets. It stressed that it was not the state's responsibility to provide services that enabled women to be given equal opportunities, to be treated fairly or to have the right to economic equity. It also argued that governments should not interfere in the market through regulation. This was contrary to feminist discourses that associated empowerment as challenging the prevailing patriarchal norms and behaviour as well as linked to collective action.[43] The popularisation of neoliberal principles meant that policymakers promoted the belief that women were primarily responsible for their own political and economic empowerment. This has had and continues to have, implications for women in STEM. Further sections will illustrate how recommendations advocated by concerned groups have not been successful in their implementation because of the

[41] Professionals Australia, *The Slower Track*, 37.
[42] Gellecum, Baxter and Western, "Neoliberalism", 59.
[43] Dalingwater, "Neoliberalism", 2-3, 5.

framing of neoliberal principles which have contributed to a lack of government action regarding policies for women in STEM. Similarly, Susan Harris Rimmer and Marian Sawer's work also reaffirms this idea noting that as the influence of neoliberalism increased, both Labor and Liberal's commitment to women's policy became more complicated.[44] From the 1990s, at the federal level, governments particularly, those headed by the Coalition began to limit the influence of women's policy coordinating agencies which had previously been at the centre of government and had played a large role in establishing Australia as an early initiator in the development of women's policy machinery.[45] This shift away from women's policy was also not readdressed by Labor governments.

The lack of female representation in STEM and the repercussions it has for Australia has been well established by advisory and advocacy groups. A 1995 discussion paper by WISET, demonstrates that the federal Labor government under Paul Keating was aware of the social and cultural challenges girls and women faced when they decided to pursue Science, Engineering and Technology (SET) (excluding mathematics). The group advocated for "the need to adopt a holistic approach to the various clusters of issues associated with girls' and women's participation in SET."[46] This idea arose out the realisation that past governmental policies that sought to increase women's involvement in STEM were linear or un-dimensional. WISET hoped to shift neoliberal attitudes towards women's policy by addressing the fact that women in STEM working environments were particularly vulnerable to barriers including flexible working arrangements and childcare. Some of the recommendations suggested by the 1995

[44] Rimmer and Sawer, "Neoliberalism", 744.
[45] Rimmer and Sawer, "Neoliberalism", 746.
[46] Women in Science, Engineering and Technology Advisory Group, Office of the Chief Scientist – Department of Prime Minister and Cabinet, *Women in Science, Engineering and Technology*, (Canberra, May 1995), 5.

WISET group included maintaining employment statistics on women in SET. Recommendation 2a and 2b suggested for the need of dedicated funding. Notably, this recommendation was directed at higher education institutions rather, than at government agencies. A further recommendation involved the Affirmative Action Agency creating a selection criterion for government contracts. This recommendation would mean that government tenders would privilege companies with good gender equality outcomes which would provide an economic incentive for companies to adopt gender equality measures that in turn, would potentially increase the representation of women in STEM roles. Recommendation 13a and 13b both advocated for the need of a Women in Science, Engineering and Technology Unit (WISETU). The WISETU would initiate, develop and monitor policies for women in SET with the collaboration of government agencies, professional associations, and employer and union groups. The WISETU would also hold public awareness campaigns and be responsible for providing funding.[47]The WISET recommendations mark a significant difference with current measures undertaken by the WGEA which will be explored further below in this chapter.

However, the socially conservative Australian government under John Howard chose not to pursue the recommendations despite the fact that they may have potentially helped to not only monitor women's progress in SET, but also ensured, that the government-based group WISETU would oversee women's participation in SET. In 1997, then-senator Stott Despoja asked about the actions taken following the report. Liberal member and former senator, Warwick Parer maintained that the paper's recommendations were more relevant to the previous government. Instead, the Liberal government's approach would be to "create a broad, positive environment in which all Australians have the maximum

[47] Women in Science, Engineering and Technology Advisory Group, *Women in Science, Engineering and Technology*, 5, 7-10, 16.

opportunity to achieve their potential."[48] The government would increase female participation in SET through initiatives such as merit-based scholarships, flexible working arrangements and the introduction of part-time traineeships. However, the scope or impact of these initiatives is questionable.

Within a broader context, the Howard government began to suggest that women were liberal individuals with freedom of choice. The emphasis on individual 'choice' meant that the government could ignore or rather, not recognise that women had the potential to be affected by cultural and societal influences, practices and norms. It also meant that women were not recognised as a disadvantaged group that required exclusive policies and initiatives targeted at them. Female activists and Non-Governmental Organisations (NGOs) were deemed as special interest groups. Agencies such as the Australian Bureau of Statistics Women's Statistics Unit were abolished. This impacted the amount of information available on women in STEM fields. It may have also resulted in lesser policies and programs for women in STEM given that the government would not have been able to ascertain whether there was a lack of engagement. Howard's government also publicly limited the amount of information available on women. Documents such as the Women's Budget Statement were reduced in size and politicians such as Judi Moylan were prevented from providing a gender analysis of the government's tax package. The Women's Bureau in the Department of Employment, Education and Training was also abolished. This meant that the government was less likely to actively promote the need for female participation in STEM workplaces. This was compounded by a lack of statistical information. Policymakers with a lack of statistical data were unlikely to

[48] "Questions On Notice – Women in Science, Engineering and Technology (Question No. 447)", Parliament of Australia, March 24, 1997, https://parlinfo.aph.gov.au/parlInfo/search/display/display.w3p;query=Id%3A%22chamber%2Fhansards%2F1997-03-24%2F0273%22.

identify whether there were barriers and challenges for working women in STEM. This may have attributed to some women leaving their STEM professions out of the realisation that the federal government would not intervene. As Johnson remarks, the Howard government began to treat individuals as "de-gendered."[49] Issues relating to childcare and caretaking were instead reframed and constructed as problems that arose out of family or parental choices. This approach had the potential to significantly deter women from pursing STEM education and careers.

Correspondingly, Sawer suggests that the government was successful in shifting to neoliberal principles and subsequently, became less interventionist with regards to women-centric policies due to a number of factors. Firstly, the women's movement during the 1990s had become a less effective force in propelling government gender policies. This could be attributed to the fact that feminists were perceived as "being out-of-touch elitists who ignored the preferences of the majority of women."[50] Sawer cites that this negative annotation started when the press began to engage with anti-feminist columnists and popularised their views in the 1970s. By the 1990s, individuals and groups who promoted gender equality initiatives were associated as class elitists. Feminists were perceived to be "seeking to do better out of the state than they could out of marriage or the market."[51] Subsequently, this discursive framing of feminist groups may have attributed to lower community and public outrage when women's policy agencies were dismantled. It should be acknowledged that the Labor party was also influenced by neoliberal ideology and as such subsequent federal Labor governments did not

[49] Johnson, "Governing Change", 77, 79-80.
[50] Marian Sawer, "Australia: The Fall of the Femocrat", in *Changing State Feminism*, ed. Joyce Outshoorn and Johanna Kantola (London: Palgrave Macmillan UK, 2007), 23, https://doi.org/10.1057/9780230591424_2.
[51] Sawer, "Australia: The Fall of the Femocrat", 24.

sufficiently restore women's agencies.[52] Within this context, it can be argued the Howard government pushed forward the neoliberal belief that that the state is primarily not responsible for individual progress. This neoliberal idea was also shared by the Labor party. Thus, in line with neoliberal ideology, the government under both Labor and Liberal parties have often neglected the issues which significantly affected women in STEM and framed its position as one that believes in implementing policies that are universally accessible to all Australians.

Despite this, the Rudd (2007-2010, 2013) and Gillard (2010-2013) Labor governments did commit more to the idea of gender equality and implemented policies and programs that while not exclusive to women in STEM, did have the potential to benefit them. In the lead up to the 2007 election, Former-Prime Minister Kevin Rudd acknowledged that there was a gendered pay gap that saw women at the time earn $87.40 per week less than their male counterpart.[53] He announced that his government would be a fairer one. Subsequently, the Fair Work Act 2009 attempted to address the issue of gendered pay gaps by "ensuring equal remuneration for men and women workers for work of equal or comparable value."[54] While the Act has limitations as explored by Adriana Orifici and Dominque Allen, it has the potential to provide working women, including those in STEM with some legal means to dispute gendered pay discrimination.[55] The Rudd government also implemented the Paid Parental Leave scheme.[56] The still active scheme

[52] Sawer, "Australia: The Fall of the Femocrat, 23, 40.
[53] "Forward with Fairness: Labor's Plan for Fairer and More Productive Australian Workplaces", Parliament of Australia, April 2007, https://parlinfo.aph.gov.au/parlInfo/search/display/display.w3p;query=Id:%22library/partypol/WTWM6%22.
[54] "Fair Work Act 2009", Australian Government, accessed February 24, 2021, http://www.legislation.gov.au/Details/C2017C00323.
[55] Adriana Orifici and Dominque Allen, "Expecting More: Rethinking the Rights and Protections Available to Pregnant Workers under the Fair Work Act 2009 (Cth)", *Federal Law Review* 50, no. 4 (2022): 504-526, https://journals.sagepub.com/doi/epdf/10.1177/0067205X221126556.
[56] "Speech: Series Women's Business Conference 2009 (Hon Julia Gillard MP)", Trove, November 9, 2009,

enables parents to claim up to 18 weeks payment following the birth or adoption of a child.[57] This has the potential for women, including those employed in STEM industries to mitigate the economic risks involved with taking a break from their employment following childbirth. As the Rudd government explained, the scheme would possibly encourage more women to stay in their jobs which would boost national workforce participation.[58] A further measure that was introduced during the Rudd government was the right to request flexible working arrangements. Under this provision, employees could request a change in their working arrangements in order to accommodate the needs of a child.[59] This provision may have appealed to many women, including those in STEM who may have rationalised that a career in STEM would interfere with their caretaking responsibilities.

The Rudd government's efforts to improve the rates of girls and women in STEM education and occupations was somewhat limited, however. While the then- Minister for Education and Minister for Employment and Workplace Relations, Julia Gillard did raise awareness on the underrepresentation of women in science, engineering and technology, there were few programs or policies aiming to address this specifically.[60] For instance, analysis reveals that the 2008-09 Women's Budget Statement does list measures that have the potential to aid girls and women in STEM.[61] Yet, it does not make any mention about the low participation rates of girls and women in STEM courses and occupations.

---

https://webarchive.nla.gov.au/awa/20100628092709/http://pandora.nla.gov.au/pan/80087/20100628-1337/www.deewr.gov.au/Ministers/Gillard/Media/Speeches/Pages/Article_091109_181844.html.

[57] "Parental Leave Pay", Services Australia, accessed February 24, 2021, https://www.servicesaustralia.gov.au/individuals/services/centrelink/parental-leave-pay.

[58] "Rudd Government to Introduce Paid Parental Leave", Ministers' Media Centre, May 10, 2009, https://ministers.dese.gov.au/gillard/rudd-government-introduce-paid-parental-leave.

[59] Marian Baird and Sue Williamson, 'Women, Work and Industrial Relations in 2008', *Journal of Industrial Relations* 51, no. 3 (1 June 2009): 338, https://doi.org/10.1177/0022185609104301.

[60] Trove, "Speech: Series Women's Business Conference 2009".

[61] "Women's Budget Statement 2008-09", Department of Social Services, May 1, 2008, https://www.dss.gov.au/our-responsibilities/women/publications-articles/government-international/budget-publications/womens-budget-statement-2008-09.

Similarly, the 2009-10 Women's Budget Statement does not mention policies or programs that benefit girls and women in STEM exclusively. Instead, much emphasis is on providing women with paid parental leave, childcare schemes, as well as extending flexibility so that women on support payments can access education and training.[62] Consequently, it can be argued that the Rudd government did implement a range of measures that had the potential to benefit girls and women in STEM. However, the gendered discursive framing analysis of policy documents reveals that it did not perceive the underrepresentation of girls and women in STEM to be a key issue and as such, did not develop many programs and initiatives exclusively for them.

Contrastingly, the Gillard government did attempt to make some minor commitments to tackling the underrepresentation of girls and women in STEM. This may have arisen out the government's acknowledgement that women were overrepresented in areas of study that resulted in lower paying jobs while men were overrepresented in areas of study that led to higher paying jobs.[63] The government was motivated by the belief that encouraging more women to undertake traditionally male dominated occupations such as those within the field of STEM would reduce the gender pay gap and improve women's economic outcomes.[64] Notably, the Gillard government discursively framed this position as one that ultimately would benefit businesses and subsequently the economy the most. As the then-Minister for the Status of Women, Kate Ellis posited, improving women's workplace participation was a priority for the Gillard government "not because it's the right thing to

[62] "2009 Women's Budget Statement", Department of Social Services, May 1, 2009, https://www.dss.gov.au/our-responsibilities/women/publications-articles/government-international/budget-publications/2009-womens-budget-statement. PDF available on webpage, 8.
[63] Carol Johnson, *Social Democracy and the Crisis of Equality: Australian Social Democracy in a Changing World* (Singapore: Springer Singapore 2019), 65, https://doi.org/10.1007/978-981-13-6299-6_3.
[64] "Speech, Launch of the Women in Male-Dominated Industries Toolkit" (Hon Julie Collins MP), Trove, May 21, 2013, https://webarchive.nla.gov.au/awa/20130630235913/http://pandora.nla.gov.au/pan/131352/20130701-0936/juliecollins.fahcsia.gov.au/node/362.html.

do. Not because (we're) in the grip of a feminist frenzy, but because it makes good economic sense. Gender equity is a smart business decision."[65] As such, it is clear that the Gillard government was pursuing other economic agendas. This meant that there were fewer initiatives and programs developed to tackle the lowering participation rates of girls and women in STEM. Despite this, one of the initial measures undertaken by the Gillard government and subsequently, the Australian Research Council was to develop the Georgina Sweet Australian Laureate Fellowship in 2010. The fellowship aimed at female Australian laureate fellows from science and technology fields provides $20,000 per year to support and promote women in research. The fellowship continues to benefit one woman STEM researcher per year.[66] The then-Prime Minister Julia Gillard noted that the fellowship would attract a larger number of applications from female researchers.[67]

A speech from the 2011 International Conference for Women Engineers and Scientists makes it clear that the Gillard government was becoming aware of some of the issues that faced girls and women wishing to pursue STEM education and occupations. The then-Minister for the Status of Women, Kate Ellis revealed that Australian women in science and engineering faced issues such as pay inequities, sexual harassment and gendered discrimination. This had contributed to a growing number of women choosing to leave their occupation within five years. Ellis remarked that "there were not a lot of easy answers for improving gender equality" in STEM fields.[68] She proposed that better data

[65] "Women and Leadership Australia's National 2011 Adelaide Symposium" (Hon Kate Ellis MP), Australian Government – Former Ministers, July 15, 2011, https://formerministers.dss.gov.au/583/women-and-leadership-australias-national-2011-adelaide-symposium/.
[66] "Kathleen Fitzpatrick and Georgina Sweet Australian Laureate Fellows", Australian Research Council, last modified August 24, 2021, https://www.arc.gov.au/policies-strategies/strategy/gender-equality-research/kathleen-fitzpatrick-and-georgina-sweet-australian-laureate-fellows.
[67] "2010 Prime Minister's Prizes for Science", Transcript ID: 17502, Department of Prime Minister and Cabinet – PM Transcripts, accessed March 1, 2021, https://pmtranscripts.pmc.gov.au/release/transcript-17502.
[68] "The International Conference for Women Engineers and Scientists" (Hon Kate Ellis MP), Australian Government – Former Ministers, July 20, 2011, https://formerministers.dss.gov.au/582/the-international-conference-for-women-engineers-and-scientists/.

was needed in order to assess the needs of women in STEM and cited the creation of the Equal Opportunity for Women in the Workplace Agency as a way in which the government would be able to measure gender equality. However, as subsequent sections of this chapter will illustrate, the Equal Opportunity for Women in the Workplace Agency which, was later renamed the WGEA following changes to legislation, has a number of policy flaws.

Throughout 2012, the Gillard Labor government undertook further initiatives which attempted to encourage women to undertake occupations in traditionally male-dominated sectors. While potentially beneficial, it is unclear how much women benefited from the established funding allocations and initiatives. For instance, the Gillard government became a member of the Equal Futures Partnership with the United States in 2012 and pledged that it would seek to improve upon women's representation and leadership in male-dominated industries.[69] These industries included mining, utilities and construction. It is not certain as to whether the Gillard government included STEM industries as an area of key concern and this may have had implications for how funding was allocated for programs relating to women in STEM. This was in contrast to the Obama administration.[70] Conversely in 2013, the Gillard government announced that it would provide $50,000 towards a toolkit that would assist employers with attracting and retaining women into industries traditionally dominated by men.[71] However, the then-Minister for the Status of Women, Julie Collins did not elaborate on whether STEM

[69] Trove, "Speech, Launch of the Women in Male-Dominated Industries".
[70] "Fact Sheet: The Equal Futures Partnership to Expand Women's Political and Economic Participation", The White House – Office of the Press Secretary, September 24, 2012, https://obamawhitehouse.archives.gov/the-press-office/2012/09/24/fact-sheet-equal-futures-partnership-expand-women-s-political-and-econom.
[71] "More Support for Women in Male Dominated Industries" (Julie Collins MP), Parliament of Australia, May 21, 2013, https://parlinfo.aph.gov.au/parlInfo/search/display/display.w3p;query=Id%3A%22media%2Fpressrel%2F2478071%22.

industries were able to access the funding. During a Women's Budget Statement Breakfast in 2012, Julie Collins announced that the Gillard government had allocated $54 million over four years to encourage more young women to study mathematics and science at school and university.[72] This was again highlighted in the 2012 Women's Statement report.[73] However, this funding was not exclusively aimed at women students. The 2012-2013 budget states that the $54 million would be used to encourage greater participation in maths and science, improve the quality and supply of mathematics and science teachers as well as reward high achieving students.[74] Using a gendered discursive policy framing analysis approach reveals that the Gillard government did frame measures in a way that made it seem that policies and programs were available exclusively to women despite this not being the case. In light of the above, it can be argued that the Gillard government was committed to increasing the participation rates of women in male-dominated industries such as STEM, however, it was not entirely successful in providing suitable policies and programs solely for women in STEM. The Gillard government tended to frame certain measures as female-centric when in fact they were aimed at all individuals regardless of gender reflecting neoliberal ideals.

Correspondingly, both Coalition and Labor governments have tended to develop and promote gender-neutral schemes rather than specific policies for women in STEM. In 2017, under a Coalition government, Liberal Member of Parliament (MP) Ann Sudmalis

[72] "Women's Budget Statement Breakfast, Parliament House, Canberra" (Hon Julie Collins MP), Trove, June 21, 2012, https://webarchive.nla.gov.au/awa/20130630235912/http://pandora.nla.gov.au/pan/131352/20130701-0936/juliecollins.fahcsia.gov.au/node/196.html.

[73] "Women's Statement 2012 – Achievements and Budget Measures", Department of Social Services, May 1, 2012, https://www.dss.gov.au/our-responsibilities/women/publications-articles/government-international/budget-publications/womens-statement-2012-achievements-and-budget-measures. PDF available on webpage, 13.

[74] Department of the Treasury, *Budget – Budget Strategy and Outlook: Budget Paper NO.1 2012-13,* (Canberra, May 2012), 1-33, https://archive.budget.gov.au/2012-13/bp1/bp1.pdf.

promoted the initiative, digIT as particularly beneficial for girls in STEM. A closer examination reveals that digIT targets all school students irrespective of gender. Moreover, digIT has not implemented additional measures to support girls from disadvantaged backgrounds. As a result, girls from wealthier backgrounds may find it easier to benefit from the program over those from low income households. This raises concerns over how inequitable programs are as well as how they may unintentionally widen existing socio-economic inequalities.[75] Much like the criticism of the past, the policy framing of the initiative is limited because it neglects barriers including costs associated with the program, flights and travel. It also omits the fact that Australian girls are less likely to compete for the program because of lower self-efficacy.[76] Coalition government policies and initiatives for women in STEM have also been tied to increasing the public visibility of women in STEM and encouraging STEM workplaces to implement gender equality policies. For example, initiatives such as the 2014 Women in Astronomy Workshop and Superstars of STEM program were both supported by Michaelia Cash. However, the 2014 Women in Astronomy workshop performed a mostly advisory function to workplaces. Correspondingly, the Superstars of STEM program is limited in its scope and has not been entirely effective in raising the profile of women in STEM particularly, domestically.[77] It can be argued that these initiatives were influenced by the Coalition government's neoliberalist ideals because they do not impact the market nor do they impose regulations on businesses. As Johnson notes, the Liberal government frames its equality policies as pro-individual achievement and involved with changing

[75] "DigIT FAQs", Australian Maths Trust, accessed April 4, 2019, https://www.amt.edu.au/digit-faqs.
[76] Lisa Harvey-Smith, "Women in STEM Need Your Support – and Australia Needs Women in STEM", *UNSW Newsroom*, March 9, 2019, https://newsroom.unsw.edu.au/news/science-tech/women-stem-need-your-support-%E2%80%93-and-australia-needs-women-stem.
[77] "Questions Without Notice - Women in Science", Parliament of Australia, February 14, 2018, https://www.aph.gov.au/Parliamentary_Business/Hansard/Hansard_Display?bid=chamber/hansards/5bb8ba07-678d-41a7-a360-7109e871eeed/&sid=0139.

cultural attitudes.[78] Other government initiatives that seek to increase the representation of women in STEM can also be deemed as inadequate as is the case for major awards that are considered gender-neutral. The 2018 Prime Minister's Prizes for Science gave only one woman, Dr Lee Berger, an award. Out of 128 nominations, less than 27% were women. During a parliamentary debate in 2018, Senator O'Neill observed that moves to acknowledge the contributions of female scientists has been challenging.[79] As such, most federal government's policies, initiatives and programs are limited in functionality given that many of them are focused on increasing public visibility on the issue. While this is advantageous in encouraging public discourse on the subject, these initiatives and particularly, the way they are framed do not change or enforce legislation designed to aid women in STEM. By using a gendered discursive policy framing analysis, it is clear that government initiatives reflect neoliberal ideas, that is, that governments do not heavily intervene in the market, and that women are largely responsible for their own economic and social standing. Moreover, occurrences such as the 2018 Prime Minister's Prizes for Science highlight that issues such as competition criteria and practices are susceptible to unconscious bias, gendered norms as well as social and cultural influences in the workforce. These influences maintain the idea that STEM is not an appropriate area of study or employment for women. It also enforces the pervasive belief that women are not biologically equipped to study or work in STEM. Thus, gendered discursive policy analysis has revealed that the described government policies and programs from both political persuasions do not reject these predisposed beliefs, nor do they adequately or

[78] Johnson, "Gender Research and Discursive Policy Framing", 204.
[79] "Adjournment – Women in Science, Technology, Engineering and Mathematics, Eating Disorders", Parliament of Australia, November 13, 2018, https://www.aph.gov.au/Parliamentary_Business/Hansard/Hansard_Display?bid=chamber/hansards/8a611160-5451-4f48-bcda-57b8b94c6bee/&sid=0234.

meaningfully address the more pragmatic and significant barriers that affect women in STEM, such as unfair recruitment practices and the lack of viable childcare crèches.

Advocacy groups such as the National Foundation for Australian Women (NFAW) have found that funding for policies and initiatives designed to increase the participation rates of girls and women in STEM has been inadequate. One of the reasons why funding has been deemed poor is because federal budget papers from the following periods; 2013-2014, 2014-2015, 2015-2016, 2016-2017 and 2017-2018 do not make any mention of funding policies and initiatives for women in STEM.[80] One of the few initiatives identified includes the Prime Minister's Queen Elizabeth II Diamond Jubilee Scholarship. Announced in Labor's 2012-2013 federal budget measure paper, the scholarship was intended for a female recipient undertaking postgraduate study.[81] It may have been the intention to aid women in STEM given that the Department of Industry, Innovation, Science, Research and Tertiary Education was also responsible for its operation. Yet, it was not strongly identified as an initiative for women in STEM. There were policies and initiatives developed for women in STEM, particularly in 2016, by which time Australia had a Liberal Coalition government. However, as noted by the NFAW, the federal government does not specifically or clearly identify policies and programs for women in STEM in policy documents such as the budget.[82] Instead, the

[80] Department of the Treasury, *Budget 2013-14 – Budget Measures - Budget Paper No. 2*, (Canberra, May 2013), 1-321, https://archive.budget.gov.au/2013-14/bp2/BP2_consolidated.pdf.
Department of the Treasury, *Budget 2014-15: Budget Measures - Budget Paper No.2*, (Canberra, May 2014), 1-256, https://archive.budget.gov.au/2014-15/bp2/BP2_consolidated.pdf.
Department of the Treasury, *Budget 2015-16: Budget Measures - Budget Paper No.2*, (Canberra, May 2015), 1-216, https://archive.budget.gov.au/2015-16/bp2/BP2_consolidated.pdf.
Department of the Treasury, *Budget 2016-17: Budget Measures – Budget Paper No.2,* (Canberra, May 2016), 1-188, https://archive.budget.gov.au/2016-17/bp2/BP2_consolidated.pdf.
Department of the Treasury, *Budget 2017-18: Budget Measures – Budget Paper No.2* (Canberra, May 2017), 1-206, https://archive.budget.gov.au/2017-18/bp2/bp2.pdf.
[81] Department of the Treasury, *Budget 2012-13*, 235.
[82] "Gender Lens on the Budget 2016-17", National Foundation for Australian Women, May 15, 2016, https://nfaw.org/policy-papers/gender-lens-on-the-budget/a-gender-lens-budget-2016-17/. PDF available on webpage, 100.

government's approach has been to accentuate policies and initiatives through Ministerial Media releases. For instance, the 2016 media release by Michaelia Cash revealed that the Turnbull government had provided two fellowships for women in STEM. Furthermore, Cash declared that "the Coalition is making a targeted investment of $13 million to encourage women to choose and stay in STEM fields, start-ups and entrepreneurial businesses." [83] This statement relates directly to the Women in STEM and Entrepreneurship initiative which will be explored in Chapter Six. Yet, as previously mentioned, these initiatives were not listed on the federal budget or in key policy documents. This policy framing suggests that the government did not consider women's underrepresentation in STEM to be a key priority.

The Coalition government's attempts to improve women's participation in STEM have also been limited because they have not adequately provided funding for gender-specific programs. For example, the 2018 budget document did report that funding had been allocated to VET programs including those STEM based. The NFAW note that this funding did not include programs specifically targeted at women interested in pursuing STEM.[84] All of these instances highlight the fact that the federal government's approach to aiding women in STEM has been limited because of neoliberal ideology that continues to instil the idea that the individual is primarily responsible for their own economic wellbeing. This belief has influenced policy framing and as a result, has meant that programs are directed at all Australians regardless of gender. In addition, the above examples also demonstrate that the Liberal government did not enforce stronger policies and programs for women in STEM because it believed that businesses would see the

[83] "Turnbull Government Supporting Women to Succeed in STEM" (Hon Michaelia Cash), Trove, August 19, 2016, http://pandora.nla.gov.au/pan/156011/20171219-1417/ministers.pmc.gov.au/cash/2016/turnbull-government-supporting-women-succeed-stem.html.
[84] National Foundation for Australian Women, "Gender Lens on the Budget 2016-17", 100.

significant economic advantages of increasing the amount of women in the workplace. As such, businesses would be the key drivers of change. The Liberal government and policymakers would instead task themselves with, providing "assistance and information, not over-regulation."[85] As Johnson accentuates, gender equality was and arguably, continues to be, 'bent' to fit into another agenda, which is a neoliberal market-based policy.[86] This has implications for women. It indicates that issues that directly affect women in STEM may not have been adequately addressed by the implemented government initiatives. The same barriers that affect women from pursuing or excelling in STEM may have also impacted their ability to pursue the initiatives.

Subsequent sections of this chapter will illustrate that policies, initiatives and programs designed to increase the participation rate of girls and women in STEM, have been challenging due to the prescribed flaws mentioned above. However, it will also be found that the lack of a unified portal for women in STEM has made it challenging to identify initiatives. Moreover, many government programs do not have an evaluating framework that identifies whether programs for women in STEM are effective. It can be demonstrated that all of these factors have had the potential to dissuade girls and women from pursuing STEM.

3.5 Australian Federal Policies, Initiatives and Programs for Women in STEM

Drawing from a broad range of government materials and using a gendered discursive policy framing approach, this thesis will now examine key federal policies and initiatives that aim to increase the participation rates of Australian girls and women in STEM. The

[85] Johnson, "Gender Research and Discursive Policy Framing", 205.
[86] Johnson, "Gender Research and Discursive Policy Framing", 206.

thesis has examined policies and programs that were active as of February 2022 with many running during the Coalition's time in power. In April of 2019, the federal government under Scott Morrison produced a significant document that detailed initiatives for girls and women in STEM. Some of the identified programs are developed and initiated by Australian services such as the Australian Federal Police, Geoscience Australia, Department of Defence and Geoscience Australia. However, some of the listed initiatives are no longer in progress while others such as the digIT and Digital Technologies in Focus programs are marketed as for girls and women in STEM, despite the fact that this is not the case. Analysis into these programs reveals that all individuals regardless of gender are able to access them and the programs do little to address issues specific to girls and women in STEM. There are also programs for working women including the Women in IT Executive Mentoring EL1 & EL2 Coaching Program and the Elizabeth Blackburn Fellowship which are directed at women who are already members of the public service or are highly established female researchers. [87] Documentation suggests that these initiatives are highly competitive and are only available to a select group of women in STEM, rather than those at an early stage of their career. Other schemes such as Department of Defence's scholarships for women studying STEM are awarded to a few select individuals.[88] This means that it is unlikely to significantly increase the participation rates of Australian women in STEM occupations. Notably, this section will not be providing a detailed study of Australian secondary school education policies, however, Brigid Freeman's chapter provides insight into STEM policies and

[87] "Australian Government Science, Technology, Engineering and Mathematics (STEM) Initiatives for Girls and Women", Department of Industry, Science, Energy and Resources, April 2019, 1-4, https://www.industry.gov.au/sites/default/files/2019-04/australian-government-stem-initiatives-for-women-and-girls.pdf

[88] "Women in STEM Support Hits Record High", Department of Defence, August 18, 2021, https://www.minister.defence.gov.au/minister/melissa-price/media-releases/women-stem-support-hits-record-high.

programs within the Australian education system.[89] Moreover, the thesis will not evaluate TAFE [Technical and Further Education], however, it should be noted that Australian federal and state governments have invested heavily in Skills Agreements which support the delivery of fee-free TAFE and vocational educational places. In 2023, Australian governments identified women undertaking study in non-traditional fields, unpaid carers and women facing economic insecurity as priority groups.[90] Subsequent sections of this chapter will now further examine these policy flaws while assessing the main policies and initiatives that aim to increase the participation rates of girls and women in STEM.

3.5.1 Workplace Gender Equality Act and Workplace Gender Equality Agency

One of the key pieces of legislation established by the Australian Labor federal government under Gillard includes the Workplace Gender Equality Act (2012). While this legislation does not refer to women in STEM workplaces specifically, the act does provide women in STEM with some legal means of countering workplace discrimination as well as ensuring that employers regardless of industry incorporate measures that provide equal remuneration between men and women.[91] One of the reasons why this thesis is exploring the Workplace Gender Equality policy is because there is a lack of legislation directed at women in STEM workplaces. However, the WGEA can be utilised by women in STEM. The act requires non-public sector employers to annually report on

[89]Freeman, "Federal and State STEM Policies and Programs", 178-200.
For research on Australian undergraduate engineering education see Andrea M Goncher and Shara Cameron, "Approaches for Attracting, Retaining, and Progressing Women in Australian Undergraduate Engineering: Curricular Innovation Focused on Humanitarian and Human-Centered Design Concepts", in *Gender Equity in STEM in Higher Education: International Perspective on Policy, Institutional Culture, and Individual Choice*, ed. Hyun Kyoung Ro, Frank Fernandez and Elizabeth Ramon (London: Routledge, 2022), 174-186.

[90] "Fee-Free TAFE", Department of Employment and Workplace Relations – Australian Government, accessed 31 August 2023, https://www.dewr.gov.au/skills-reform/fee-free-tafe.
See also "TAFE Technology Fund", Department of Employment and Workplace Relations – Australian Government, accessed 31 August 2023, https://www.dewr.gov.au/skills-reform/tafe-technology-fund.

[91] "Workplace Gender Equality Act 2012", The Office of the Parliamentary Council, accessed May 25, 2018, http://www.legislation.gov.au/Details/C2016C00895.

information that pertains to gender equality indicators.[92] These indicators can include the amount paid to employees as well as the hours worked. The act also makes reports publicly available with the exception of personal information which may include remuneration. The Workplace Gender Equality Act (2012) also established the WGEA. The agency aims to protect all women in the workplace and ensure that all registered Australian businesses and corporations adhere to measures that aim to eliminate discrimination and prevent pay inequality. These issues which have been explored above, significantly affect women in STEM education pathways and careers. In 2016-2017, approximately 33% of reporting businesses were from the STEM sector.[93]

Despite its aims, the Gender Equality Agency does have fundamental issues with regards to the way that it attempts to implement procedure and penalise companies who do not adhere to the set standards. Notably, the Abbott government considerably reduced the reporting requirements initially proposed by the Labor Gillard and Rudd governments. The subsequent Abbott Coalition government cited that the reporting process was complex and time consuming. It was also concerned that such measures would not improve gender equality within businesses.[94] These reasons may have contributed to the fact that only businesses with more than 100 employees are required to submit to a report.[95] A non-compliant business or corporation is penalised through the development of a Portable Document Format (PDF) document that lists the legal and trading name of the company and the parent company it may be affiliated with.[96] No other relevant

[92] The Office of the Parliamentary Council, "Workplace Gender Equality Act 2012", see part one, under section 2b.
[93] Australian Academy of Science, *Women in STEM Decadal Plan,* 17.
[94] Johnson, "Gender Research and Discursive Policy Framing", 204.
[95] "Reporting", Workplace Gender Equality Agency, accessed November 24, 2021, https://www.wgea.gov.au/what-we-do/reporting.
[96] "Non-Compliant Organisations List", Workplace Gender Equality Agency, accessed February 15, 2019, https://www.wgea.gov.au/non-compliant-list.

information is included. This is somewhat problematic because companies may choose to change the legal or trading name of a business in order to escape public scrutiny. Further research into the measure revealed that the PDF document with the names of uncompliant organisations does not attract much media attention with few news outlets publishing or sharing it. This thesis suggests that 'naming' uncompliant businesses is not an effective form of penalty because it is also dependent on whether the business is a publicly recognised brand. If it is so, then it is more likely to attract media and public scrutiny.[97] As such, it is clear that the measure does not sufficiently deter STEM companies from failing to implement or enforce gender equality policies and practices.

A further issue with the Workplace Gender Equality Act and Agency is that all workplaces are measured under the same requirements despite the fact that STEM industries can be more hostile to women employees. Currently, there are four broad indicators that determine whether an employer has fulfilled their gender equality obligations. These indicators include workplace overview, action on gender equality, employee work/life balance and employee support.[98] While these indicators are beneficial in determining whether a business is compliant, the act and agency fail to account for institutional barriers that may silence women employees in STEM. As explored in Chapter Two, women in STEM industries are often unable to discuss pay disparities due to strict confidentiality clauses. Women in STEM are also more likely to experience gendered behaviour, practices and norms than in contrast to women from many non-STEM workplaces. Some STEM work cultures also deter women from speaking out

[97] "Review of the Equal Opportunity for Women in the Workplace Act and Agency", Department of Social Services, accessed March 5, 2019, https://www.dss.gov.au/our-responsibilities/women/programs-services/economic-security/review-of-the-equal-opportunity-for-women-in-the-workplace-act-and-agency. PDF available on webpage, 53.

[98] "Explore the New, Self-Service WGEA Portal", Workplace Gender Equality Agency, accessed November 24, 2021, https://www.wgea.gov.au/what-we-do/compliance-reporting/new-wgea-portal/exploring-the-self-service-WGEA-Portal.

about hostile working environments and as such, experiences may not be formally reported. These factors have the potential to limit information that is conveyed to the WGEA. Additionally, the WGEA only requires a company to have a formal policy or strategy in one indicator area to be considered as compliant. Moreover, WGEA reports do not require businesses to describe their policies or provide information on their quality, implementation, uptake and effectiveness.[99] Research reveals that many gender equality policies from Australian businesses are ineffective.[100] Yet, Leah Ruppanner and Sophie Squires contend that companies with more generous policies have lower cessation rates amongst women employees.[101] The WGEA's low requirements mean that it is less likely STEM workplaces may proactively implement more policies that lead to reduced cessation rates. Recent WGEA data seems to validate this.[102] Thus, discursive policy framing analysis has found that the limited measures of the WGEA may have contributed to inadequate gender equality policies that are not heavily scrutinised despite the fact that women in STEM are more likely to be affected by gendered practices and norms than those from non-STEM fields. Analysing discourse, including government materials also suggests that policymakers are influenced by the neoliberal idea that governments should not heavily interfere in private markets. Consequently, this lack of government scrutiny and the fact that WGEA assesses all workplaces on the same gender equality

[99] Miriam Glennie, Anna von Reibnitz, Jananie William, Sally Curtis and Sarbari Bordia, *Gender Pay Gap Reporting in Australia: Time for an Upgrade*, (Global Institute for Women's Leadership, Australian National University and King's College London, October 2021), 24-25 https://giwl.anu.edu.au/research/publications/gender-pay-gap-reporting-australia-time-upgrade.

[100] Glennie, Reibnitz, William, Curtis and Bordia, *Gender Pay Gap Reporting in Australia: Time for an Upgrade*, 24.

See also Natalie Galea et al., "Designing Robust and Revisable Policies for Gender Equality: Lessons from the Australian Construction Industry", *Construction Management and Economics* 33, no. 5–6 (3 June 2015): 375–89, https://doi.org/10.1080/01446193.2015.1042887.

[101] Leah Ruppanner and Sophie Squires, *The Future of Women @ Work*, (The Policy Lab: The University of Melbourne), 7, https://arts.unimelb.edu.au/the-policy-lab/projects/women-at-work/the-future-of-women-@-work.

[102] Workplace Gender Equality Agency, "New WGEA Data Shows Employer Action on Gender Equality Has Stalled".

requirements may have contributed to Australia's declining women's representation rate in STEM.

An exploration of the Workplace Gender Equality Act and agency reflects the finding that it is limited in its ability to support women, including those employed in STEM workplaces. By analysing the discourse, it can also be found that some policymakers may assume that all women regardless of workplace, face a similar level of challenges. Yet, as demonstrated in Chapter Two, women in STEM face a higher number of barriers which are influenced by social, political, economic, national, and cultural conditions that influence the types of work that are appropriate for women. In many cases, it does not comprise of learning or working in STEM workplaces.

3.5.2 Women in STEM Cadetships and Advanced Apprenticeships Program

In the 2020-21 budget, the Australian federal government indicated that women's participation in STEM education and occupations was one of the key drivers to increasing women's economic participation in Australia.[103] During this time, the federal Coalition government pledged $24.8 million to support working women wishing to undertake industry-relevant higher education diplomas, associate degrees or advanced diplomas in STEM fields.[104] The Minister for Education and Youth, Alan Tudge stated that Australia needed more women in STEM and the program would enable women to gain qualifications in critical areas giving them advantages over others with regards to future

[103] "Budget 2020-21 Economic Recovery Plan for Australia: JobMaker – Creating Jobs and Rebuilding Our Economy", Department of the Treasury, accessed March 11, 2021, 40, https://archive.budget.gov.au/2020-21/download/glossy_jobmaker.pdf.
[104] "Women in STEM Cadetships and Advanced Apprenticeships", Department of Education, Skills and Employment, accessed March 8, 2021, https://www.dese.gov.au/women-stem-cadetships-and-advanced-apprenticeships.

jobs.[105] Conversely, the Minister for Industry, Science and Technology Karen Andrews accentuated that the program demonstrated the Australian federal Liberal Coalition government with Prime Minister Scott Morrison is "committ[ed] … to seeing more women take advantage" of opportunities to learn STEM skills.[106] Notably, this discursive policy framing indicates that the government perceived that having more women educated in STEM could be economically and strategically beneficial to the state.

The Women in STEM Cadetships and Advanced Apprenticeships Program offers higher education providers a grant to deliver a four-year STEM program aimed at women.[107] The popularity of the program has meant that the number of places made available to women applicants has increased from 500 to almost 600.[108] In March of 2021, the Department of Education, Skills and Employment announced that the program approved the awarding of grants to support almost 600 women across Australia.[109] 18 higher education providers were approved to deliver 37 courses including an Associate Degree of Engineering, Diploma of Applied Data Science, Advanced Diploma of Cyber Security, Diploma of Science and an Associate Degree in Agribusiness.[110] More than 40 employers chose to participate in the 2021 program and many of the providers were universities and TAFE institutes.[111] There is no detailed information relating to how many spots providers

[105] "Funding to Boost STEM Opportunities For Women", Technology Decisions, accessed March 12, 2021, http://technologydecisions.com.au/content/it-management/news/funding-to-boost-stem-opportunities-for-women-1095983861.
[106] "More STEM Opportunities For Australian Women", Liberal NSW, accessed March 18, 2021. https://nsw.liberal.org.au/Shared-Content/News/2021/More-STEM-opportunities-for-Australian-women.
[107] Department of Education, Skills and Employment, "Women in STEM Cadetships and Advanced Apprenticeships".
[108] Technology Decisions, "Funding to Boost STEM Opportunities For Women".
[109] "The Outcomes of the Women in STEM Cadetships and Advanced Apprenticeships Program 2021 Application Round Have Now Been Announced", Department of Education, Skills and Employment, accessed March 8, 2021, https://www.dese.gov.au/women-stem-cadetships-and-advanced-apprenticeships/announcements/advanced-apprenticeships-program-2021-application-round-announced.
[110] "STEM Study Encouraged as Kerry Chant Wins NSW Woman of the Year", Lab+Life Scientist, accessed March 10, 2021, http://labonline.com.au/content/lab-business/news/stem-study-encouraged-as-kerry-chant-wins-nsw-woman-of-the-year-1021660308.
[111] Department of Education, Skills and Employment, "The Outcomes of the Women in STEM Cadetships".

were able to obtain. However, a Twitter post from Flinders University states that they acquired 120 of the 600 spots made available nationally.[112]

The Women in STEM Cadetships and Advanced Apprenticeships Program enables working women to participate in STEM education whilst maintaining their employment thereby enabling them to earn a salary and gain career experience while also maintaining entitlements such as sick leave and annual leave.[113] The program may also provide more women, including those returning from career breaks with the opportunity to advance higher in their profession or move into STEM based occupations which provide greater remuneration. Moreover, the program is attractive to employers given that they are provided with a chance to upskill their employees and allows them to offset some costs involved with flexible working arrangements. Employers are not required to be in a STEM industry.[114]

A further advantage is that the program requires higher education providers and employers to evaluate the performance of the program and report twice annually to the Department of Education, Skills and Employment. Information on the number of students enrolled, the courses students are enrolled in as well as student attrition, progression and completion is required. Employers must provide information on the number of female

---

Department of Education, Skills and Employment, "Women in STEM Cadetships and Advanced Apprenticeships".

[112] Flinders University, (@Flinders University), "Aus Women will be Encouraged to Study #STEM While They're Working, Through the Fed Gov Expanded $124.8 Mill Women in STEM Cadetships and Advanced Apprenticeships Program", Twitter, March 9, 2021, https://twitter.com/Flinders/status/1369177886289055745.

[113] Pi-Shen Seet and Janice Jones, "Industry Cadetships: A Good but Small Step to Tap the Talents of Women in STEM", *The Conversation,* October 28, 2020, http://theconversation.com/industry-cadetships-a-good-but-small-step-to-tap-the-talents-of-women-in-stem-148170.

"Welcome to the Fair Work Ombudsman Website", Fair Work Ombudsman, accessed March 18, 2021, https://www.fairwork.gov.au/.

[114] "Women in STEM Cadetship and Advanced Apprenticeship Program Frequently Asked Questions", Department of Education, Skills and Employment, accessed March 5, 2021, https://www.dese.gov.au/women-stem-cadetships-and-advanced-apprenticeships/frequently-asked-questions.

employees enrolled and the hours of study and work.[115] Information provided by the reporting means that policymakers will be able to assess the effectiveness of the program and determine whether additional measures are required to aid women applicants as they progress into their studies. Yet, information provided by the Department of Education, Skills and Employment does not make it clear if employers and higher education providers will collect information on the number of women participants who come from disadvantaged communities and backgrounds. As acknowledged by the NFAW's Gender Lens on the Budget 2020-2021, women from diverse backgrounds are likely to face additional barriers to entry, retention and progression with regards to STEM areas that are overrepresented by males.[116]

The Women in STEM Cadetships and Advanced Apprenticeships Program does also have some additional policy flaws as identified by analysing policy documents and government materials. Higher education providers do not need to design and accredit new courses, and the course requirements are broad.[117] Providers can deliver a course of study that only leads to a STEM qualification.[118] Higher education providers are also not required to assess whether current courses encourage or deter women students from participating and are not required to implement measures that can address issues specific to female students.

[115] "Other Grants Guidelines (Education) Amendment (Women in STEM) 2020", Office of the Parliamentary Counsel, accessed March 22, 2021, https://www.legislation.gov.au/Details/F2020L01515/Html/Text.
[116] "Gender Lens on the Budget 2020-2021", National Foundation for Australian Women, October 18, 2020, https://nfaw.org/gender-lens-on-the-budget/gender-lens-on-the-budget-2020-2021/. PDF available on webpage, 7.
[117] Department of Education, Skills and Employment, "Women in STEM Cadetship and Advanced Apprenticeship Program Frequently Asked Questions".
[118] Office of the Parliamentary Counsel, "Other Grants Guidelines".

While the program features an evaluation component, there are opportunities to collect additional data which may further assist policymakers. Government materials do not explicitly reveal whether women participants are provided an opportunity to assess and evaluate the program. This lack of insight may mean that policymakers will not be able to effectively develop meaningful measures to address issues faced by women. It is also unknown as to whether the department will track and monitor the career progression of the women applicants following the completion of their qualifications. This is important because as stated in previous sections, working women in STEM face challenges throughout their career.[119] Data may provide further explanations or assess what particular barriers lead to women leaving STEM workplaces.

An additional disadvantage is that the funding allocated for the program is relatively little thereby limiting its ability to support to more women. This lack of funding may be attributed to neoliberal ideology as well as how governments have discursively framed the issue of women's underrepresentation in STEM. As researchers Pi-Shen Seet and Janice Jones note, the program will not significantly increase the participation rates of women undertaking STEM qualifications and employment.[120] Limited funding also means that it is unlikely that the program will be able to develop additional measures that support women students. According to the Department of Education, Skills and Employment, women applicants must still pay tuition fees and some may also have to pay the costs associated with attending courses. There are no measures that support working women who may encounter financial challenges and notably, women in the program are likely to be earning less because they are working part-time. Women with children may also be impacted given that they may struggle to afford childcare during the

[119] Australian Academy of Science, *Women in STEM Decadal Plan*, 2.
[120] Seet and Jones, "Industry Cadetships: A Good but Small Step".

times that they are required to participate in their courses. Under the program's requirements, there are no specific requirements on how grant funding can be used.[121] As such, employers may choose to use the money to offset the costs of flexible working arrangements rather than provide some funding to their female employees undertaking the program. Gendered discursive policy framing analysis has thus found that this factor has the potential to significantly undermine the efforts to encourage working women, especially those with lower financial means to pursue STEM education.

It can be argued then, that the identified flaws indicate that the government has been influenced by neoliberal ideology which has often neglected to consider the needs of women particularly, with regards to social reproduction. For instance, a gender policy framing analysis approach found that the program neglects to consider the needs of mothers who may struggle to afford childcare whilst managing part-time work and study. A lack of data and funding also means that the program is limited in its ability to encourage greater participation in STEM.

3.5.3 STARportal

Created in 2017, STARportal has been cited as Australia's first centralised national portal for STEM activities and events.[122] The program has been identified as an initiative for girls in STEM by the federal government, however, using a gendered policy framing analysis, the thesis has found that STARportal is targeted at all students, regardless of

[121] Department of Education, Skills and Employment, "Women in STEM Cadetship and Advanced Apprenticeship Program Frequently Asked Questions".
[122] Department of Industry, Science, Energy and Resources, "Australian Government Science, Technology, Engineering and Mathematics (STEM) Initiatives for Girls and Women", 2.
Michael Timms, Katheryn Moyle, Paul R Weldon and Pru Mitchell, "Policy Insights: Challenges in STEM Learning in Australian Schools", issue 7, (Australian Council for Educational Research, May 2018), 7, https://research.acer.edu.au/cgi/viewcontent.cgi?article=1007&context=policyinsights.
Also see "STARportal", Office of the Chief Scientist, accessed March 21, 2019, https://starportal.edu.au.
"STARportal 'About Us'", Office of the Chief Scientist, accessed March 21, 2019, https://starportal.edu.au.

gender.[123] The Department of Education was consulted to ensure its accessibility to all Australian families. At the time of its launch, Senator Sinodinos praised the initiative citing that "the beauty of the STARportal is that it is accessible from anywhere, the service is completely free, and it makes it easier for students to engage in STEM activities."[124] Analysis into the initiative has found that some aspects of Sinodinos' statement are founded. STARportal collates all programs, competitions and workshops relating to STEM allowing students and parents to find events and programs more efficiently. As described on the website, the STARportal enables individuals to search for STEM activities that are geographically close and, in some instances, are free.[125] In addition, unlike other government initiatives, the STARportal can be considered as a long-term program that seeks to inform girls and interested shareholders about the STEM opportunities that are available.

Similarly to the WISE program, the STARportal has not established an evaluation framework. This has meant that girls and women are unable to examine if a program listed on STARportal is effective. Moreover, Michael Timms, Kathryn Moyle, Paul Weldon and Pru Mitchell note that a majority of the offered programs take place outside of school hours. This could conflict with other extracurricular activities that take place outside of school. A further issue is that the group most likely to benefit from STARportal are students who already have an interest in undertaking STEM education and careers. As outlined in this thesis, girls' participation in STEM is low. In addition, the program

[123] Department of Industry, Science, Energy and Resources, "Australian Government Science, Technology, Engineering and Mathematics (STEM) Initiatives for Girls and Women," 2.
[124] "Helping Girls on the Path to High-Tech Jobs" (Hon Karen Andrews), Department of Industry, Science, Energy and Resources, September 26, 2018, https://www.minister.industry.gov.au/ministers/karenandrews/media-releases/helping-girls-path-high-tech-jobs.
[125] Office of the Chief Scientist, "STARportal 'About Us'".

does not entirely fulfil the obligation to provide equitable access to all.[126] This can be demonstrated when evaluating the courses available to girls pursuing STEM. For instance, the Victorian based program, Girls Invent Workshops typically cost $25, however, the ACT based STEM Sells Season 2 Workshop for girls can cost between $101 and $500.[127] This is also the case for a four day NSW STEM Camp for Girls program.[128] While there are scholarships available, it is unknown about how many are on offer and the amount they subsidise. As such, some girls in states such as ACT and NSW may be forced to pay more for programs that aim to increase their interest in STEM. Families from disadvantaged backgrounds may struggle to access these programs due to the expensive program costs and location challenges. Subsequently, this has the potential to deter many families from encouraging their daughters to undertake STEM education. These findings raise questions over the validity of Senator Sinodinos statement given that the program does not guarantee free initiatives to girls and nor does it allow all girls in STEM to access and take part in programs nationwide. This raises issues for girls who live in regional and rural parts of Australia.

The initiative has also received relatively little media attention with many major news outlets not reporting on the launch or progress of the initiative. While the Department of Industry, Innovation and Science has made small attempts to increase the awareness of the portal by using social media platforms such as Twitter, there has been no drastic

[126] Timms, et al., "Policy Insights", 7.
[127] "Girls Invent (STARportal)", Office of the Chief Scientist, accessed March 21, 2019, https://starportal.edu.au/program/girls-invent.
"STEM Sells Season 2 Workshop (STARportal)", Office of the Chief Scientist, accessed March 21, 2019, https://starportal.edu.au.
[128] "STEM Camp for Girls (STARportal)", Office of the Chief Scientist, accessed March 21, 2019, https://starportal.edu.au.

increase in the amount of parents who have shared or linked posts relating to it.[129] Examining the Twitter home page for STARportal reveals that little has been done by government agencies to increase public awareness with few posts and a general lack of online activity.[130] Further analysis into the STARportal indicates that some programs have not been updated by the government and feature outdated information with lapsed dates as seen on the STEM Camp for Girls webpage.[131] These instances may have led to a decline in the number of activities listed on STARportal. In 2017, approximately 330 activities nationwide have been recorded on the website.[132] Yet, as of 2019, this figure stands at 200.[133] As such, it can be demonstrated that the Australian government has not thoroughly considered issues that may affect girls from diverse geographic areas and low socio-economic areas. The current framing of STARportal also reflects that the government does not consider it to be an initiative solely for girls meaning that barriers specific to them are unlikely to be addressed.

3.5.4 Women in STEM Ambassador

In October of 2018, Professor Harvey-Smith was announced as Australia's first Women in STEM Ambassador by the Liberal federal government.[134] The primary aims of the ambassador is to advocate for gender equity in STEM, raise awareness and push for

[129] Sciencegovau (@sciencegov.au), "Stuck for Activities for Kids this Weekend? #STARportal has almost 400 #STEM Events Listed", Twitter, September 14, 2017, https://twitter.com/ScienceGovAu/status/908261585394814976.
[130] Twitter, "#STARportal", accessed March 21, 2019, https://twitter.com/hashtag/starportal?f=tweets&vertical=default&src=hash.
[131] Office of the Chief Scientist, "STEM Camp for Girls (STARportal)".
[132] "Expanding STEM Options for All Australian Students", Get Education, last modified August 16, 2017, http://geteducation.com.au/expanding-stem-options-australian-students/.
[133] "Find an Activity (STARportal), Office of the Chief Scientist, accessed March 21, 2019, https://starportal.edu.au.
[134] Primrose Riordan, "Women to STEM Imbalance in Major Projects", *The Australian*, October 12, 2018, https://www.theaustralian.com.au/national-affairs/women-to-stem-imbalance-in-major-projects/news-story/b90687d07a4b7f3198ceea66ba018223.

change while also promoting women in STEM.[135] Former Prime Minister, Malcolm Turnbull, explained that the role would "build on the momentum created by Australian of the Year Professor Michelle Simmons."[136] One of the agendas promoted by the Women in STEM Ambassador, Professor Lisa Harvey-Smith has been to promote a need for evidence based evaluations on programs designed to aid girls and women in STEM.[137] In 2020, the Office of the Women in STEM Ambassador developed an evaluation guide for organisations wishing to evaluate their STEM engagement programs.[138] The Women in STEM Entrepreneurship (WISE) program will be trialling the framework before it is promoted to Australian organisations and businesses.[139] This promotion of evidence based research into programs is particularly important to increasing the rates of girls and women in STEM. The Australian National University found that only seven of 337 STEM initiatives have publicly available reports, evidence or evaluations of their effectiveness.[140] Best illustrated by Harvey-Smith, the Office of the Women in STEM Ambassador is "creating a place where people can share their evaluations to show what works and what doesn't work transparently, and then we will put money into things that do work."[141] As such, the Women in STEM Ambassador's push for evidence based

[135] Department of the Prime Minister and Cabinet, "Long-Term Action to Support Girls and Women in STEM" (Hon Kelly O'Dwyer), accessed June 19, 2018, https://ministers.pmc.gov.au/odwyer/2018/long-term-action-support-girls-and-women-stem.
[136] *SBS News*, "Women in Science Ambassador Will be Appointed to Inspire Schoolgirls", *SBS News,* March 8, 2018, https://www.sbs.com.au/news/women-in-science-ambassador-will-be-appointed-to-inspire-schoolgirls.
[137] Lisa Harvey-Smith, "Australia Has Hundreds of Programs to Get Women into Science, but Are They Working? Time to Find Out", *The Conversation,* March 9, 2020, http://theconversation.com/australia-has-hundreds-of-programs-to-get-women-into-science-but-are-they-working-time-to-find-out-133061.
[138] "It's Time to Find Out What Works For Women in STEM: A Guide to Evaluating STEM Gender Equity Programs Launched Today", Women in STEM Ambassador, December 8, 2020, https://womeninstem.org.au/latest-news/evaluation-guide-launched-today/.
"National STEM Evaluation Guide", Women in STEM Ambassador, accessed March 22, 2021, https://womeninstem.org.au/national-evaluation-guide/.
[139] Harvey-Smith, "Australia Has Hundreds of Programs".
[140] Women in STEM Ambassador, "It's Time to Find Out What Works".
[141] Jill Rowbotham, "Revamping the Effort to Shift the Dial on Girls and STEM", *The Australian,* March 7, 2021, https://www.theaustralian.com.au/nation/revamping-the-effort-to-shift-the-dial-on-girls-and-stem/news-story/b5cd8dd87ffaf03194dff0906ad3c410.

evaluations can be considered as vital in understanding the ways that policymakers can better develop programs and measures for girls and women in STEM.

While there are advantages, the Women in STEM Ambassador's promotion of evidence-based evaluations raises some concerns. It is not known whether the federal government will make it mandatory for businesses and entities to submit a program evaluation. It is also unclear as to whether organisations will complete the evaluation guide fairly and without biasness given that there are potential economic risks if their STEM initiative is found to be lacking in effectiveness. Moreover, organisations may have differing understandings of what constitutes a successful and efficient policy or initiative. In her research, Merryn McKinnon uncovered that organisations with gender equity programs tend to base the success of a program or initiative on a participant's satisfaction of it. While it is important that girls are having fun undertaking a STEM program, enjoyment of an initiative does not necessarily translate into increased participation in STEM education and occupations. As McKinnon remarks organisations may not base the success of a program on evidence. To gain attention, organisations may choose to create a persuasive narrative, which generates more support from participants. McKinnon also notes that programs targeted at increasing the rates of girls and women in STEM may not be able to demonstrate their impact until years later due to time and cost constraints. As such, while establishing a culture of evidence-based research as well as promoting an evaluation framework is significantly important in assessing the needs of girls and women in STEM, there are some potential challenges as discussed above.[142] Despite this, the Women in STEM Ambassadors work in establishing an evaluation guide and promoting an evidence database on STEM schemes for girls and women is significantly

[142] Merryn McKinnon, '"The Absence of Evidence of the Effectiveness of Australian Gender Equity in STEM Initiatives", Australian *Journal of Social Issues* (October 2020): 9, https://doi.org/10.1002/ajs4.142.

important in assessing whether certain programs and initiatives are effective in increasing participation rates.

The Office of the Women in STEM Ambassador has also been involved in a digital awareness initiative known as Future You that was first announced in March of 2019 by the Australian Federal Liberal Coalition government under Prime Minister Scott Morrison.[143] Aptly summarised by the then-Minister for Industry, Science and Technology, Karen Andrews, Future You is "about increasing girls' participation in STEM subjects and opening their eyes to a career which uses these skills."[144] Notably, this discursive framing suggests a neoliberal influence as well as a government preference for encouraging awareness rather than proactively adopting measures that significantly challenge other barriers, including hostile education and work environments. The Office of the Women in STEM Ambassador also encourages parents, peers and teachers to participate in the program in order to challenge the belief that girls are not naturally good at STEM subjects.[145]

According to the Women in STEM Ambassador Year in Review 2020, the Future You initiative has reached 2.3 million parents, carers and educators.[146] The mini games have been played over 2000 times whilst the microsite has had 142,232 unique page visits.[147]

---

[143]Rebecca Urban, "Budget to Deliver STEM Boost for Women", *The Australian*, March 29, 2019, https://www.theaustralian.com.au/federal-budget/budget-to-deliver-stem-boost-for-women/news-story/8c4f07111c1206e3cfd02f8bfdb0dd32.
See also "Future You – Microsite", Women in STEM Ambassador, accessed March 26, 2021, https://womeninstem.org.au/futureyou/#games.

[144] "Supporting Girls to See a Future in STEM" (Hon Karen Andrews), The Department of Industry, Science, Energy and Resources, October 30, 2020, https://www.minister.industry.gov.au/ministers/karenandrews/media-releases/supporting-girls-see-future-stem.

[145] "Future You FAQs", Women in STEM Ambassador, accessed March 26, 2021, https://womeninstem.org.au/work/future-you/.

[146] Women in STEM Ambassador, "Year in Review 2020", (UNSW Sydney, 2020), 3, https://secureservercdn.net/198.71.233.254/f8f.f75.myftpupload.com/wp-content/uploads/2021/03/Year-in-Review-2020-Women-in-STEM-Ambassador.pdf.

[147] Women in STEM Ambassador "Year in Review 2020", 4.

A large target audience indicates that the platform may be able to counter some of the gendered beliefs that appropriate STEM as a masculine area of study and work. However, it is unknown as to whether Future You will be able to effectively challenge long-held and pervasive societal and cultural influences that deter girls from pursing STEM given that the initiative is limited to its basic advisory functions.

A further flaw with the initiative lies in the fact that there is little information provided to girls and caretakers with regards to how to work towards a STEM education pathway or career. The program lacks information relating to programs that girls can undertake in order to better further their understanding of STEM or increase their interest in STEM. Therefore, Future You could be further utilised to aid girls and caregivers by presenting them with information on current government initiatives as well as programs by training and education providers aimed at increasing STEM engagement.

While there are some policy flaws in the initiatives undertaken by the Office of the Women in STEM Ambassador, it can be argued that the promotion of an evidence-based database on schemes for girls and women is a significant step to assessing whether current measures are effectively encouraging participation in STEM.

3.5.5 STEM Equity Monitor

Introduced in 2020, the STEM Equity Monitor reports on the participation rates of girls and women in STEM. The monitor allows users to examine the change and trends over time in key sectors as well as career phases with regards to girls and women's participation in STEM. The monitor provides data on female participation in STEM through primary and secondary school, higher education, graduate outcomes and the

workforce.[148] The monitor can be considered as useful to policymakers because it collates all data relevant to girls and women in STEM to one website. This means that it is less time consuming and challenging to find information on the past and current status of girls and women in STEM. The monitor also enables policymakers to potentially assess whether current or past initiatives, programs, policies and measures have been successful in retaining women in STEM employment or increasing the rates of girls who undertake STEM education. This view is also shared by the Australian Academy of Science President, John Shine who posits that the monitor will play "a significant role in tracking the impacts of initiatives across the STEM sector and inform the systemic changes required to achieve gender equity."[149]

There are some limitations with the STEM Equity Monitor with one being that it does not consider or provide statistical information on women from culturally diverse communities. The monitor also neglects other factors such as the age, and socioeconomic background of women. This is a limitation because policymakers are unable to determine whether women from these particular groups are increasing their participation in STEM education and careers. Moreover, a lack of data on women from these groups may impact the types of policies, programs and initiatives that are available to aid them in their pursuit of a STEM education or career.

A further concern is that the statistical data and analyses provided by the monitor is sourced by a variety of research institutes and government agencies. For instance, information about university graduate outcomes is sourced from the Social Research

[148] "STEM Equity Monitor", Department of Industry, Science, Energy and Resources, accessed March 24, 2021, https://www.industry.gov.au/data-and-publications/stem-equity-monitor.
[149] "STEM Equity Monitor Will Help Drive Universal Changes in Gender Equity", Australian Academy of Science, accessed March 24, 2021, https://www.science.org.au/news-and-events/news-and-media-releases/stem-equity-monitor-help-drive-universal-changes-gender-equity.

Centre.[150] In contrast, data about Vocational Education and Training graduate outcomes is provided by the National Centre for Vocational Education Research.[151] Agencies and research institutes conduct and use research differently and there may be some flaws in the data. Agencies may employ different methodologies and some may estimate rates rather than conduct large scale surveying. It should be acknowledged that the STEM Equity Monitor does not conduct significance testing.[152]

Another issue is that the STEM Equity Monitor has not been efficiently promoted by government agencies or by media outlets. The STEM Equity Monitor is not adequately promoted on the Department of Industry, Science, Energy and Resources website. This lack of awareness may mean that the data is not being used to inform policies and initiatives for women in STEM. In addition, government social media websites such those on Facebook and Twitter have failed to generate a lot of interest in the STEM Equity Monitor.[153] Similarly, major media outlets have not extensively covered its creation or promoted its advantages to the general public. Instead, media outlets such as the ABC have used the STEM Equity Monitor as a data resource in articles surrounding the underrepresentation of women in STEM.[154] A lack of promotion may mean that policymakers and organisations will be unable to use the findings from the monitor to

[150] "STEM Equity Monitor: University Graduate Outcomes Data", Department of Industry, Science, Energy and Resources, accessed March 24, 2021, https://www.industry.gov.au/data-and-publications/stem-equity-monitor/graduate-outcomes/university-graduate-outcomes-data.
[151] "STEM Equity Monitor: Vocational Education and Training Graduate Outcomes Data for STEM and Other Fields", Department of Industry, Science, Energy and Resources, accessed March 24, 2021, https://www.industry.gov.au/data-and-publications/stem-equity-monitor/vocational-education-and-training-graduate-outcomes-for-stem-and-other-fields.
[152] Department of Industry, Science, Energy and Resources, "STEM: Equity Monitor: Methodology".
[153] "STEM Equity Monitor", Facebook, accessed March 24, 2021, https://en-gb.facebook.com/IndustryGovAu/videos/stem-equity-monitor/2210597485709620/.
"sciencegovau", Twitter, accessed March 24, 2021, https://twitter.com/ScienceGovAu/status/1359655910214361092.
[154] Emma Nobel, "The X-Files and the Scully Effect – Fake Aliens Real-World Phenomenon For Women In STEM", *ABC News*, August 19, 2020, https://www.abc.net.au/news/2020-08-19/x-files-and-scully-effect-real-world-phenomenon-women-in-stem/12562440.

create effective policies, programs and initiatives for women in STEM education and careers. Utilising a gendered policy framing analysis also reveals that the government has not considered data on marginalised groups of women, including those from diverse cultural and socio-economic backgrounds.

3.5.6 Girls in STEM Toolkit

The Girls in STEM Toolkit (GiST) first announced in 2018 and delivered in August 2019 is an online platform established by the Australian government.[155] At the time of its announcement, the then- Minister for Industry, Science and Technology, Karen Andrews explained that the toolkit "will feature articles and case studies to motivate students on a new digital platform."[156] Similarly to the Future You initiative, the primary aim of GiST is to encourage girls to undertake studies in STEM and inform girls on the types of STEM careers that are available.[157] Information provided by the Australian Department of Industry, Innovation and Science notes that GiST was initially provided funding from 2018-2019 to 2021-22.[158] The 2020 Women's Economic Security Statement reveals that the Australian government committed an additional $900,000 to continue the program to 2023-24. The statement posits that the new funding will be used to expand GiST as well as increase visibility and resources. Notably, GiST is considered to be a federal measure

[155] "Advancing Women in STEM Strategy", Department of Industry, Science, Energy and Resources, accessed November 13, 2020, https://www.industry.gov.au/data-and-publications/advancing-women-in-stem. PDF available on webpage, 14.
[156] Department of Industry, Science, Energy and Resources, "Helping Girls on the Path".
[157] "The Girls in STEM Toolkit – The GIST", Education Services Australia, accessed May 24, 2021, https://www.esa.edu.au/solutions/our-solutions/girls-in-stem-toolkit.
Department of Industry, Innovation and Science, "Grant Opportunity Guidelines – Girls in STEM Toolkit", (Canberra, May 2018), 5-6, https://www.bulletpoint.com.au/wp-content/uploads/2018/06/Girls-in-STEM-Toolkit-Grant-Opportunity-Guidelines.pdf.
[158] "Archived Grant Opportunity View - GO1323", Australian Government - Grant Connect, accessed March 19, 2019, https://www.grants.gov.au/?event=public.GO.show&GOUUID=6CD0AD8E-003C-7940-C57A97C2C0B9D9F3.

that is being used to advance the recommendations suggested by the Advancing Women in STEM Strategy and 2020 Action Plan and the Women in STEM Decadal Plan.[159]

One major issue is that GiST does not promote other government initiatives that have the ability to aid girls wishing to pursue STEM education and careers. Other government programs explored in this chapter such as STARportal and the Indigenous Girls' STEM Academy are not promoted or featured. In addition, government programs which are listed and featured on GiST have webpages with few sentences about their purpose.[160] Girls and their families must independently search for information regarding programs themselves. Moreover, GiST overwhelmingly features events, internships and IT boot camps that are organised and run by private companies, rather than relevant government policies and programs for girls in STEM.[161] This lack of information means that girls must navigate multiple pages in order to find information relating to state and federal programs resulting in a time-consuming exercise. There is also the risk that many families and girls may not become aware of beneficial state or federal government supports due to a lack of visibility. Families may be unaware of policies and programs that can potentially offset the financial costs associated with girls undertaking STEM education or accessing grants to attend STEM events, activities, workshops and internships. This has implications for families living in regional and rural areas as well as families from Indigenous backgrounds. It is clear then, that GiST is framed in a manner that neglects

[159] "Women's Economic Security Statement 2020", Department of the Prime Minister and Cabinet, accessed May 28, 2021, https://www.pmc.gov.au/office-women/economic-security/wess. PDF available on webpage, 26.
[160] Department of Industry, Science, Energy and Resources, "Academy for Enterprising Girls", accessed May 27, 2021, https://www.thegist.edu.au/students/get-involved/activities-and-events/academy-for-enterprising-girls/.
[161] Department of Industry, Science, Energy and Resources, "Activities and Events", accessed May 27, 2021, https://www.thegist.edu.au/students/get-involved/activities-and-events/?ItemsPerPage=3&Page=2&DocType=eventDetail&SortBy=startDate_solis_s&SortDirection=ASC.

how some girls may be impacted by economic, social and geographical factors that can affect their participation in STEM activities. Instead, the government has applied a narrow lens and has focused more on merely raising awareness of initiatives with no solutions as to how girls with additional barriers can access them.

While the student section of GiST is beneficial to high school students especially, those in grades 10 to 12, academic research from experts such as Robyn Jorgensen and Kevin Larkin demonstrates that students develop a mathematical identity in the early years of primary school.[162] Furthermore, work from Hengameh Kermani and Jale Aldemir suggests that a child's attitudes towards STEM and particularly, science is shaped during the early years of their education. Students' aspirations about science are commonly formed during their primary school years. By the age of 14, many students have solidified their views about STEM.[163] As such, the student section of GiST is flawed in its ability to successfully attract and aid girls from primary and secondary school. This is considerably important because as demonstrated above, most students tend to develop a view about STEM by the time they finish primary school. As such, a lack of information targeting girls from this grade range may have serious implications.

Concerningly, GiST also features information that does not benefit primary, secondary or even high school girls. For instance, the 'Network and Connect' webpage on the GiST student platform suggests that students can network with organisations such as Digital Learning and Teaching Victoria and CSIRO's [Commonwealth Scientific and Industrial

[162] Robyn Jorgensen and Kevin Larkin, *STEM Education in the Junior Secondary: The State of Play*, (Singapore, Springer, 2018), 7. https://doi.org/10.1007/978-981-10-5448-8_2.
Department of Industry, Science, Energy and Resources, "Future Employment", accessed May 28, 2021, https://www.thegist.edu.au/students/explore-stem-careers/future-employment/.
[163] Hengameh Kermani and Jale Aldemir, "Preparing Children for Success: Integrating Science, Math, and Technology in Early Childhood Classroom", *Early Child Development and Care* 185, no. 9 (2 September 2015): 1505, https://doi.org/10.1080/03004430.2015.1007371.

Research Organisation] STEM Professionals in Schools.[164] Yet these organisations are primarily interested in providing networking opportunities for professionals in education fields rather than primary and high schoolers.[165] Other organisations promoted on the webpage including Women in Science, Technology, Engineering, Mathematics and Medicine (STEMM) Australia are more likely to benefit undergraduate women in STEMM education or early career STEMM researchers rather than high school girls.[166] As such, it can be suggested that GiST is not clear on its target audience and its current state may deter girls from using the site.

By analysing the families section of GiST, the thesis found that home activities focusing on STEM skills and knowledge are provided.[167] Notably, families who undertake activities with STEM practices, knowledge and concepts embedded into them are more likely to see positive impacts on their child or daughter's learning.[168] While home activities have the potential to aid girls in primary school and possibly, some in the lower grades of high school, it can posited that these activities are short-term and may not necessarily spark a deep or long-lasting interest in STEM. Correspondingly, GiST only suggests that parents look at books, YouTube channels and film recommendations to further girls interest in science.[169] The families section can thus be considered as cursory

[164] Department of Industry, Science, Energy and Resources, "Network and Connect", accessed June 2, 2021, https://www.thegist.edu.au/students/get-involved/network-and-connect/.
[165] "Digital Learning and Teaching Victoria", Digital Learning and Teaching Victoria, accessed May 28, 2021, https://dltv.vic.edu.au/.
"STEM Professionals in Schools", CSIRO, accessed May 28, 2021, https://www.csiro.au/en/education/programs/stem-professionals-in-schools.
[166] "Free Membership", Women in STEMM Australia, accessed May 28, 2021, https://womeninscienceaust.org/free-registration/.
[167] "Stargazing", Real Play Coalition, accessed May 27, 2021, https://www.realplaycoalition.com/uk/activities-for-kids/stargazing/.
"Design Your Own Car", Real Play Coalition, accessed May 27, 2021, https://www.realplaycoalition.com/uk/activities-for-kids/design-your-own-car/.
[168] Kermani and Aldemir, "Preparing Children for Success", 1522.
[169] "Tips and Resources", Department of Industry, Science, Energy and Resources, accessed May 27, 2021, https://www.thegist.edu.au/families/getting-her-interested-in-stem/tips-and-resources/.

and superficial, with limited potential to spark a deep or lasting interest of STEM in girls. Yet, as noted in sections above, this initiative's framing may reflect the government's neoliberal beliefs that suggest that it should not heavily intervene unless necessary. The framing also suggests that the government has not adequately considered particular challenges that are faced by girls in STEM.

This thesis proposes that the GiST platform and the Australian government could be doing more to advertise and promote online resources to families that have the potential to be long-term and far more beneficial to girls of any school grade. For instance, child-friendly websites like Scratch, Blocky Games and Grasshopper are free educational resources that enable girls to learn new technological skills and apply mathematical concepts.[170] These resources may be more beneficial to families who may encourage their daughters to undertake these long-term activities that are self-paced. These platforms are also cost effective given that many are free and do not have any geological constraints. This is in comparison to activities and workshops that can often be more expensive as discussed when examining STARportal. As such, it is evident that the families section of GiST could be promoting or sharing long-term activities that have a significant potential in aiding girls from any stage of primary or secondary school. A lack of information about effective, long-term and free resources for high school girls wishing to pursue STEM education may mean that families are less informed about the particular ways girls can use such experiences to further their STEM education or careers, and may unconsciously deter their daughters from pursuing STEM. Therefore, as illustrated above, this thesis believes that GiST and subsequently, the government has not effectively considered the

[170] "Scratch - Imagine, Program, Share", Scratch, accessed May 24, 2021, https://scratch.mit.edu/.
"Blockly Games", Blockly Games, accessed May 24, 2021, https://blockly.games/.
"Learn to Code for Free", Grasshopper, accessed May 24, 2021, https://grasshopper.app/.

wide range of existing tools that can benefit families particularly, those from particular socio-economic backgrounds or geographic locations.

3.5.7 Curious Minds

Administered by the Australian Mathematics Trust and Australian Science Innovations, the Curious Minds STEM program includes a STEM summer and winter school or residential camp, and a mentoring program to high achieving year 9 and 10 female students.[171] The program was created in response to the 2014 Australian government's Restoring the Focus on STEM initiative.[172] In 2019, the then-Minister for Education, Dan Tehan remarked that Curious Minds encourages "high-potential young women who might have limited opportunities to challenge themselves and pursue a career in STEM."[173] Curious Minds is also regarded as a way in which Australia can build a successful STEM-enabled workforce. As a part of the Women's Economic Security Package, Curious Minds has been provided $2.35 million over four years.[174]

Girls are invited based on their performance in the Australian Mathematics Competition, Computational and Algorithmic Thinking competition and the Big Science Competition. Curious Minds has a particular focus on girls from disadvantaged backgrounds, rural or remote areas, and those belonging to Aboriginal or Torres Strait Islander communities. Successful applicants are required to pay $200 to help contribute to the program's cost.[175]

---

[171] Department of Industry, Science, Energy and Resources, "Advancing Women in STEM, 14.

[172] "STEM Coach Opportunity", Australia Science Innovations, accessed June 2, 2021, https://www.asi.edu.au/programs/curious-minds/how-to-participate-in-the-curious-minds-program/mentoring-program/.

[173] "Summer Camp Brings Curious Young Minds to Canberra", Department of Education, Skills and Employment, December 12, 2019, https://ministers.dese.gov.au/tehan/summer-camp-brings-curious-young-minds-canberra.

[174] "Support for Science, Technology, Engineering and Mathematics (STEM)", Department of Education, Skills and Employment, last modified October 6, 2021, https://www.dese.gov.au/australian-curriculum/support-science-technology-engineering-and-mathematics-stem.

[175] "What is Curious Minds?" Australia Science Innovations, accessed June 2, 2021, https://www.asi.edu.au/programs/curious-minds/what-is-curious-minds/.

However, a fee waiver is available for girls unable to contribute. The residential camps provide girls with the ability to explore various STEM fields through attending guest lectures, interactive sessions, practicals and field trips. The mentoring program enables girls to be connected with a female STEM professional. Girls can examine study options and career pathways while also working with their mentor to develop ideas based on what they learn from the camp events. [176]

One significant benefit is that the Curious Minds program does aim to increase the participation rates of girls from disadvantaged backgrounds and communities. As illustrated in this chapter, federal government programs and initiatives have made little attempts to obtain data about girls and women in STEM from disadvantaged groups and communities. Subsequently, many programs have not targeted girls from disadvantaged communities and backgrounds who may have additional challenges when undertaking a STEM education or career. Applying a policy analysis approach reveals that the program is aware of some of the current issues that girls from these groups may face in attempting to pursue STEM. For instance, the program addresses the costs associated with undertaking STEM workshops, activities and camps as noted above. As demonstrated in the STARportal section of this chapter, some STEM workshops and camps can be expensive and may require applicants to pay for relocating. However, the Curious Minds program has addressed this issue thereby, making it attractive for many girls and particularly, those from disadvantaged communities and groups to pursue.

[176] "Curious Minds", Australia Maths Trust, accessed June 2, 2021, https://www.amt.edu.au/curious-minds. Emma Kelly, "Curious Minds Program Hopes to Foster Young Women's Passion for Science, Maths", *The Canberra Times,* December 9, 2015, https://www.canberratimes.com.au/story/6057279/curious-minds-program-hopes-to-foster-young-womens-passion-for-science-maths/.

In-depth research into the Curious Minds program is limited due to a lack of publicly available information, however, the Advancing Women in STEM Strategy suggests that 70% of girls who participated in the first two years of the program stated that it had influenced them to pursue STEM education. An estimated 80% of girls revealed that the Curious Minds program had increased their confidence in undertaking STEM.[177] Notably, these statistics are from 2015 and 2016. A lack of a publicly available evaluation report means that it is challenging to ascertain the extent to which Curious Minds benefits girls interested in STEM. This may also have implications as there may be issues with the program that have not been identified or addressed.[178] A further issue that has been uncovered is that the very few girls are able to benefit from the program. Publicly available information posits that the 2020/21 program will only have 140 girls attending.[179] This has increased from 2015 when only 54 girls were selected for the program.[180] These participation rates can be regarded as significantly low especially, when considering the amount of Australian girls undertaking STEM studies. The program's eligibility requirements also mean that girls with an already existing interest in STEM and who are high achieving students are more likely to benefit from the program. This means that Curious Minds does not have the potential to significantly influence girls who are not as committed to STEM education. It is clear then, the policy framing of the Curious Minds does address some barriers faced by girls interested in

[177] "Advancing Women in STEM Strategy – Action Area: Enabling STEM Potential Through Education", Department of Industry, Science, Energy and Resources, accessed March 2, 2021, https://www.industry.gov.au/data-and-publications/advancing-women-in-stem-strategy/vision-for-equal-opportunity-in-stem/action-area-enabling-stem-potential-through-education.
[178] "Residential Programs", Department of Education, Skills and Employment, accessed November 13, 2021, https://www.dese.gov.au/australian-curriculum/national-stem-education-resources-toolkit/introductory-material/residential-programs.
[179] Australia Science Innovations, "STEM Coach Opportunity".
[180] Martina Simos, "Curious to Explore Science", *The Advertiser*, April 12, 2016, https://infoweb-newsbank-com.proxy.library.adelaide.edu.au/apps/news/document-view?p=AWNB&t=&sort=YMD_date%3AD&page=1&fld-base-0=alltext&maxresults=20&val-base-0=%22curious%20minds%22%20STEM%20girls%20Australia&docref=news/15C2FAEA71E4DB90.

STEM and therefore, has the potential to significantly influence girls to undertake STEM education and careers. Yet, competitive eligibility requirements and limited places mean that it is unlikely that the program will significantly increase the participation rates of Australian girls in STEM.

3.5.8 The Young Indigenous Women's STEM Academy

Commencing in 2018 and ending in 2028, the Young Indigenous Women's STEM Academy is funded by the National Indigenous Australians Agency, delivered by CSIRO and in partnership with the Indigenous employment organisation, CareerTrackers.[181] The Young Indigenous Women's STEM Academy is regarded as a ten-year national investment with funding set at $25 million. The academy aims to increase the participation rates of Aboriginal and Torres Strait Islander females undertaking both STEM education and careers.[182] The academy will be made available to various regions and communities over 2023. It hopes to reach 600 participants by 2023.[183] The Young Indigenous Women's Academy seeks to provide long-term personalised support to Aboriginal and Torres Strait Islander girls and young women.[184] It aims to help a young woman successfully finish high school, complete a STEM university degree and then

[181] "About the Young Indigenous Women's STEM Academy", CSIRO, accessed June 4, 2021, https://www.csiro.au/en/education/programs/young-indigenous-womens-stem-academy/about-the-academy.
The Young Indigenous Women's STEM Academy is also commonly termed as the Indigenous Girls' STEM Academy by government agencies such as the National Indigenous Australians Agency and by government documents such as the Advancing Women in STEM Strategy. See "Indigenous Girls' STEM Academy", National Indigenous Australians Agency, September 2, 2020, https://www.niaa.gov.au/indigenous-affairs/education/indigenous-girls-stem-academy.
Department of Industry, Science, Energy and Resources, "Action Area: Enabling STEM Potential Through Education".
[182] CSIRO, "About the Young Indigenous Women's STEM Academy".
[183] "Join the Academy", CSIRO, accessed June 4, 2021, https://www.csiro.au/en/education/programs/young-indigenous-womens-stem-academy/join-the-academy.
[184] CSIRO, "About the Young Indigenous Women's STEM Academy".

progress into STEM employment. While successful applicants can withdraw at any stage, it is hoped that they stay throughout the program.[185]

The program initially offers activities that can benefit girls from year 8 onwards. These activities seek to prepare girls for undertaking STEM education at universities. As noted by CSIRO, support for young women in year 8 and onwards can be provided through tutoring, specialist STEM activities including internships and work experience, mentors and peer networks.[186] Through this program design, girls are able to access long-term support and moreover, access a range of services that can address any concerns they have with undertaking a STEM degree or occupation. The long-term services available to girls in year 8 mean that the academy can address prevalent social and economic barriers, and further build their confidence in STEM subjects and fields early.

At the university level, women applicants benefit from professional development training, receive support from a student advisor and complete internships. These support initiatives have the potential to assist Aboriginal and Torres Strait Islander young women in increasing their employability and enable them to seek assistance if they encounter challenges to their STEM career pathway. Following the completion of their STEM university degree, successful female applicants then transition into the CareerTrackers program which works to ensure that they are employed in STEM occupations.[187] Using a gendered discursive policy framing analysis, the thesis found that the Young Indigenous Women's STEM Academy has adopted a holistic approach which has the potential to

[185] "Frequently Asked Questions", CSIRO, accessed June 4, 2021, https://www.csiro.au/en/education/programs/young-indigenous-womens-stem-academy/faqs.
[186] "Academy Program", CSIRO, accessed June 4, 2021, https://www.csiro.au/en/education/programs/young-indigenous-womens-stem-academy/academy-program.
[187] CSIRO, "Academy Program".

significantly support Indigenous girls and women who wish to pursue and succeed in a STEM pathway.

While the Young Indigenous Women's STEM Academy can be considered as incredibly beneficial to girls and young women interested in STEM, further research into the program has not been able to uncover publicly available evidence that the program is being evaluated. Moreover, there is no statistical or qualitative information currently available on the effectiveness of the academy. Data that is publicly available posits that from 2019 to 2021, 275 girls from year 8 have been admitted into the program. A further 75 year 11 students and 75 university students have also been placed into the program. It is estimated that 100 students from year 8 will be able to access the program in years 2022 and 2023. Notably, 2023 will be the last year of recruitment.[188] While this can be considered as benefiting more girls than other programs analysed in this chapter, this number of students is still relatively low when considering the amount of Aboriginal and Torres Strait Islander young women in Australia. As such, it is clear that the Young Indigenous Women's STEM Academy has the potential to significantly increase the participation rates of girls and young women from Aboriginal and Torres Strait Islander communities. However, a lack of more funding and resources as well as a lack of an evaluation framework makes it challenging to ascertain to what extent they will benefit.

3.5.9 Other Initiatives in Development (2021 Onwards)

Growing concerns about the low participation rates of women in STEM as well as concerns over the future of the Australian workforce prompted the federal Liberal Coalition government under Prime Minister Scott Morrison to take greater action and implement initiatives. The 2021-22 budget speech by the Treasurer, Josh Frydenberg

[188] CSIRO, "Join the Academy".

revealed that the government was committed to funding schemes which would benefit women wishing to pursue non-traditional trades as well as STEM education.[189] Going further, the 2021-22 budget allocated 42.4 million over seven years from 2021-22. The funding will be used for the Boosting the Next Generation of Women in Science, Technology, Engineering, and Mathematics (STEM) program. [190] The program co-funds scholarships for women in STEM in partnership with industry. While this can be considered as a sign that the government is somewhat committed to tackling the underrepresentation of girls and women in STEM, ultimately, the funding allocated indicates that it is unlikely to benefit a large number of women. This analysis is also shared by the NFAW. The foundation goes further in remarking that there "may be limited benefit in investing more in recruiting women to the field without commensurate effort in addressing the barriers and inequities currently endemic within the sector."[191]

The 2021-22 budget also pledged $0.6 million over three years from 2021-22 to the Women in STEM Ambassador initiative, including evaluation planning and reporting tools for the STEM sector.[192] This can be considered as beneficial for policymakers given that in previous year's policies and programs for girls and women in STEM were not evaluated. Despite this funding allocation, however, it remains to be seen as to whether a widespread evaluation framework measure is adopted, enforced and maintained by the federal government. As noted in this chapter, the Australian government has been

[189] "Budget Speech 2021-22", The Treasury, accessed June 4, 2021, https://ministers.treasury.gov.au/ministers/josh-frydenberg-2018/speeches/budget-speech-2021-22.
[190] "Budget Paper No. 2: Budget Measures", The Treasury, accessed October 24, 2021, https://budget.gov.au/2021-22/content/bp2/index.htm. PDF available on webpage, 81.
[191] "Gender Lens on the Budget 2021-2022", National Foundation for Australian Women, May 23, 2021, https://nfaw.org/policy-papers/gender-lens-on-the-budget/gender-lens-on-the-budget-2021-2022/. PDF available on webpage, 2-3.
[192] The Treasury, "Budget Paper No. 2", 82.

influenced by neoliberal ideology which has expressed that the government should not intervene in the market nor should it seek to regulate it too much.

3.6 Conclusion

By analysing policy discourse, including political statements, press releases, official documents, and government material, this chapter has illustrated that the Australian federal Liberal Coalition government under Prime Minister Scott Morrison implemented some beneficial programs and policies for girls and women in STEM. Programs such as the Young Indigenous Women's STEM Academy demonstrate that the Australian government has recognised some of the barriers faced by girls and women wishing to pursue STEM. However, by using a gendered discursive policy framing approach and exploring feminist scholarly work, this thesis has found that the studied governments of both political persuasions have been slow to adopt change with many influenced by neoliberal ideology that maintains that women are largely responsible for their own social and economic standing, that downplays the structural disadvantage and barriers that women face, and that limit the role of government in the market economy. Similarly, gendered discursive policy framings have resulted in governments not fully adopting sufficient measures that recognise and validate the importance of social reproduction or adequately addressing its implications for women's participation in STEM. It is notable that the type of recommendations made years ago to previous governments such as the 1995 discussion paper from the WISET group, which was mentioned earlier in this chapter, have not been on the government's agenda as a result. For example, a neoliberal discursive framing that emphasises individual choice and responsibility as well as the persuasive power of a business case and the downplaying of social disadvantage has meant that major public awareness campaigns against discriminatory attitudes towards

women in STEM, as advocated in the mid-1990s', have not been on the Morrison government's agenda. Moreover, given a neoliberal framing that argues that the government should not heavily intervene in the market, the mid-1990s' recommendations that suggested tendering restrictions to favour companies that encourage good equal opportunity measures for women in STEM been not been effectively implemented. By contrast, the Morrison government was accused of giving large contracts to companies, including technological ones, that flouted existing equal opportunity reporting requirements.[193]

The Morrison government period also raised issues regarding whether Australian governments will dedicate long-term funding to women in STEM given that the programs examined have only been allocated funding for a set period of time. Drawing from government materials, the thesis has also found that government agencies such as the WGEA have not been able to effectively penalise companies that do not comply with legislation or scrutinise businesses whose policies are not producing effective outcomes. Other programs such as STARportal do not have an evaluation framework which limits their ability to benefit girls and assist policymakers. This particular policy framing aligns with the neoliberal idea that governments should not over regulate the market. While the Women in STEM Ambassador has highlighted the importance of developing evaluation processes, the Morrison government period raised questions over whether governments will make such evaluations mandatory.

[193] David Crowe, "Flouting Discrimination Rules No Barrier to Winning Government Contracts", *The Sydney Morning Herald,* March, 22, 2021, https://www.smh.com.au/politics/federal/gender-reporting-federal-funds-to-companies-flouting-rules-20210321-p57cpm.html.

This thesis covers the period up to February 2022 when this thesis was originally submitted. As such it does not cover the period of the Albanese government. Furthermore, as mentioned previously, the Albanese government's policies are still a work in progress as the government waits on the final report of the *Pathway to Diversity in STEM Review*, established by Ed Husic, the Minister for Industry and Science. However, in terms of possible future research, it is appropriate to briefly note that some of the problematic policy issues identified in this chapter may be at least partially addressed by the Albanese government in due course. Following Minister Husic establishing his Review, the Department of Industry, Science and Resources also commissioned consultants ACIL Allen to produce a *Women in STEM Evaluation* report evaluating government initiatives designed to advance women in STEM.[194] The report has confirmed some deficiencies that have already been identified in this chapter such as insufficient funding and resourcing.[195] Similarly, to the thesis, the report has also noted that the data is not currently able to assess impact.[196] However, given the remit of such consultants' reports, it has not adequately addressed key issues identified in this academic thesis such as how a neoliberal policy framing has contributed to inadequate policies and programs which do not address issues faced by women in STEM as well as neglecting the role of social reproduction. Instead, the *Women in STEM Evaluation* report briefly references key issues that impact women in STEM such as the gender stereotyping of women in STEM.

[194] The final report was published on 15 August 2023 so well after research on this chapter had been completed. The revisions made to this thesis have been required to focus on responding to the examiners' recommendations regarding the draft originally submitted in October 2022. Consequently, it has not been possible or appropriate to incorporate this 2023 report's detailed findings, given it was commissioned for the Albanese government and many of the findings involve evaluations/developments which are also outside of this thesis's period of study.

[195] Department of Industry, Science and Resources, "Women in STEM Evaluation Final Report", iii.

[196] Department of Industry, Science and Resources, "Women in STEM Evaluation Final Report", iv and 68.

The Conclusion of this thesis will use the findings in this chapter to illustrate how policies can be improved upon and provide suggestions on additional strategies. The next chapter will examine the next feminist comparative policy case study, namely India.

Chapter 4: India

4.1 Introduction

Drawing from policy discourse such as government materials, political statements, websites, reports and press releases, this chapter will examine India as a comparative case study. As acknowledged in Chapter One, India has reported higher rates of women's participation in STEM when compared to Australia. The chapter will argue that the government of Narendra Modi has implemented a number of potentially beneficial schemes for women in STEM education and careers. However, by using the feminist analytical approaches outlined previously, including a gendered discursive policy framing analysis, this chapter will also argue that Indian governments' policy framing of women's participation in STEM has been influenced by particular social, cultural, economic and historical factors that have impacted the effectiveness of policies and programs for women in STEM. These policy flaws will be articulated further in the chapter. By examining ideological and economical contexts that have shaped or influenced policy framing with regards to women in STEM, this chapter will demonstrate how patrifocal ideology has hindered Indian female participation in STEM. Carol Mukhopadhyay's work on the patrifocal family structure and ideology will be explored in order to provide insight into the complex barriers faced by Indian women interested in pursuing STEM.[1] However, the thesis will also acknowledge that in recent years, there has been a large shift in the popularisation of STEM education and careers for women. For instance, following in the footsteps of previous governments, the Modi government has associated women and particularly, those with STEM skills and knowledge as key

[1] Carol Mukhopadhyay and Susan Seymour, *Women, Education, and Family Structure in India* (Boulder: Westview Press, 1994), 3-5.

drivers to advancing India's economic development. Further sections of this chapter will then analyse gender equality policies with a particular focus on policies, programs and initiatives that are designed to increase the participation rates of Indian girls and women in STEM. The chapter will determine whether the Indian government has adequately addressed the issues that affect women in STEM as identified by the wider literature. Additionally, the chapter will briefly discuss the policy positions of past governments and analyse policies and initiatives that were active as of February 2022.

4.2 The Historical Presence of Indian Women in STEM

This thesis will now explore how women engaged with STEM historically in order to ascertain whether barriers of the past are prevalent in the current time. This section will also provide information on the ways that Indian women's roles have been construed by analysing the framing of historic texts and information and the extent that this impacts their ability to enter and excel in STEM education and careers.

Historical information about women's participation in fields such as technology and engineering are limited due to them being relatively new areas of study. Moreover, the participation of Indian women in areas other than the home have been historically omitted. Subsequently, "whatever knowledge women possessed was either not acknowledged, or not legitimized as culturally significant."[2] Historically, an Indian woman's ability to access education was also deeply dependent on factors such as her ethnicity, caste, religion, class, culture, community and language. Furthermore, support for female education varied from one Indian region to another. This meant that some

[2]Neelam Kumar, "Introduction", in *Women and Science in India: A Reader,* ed. Neelam Kumar (New Delhi: Oxford University Press, 2009), xxiii–xxx, xiv.

Indian women may have had additional challenges in obtaining an education due to the previously listed factors.

During the early periods of the nineteenth century, Indian women faced a number of social and ideological constraints from Indian beliefs, practices and norms well as those imposed by the British. In 1913, the British government of India adopted the position that: "The education of girls should be practical with reference to the position they will fulfil in social life [and] should not seek to imitate education suitable for boys nor should it be dominated by examinations."[3] Discussions about women's participation in education largely came from social reformers and western missionaries.[4] Despite debates about the role of women's participation in the wider public sphere, fears about women's education led to superstitions that proposed that girls who touched books would become widows.[5] Correspondingly, British critics were likely to believe that as women's brains developed, their ovaries would shrink.[6] These beliefs by both Indian and British critics did impede on the development of girl schools.[7] The Indian newspaper, *The Chabuk* stressed that the creation of girl schools would introduce the English language and English manners which would allow Indian women to "make slaves of their husbands."[8] Indian critics were concerned that educated women would change the cultural disposition of India and "would soon lead to women running away from her home."[9] Many Indian norms, beliefs and practices were situated around the idea that a woman's responsibility

[3] Kumar, "Introduction", xvi.
[4] Aparna Basu, "A Century and a Half's Journey: Women's Education in India, 1850s to 2000", in *Women of India: Colonial and Post-Colonial Periods,* ed. Bharati Ray, (New Delhi: SAGE Publications, 2005), 186.
[5] Kumar, "Introduction", xvi.
[6] Kumar, "Introduction", xvi.
[7] Basu, "A Century and a Half's Journey", 183.
[8] R.P Masani, *Dadabhai Naoroji: Grand Old Man Of India* (London: George Allen & Unwin Ltd, 1939), 47, https://archive.org/details/GrandOldManOfIndia.
[9] Basu, "A Century and a Half's Journey", 184.

was to look after her husband and family. This required an Indian woman to have chastity and virtue. For some Indians, discussions around the idea of educating women led to fears that they would become unsatisfied with the traditional life socially prescribed to them.[10] Therefore, educating Indian women was perceived to be damaging because it had the potential to teach them to resist societal pressure to marry and have children.

As acknowledged above, however, female education did vary from one Indian region to another. Factors such as community, class, region, religion, ethnicity, caste, culture and language played an influence in determining whether an Indian woman could receive an education. For example, women from upper and middle classes in Bengal and Mumbai (Bombay) were among the first to receive access to schooling.[11] Parsi girls in Mumbai (Bombay) achieved some of the highest literacy rates. Approximately, 70% of Parsi girls were attending schools in 1886.[12] Similarly, women in Kerala were more literate than women from other regions of India based on data from an early census taken during the nineteenth century.[13] Women from Travancore and Cochin (areas now regarded as Kerala), were more than twice as literate as those in Madras Presidency.[14] Most Hindu Indian communities belonging to the Nayar caste in Kerala were matrilineal and accounted for 15% to 20% of the population in Kerala.[15] Whilst they did not manage the household, women from Nayar castes were able to enjoy wider freedoms that enabled them to obtain an education from Christian missionary schools.[16] Travancore society was also influenced by the belief that educated women were profitable given that they could

[10] Basu, "A Century and a Half's Journey", 184.
[11] Kumar, "Introduction", xvi.
[12]Basu, "A Century and a Half's Journey", 188.
[13] Robin Jeffrey, "Governments and Culture: How Women Made Kerala Literate", *Pacific Affairs* 60, no. 3 (1987): 462, https://doi.org/10.2307/2758883.
[14] Jeffrey, "Governments and Culture", 462.
[15] Jeffrey, "Governments and Culture", 464-5.
[16] Jeffrey, "Governments and Culture", 464.

obtain employment. A few Nayar women were able to train and obtain work as midwives and anti-pox vaccinators. By 1898, Travancore needed to develop a maternity leave scheme for teachers given the prominence of female teachers.[17] However, despite the progress in areas such as Kerala, women education rates were low in India.

Culturally engrained practices such as purdah also played a role in deterring women from obtaining an education. Purdah can involve women being physically segregated in both their home and their community.[18] Purdah can also be associated with the wearing of veils which restrict their ability to interact and communicate with others, particularly, men.[19] Purdah was prevalent in Eastern and Northern India where girls from high caste Hindu and Muslim families would be socially secluded from the wider community.[20] Practices such as purdah significantly impacted a girl's ability to access education and particularly, STEM knowledge. David Arnold noted that medicine was one of the first STEM positions offered to women.[21] Yet, Indian Hindu and Muslim women were less likely to undertake study or employment in medicine than any other ethnic group in India.[22] In areas such as Bombay, compulsory education was not imposed for Muslim girls until 1920.[23] As such, culturally diverse practices such as purdah did influence some women's participation in STEM. Indian women with greater freedoms obtained education from girls' schools established by British missionaries and social reformers. Missionaries encouraged Indian women to pursue education out of the belief that they would become better wives and mothers. A knowledge of hygiene and mathematics

[17] Jeffrey, "Governments and Culture", 465.
[18] Elizabeth H. White, "Purdah", *Frontiers: A Journal of Women Studies* 2, no. 1 (1977): 31, https://doi.org/10.2307/3346105.
[19] White, "Purdah", 31.
[20] Basu, "A Century and a Half's Journey", 184.
[21] David Arnold, *Science, Technology and Medicine in Colonial India* (Cambridge: Cambridge University Press, 2000), 102. http://ebookcentral.proquest.com/lib/adelaide/detail.action?docID=202346.
[22] David Arnold, *Science, Technology and Medicine in Colonial India,* 102.
[23] Basu, "A Century and a Half's Journey", 190.

would lead to healthier children and allow women to manage household finances.[24] Conversely, the government of India and Britain believed that educated women could be used to fill in labour shortages in positions such doctors, nurses and teachers.[25] Medicine was considered to be one of the few STEM areas appropriate for women as medically trained Indian women could access the zenana or women's quarters and interact with the women of household. This was a license not afforded to Indian or western male doctors.[26] In the British context, women were perceived to be naturally attuned to caring and nursing the sick.[27]

While the above beliefs were successful in alleviating some cultural contentions about female education, they may have also severely undermined a girl's ability to engage with other disciplines within STEM. Institutions such as the Native Ladies' Normal School refused to teach females science, mathematics and philosophy.[28] Priority was given to subjects perceived to be beneficial in increasing a girl's marriageability. In one instance, the register for Punjab University remarked that "a special non-degree course should be designed for Indian girls… to train the general intelligence and character of future wives and mothers rather than provide any professional qualifications."[29] Subsequently, while some women were able to pursue certain STEM education and occupations, others faced significant social and institutional barriers. The next section will illustrate challenges that Indian women currently face when they attempt to pursue and maintain a STEM education or career.

[24] Basu, "A Century and a Half's Journey", 188.
[25] Arnold, *Science, Technology and Medicine in Colonial India,* 101.
Basu, "A Century and a Half's Journey", 192.
[26] Arnold, *Science, Technology and Medicine in Colonial India*, 87.
[27] Arnold, *Science, Technology and Medicine in Colonial India,* 101.
[28] Basu, "A Century and a Half's Journey", 189.
[29] Kumar, "Introduction", xvi.

4.3 Indian Women in STEM

Indian women in STEM face a multitude of social, cultural, familial, economic and political barriers that instil the idea that they are primarily, wives and mothers. These barriers may have contributed to a low female labour participation rate. It has been reported that women's employment rate was at an estimated 25% in 2022.[30] India's #Metoo movement has also gained little traction in STEM areas. Sexual discrimination and harassment remain ever present problems for women in STEM.[31] Moreover, in a study by the Global Institute for Women's Leadership, an estimated 60% of Indian respondents agreed that "a man who stays home to look after his children is less of a man".[32] Nonetheless, educated Indian women are likely to pursue a STEM pathway. An estimated 69% of Indian girls aged between 15 and 19 years study STEM.[33] Additionally, 63% of Indian girls expressed a desire to be employed in STEM related careers. Indian women make up 50.7% of all IT degrees and 54.1% of all science degrees.[34] Women are underrepresented in engineering and technology degrees with the participation rate at 31.4%.[35] However, these rates are higher than in Australia.[36] The United Nations Educational, Scientific and Cultural Organisation (UNESCO) attributes the rise in Indian female engineering students to changing perceptions of engineering as well as greater familial support.[37]

---

[30] "As India's Population Soars, Number of Women in Workforce Shrinks", *AlJazeera,* accessed October 2, 2023, https://www.aljazeera.com/gallery/2023/4/10/as-indias-population-soars-number-of-women-in-workforce-shrinks.
[31] Aashima Dogra and Nandita Jayaraj, "What Will It Take for Science in India to Have Its #MeToo Movement?" *The Wire,* November 4, 2018, https://thewire.in/the-sciences/what-will-it-take-for-science-in-india-to-have-its-metoo-movement.
[32] Ipsos and the Global Institute for Women's Leadership, "International Women's Day: Global Opinion Remains Committed to Gender Equality, but Half Now Believe it is Coming at the Expense of Men". PDF available on webpage, page 15.
[33] ET Bureau, "69% of Indian Girls Pick STEM Courses".
[34] Catalyst, "Women in Science, Technology, Engineering, and Mathematics (STEM) (Quick Take)".
[35] Catalyst, "Women in Science, Technology, Engineering, and Mathematics (STEM) (Quick Take)".
[36] Australian Academy of Science, *Women in STEM Decadal Plan,* 7.
[37] UNESCO, "Women Still a Minority".

Despite the high participation of women in STEM education, women continue to be severely underrepresented in STEM workplaces. The increased rates of women in STEM education has not correlated into higher STEM workplace participation.[38] While 51% of new recruits in India's tech industry are women, only 34% of tech employees are women.[39] Research institute, Catalyst, uncovered that only 30% of the IT workforce are women while only 10% of computer science researchers are female.[40] India's women labour participation rate has been in decline for decades. Statistics from 1993 and 1994 revealed that 42% of women had been employed.[41] By 2011 and 2012, this figure had dropped to 31%.[42] In 2018, India's Ministry of Finance claimed that the female labour participation rate was at just 24%.[43] These statistics are concerning as a report by the National Association of Software and Service Companies (NASSCOM) ranked India as the 4th largest start-up ecosystem with companies and start-ups focused on advanced technology such as analytics and artificial intelligence.[44] The absence of women as India makes advances in STEM has implications for India's skilled workforce. In addition, Indian women may be particularly vulnerable as new industries emerge and old ones cease to exist, and may face higher economic repercussions for not participating in STEM workplaces.

[38] For deeper insight into Indian women's overall labour participation, see Sher Singh Verick, "Employment Policy to Promote the Participation of Women in the Indian Labour Force", in *Employment Policy in Emerging Economies: The Indian Case*, ed. Elizabeth Hill and Amitendu Palit (Oxon: Routledge, 2018), 119-136.
[39] Namita Bhandare, "Motherhood Is Kicking Indian Women Out of Work", *Foreign Policy*, July 6, 2018, https://foreignpolicy.com/2018/07/06/motherhood-is-kicking-indian-women-out-of-work/.
[40] Catalyst, "Women in Science, Technology, Engineering, and Mathematics (STEM) (Quick Take)".
[41] Soutik Biswas, "Why Are Millions of Indian Women Dropping Out of Work?" *BBC News*, May 18, 2017, https://www.bbc.com/news/world-asia-india-39945473.
[42] Biswas, "Why Are Millions of Indian Women Dropping Out of Work?"
[43] Bhandare, "Motherhood Is Kicking Indian Women Out of Work".
[44] "Indian Start-Up Ecosystem – Traversing The Maturity Cycle: Edition 2017", NASSCOM, accessed February 22, 2020, https://smartnet.niua.org/sites/default/files/resources/nasscom-start-up-report-2017.pdf. Information found 6, 10.

Indian women in STEM are also impacted by diverse cultural, societal, political and economic forces that associate STEM as a masculine area of employment. While Indian women face some of the barriers explored in Chapter Two, there are unique challenges that impact their participation in STEM. As noted by Nagar, "India is a deeply multifaceted society where no generalisation could apply to all of the nation's various religious, social, and economic groups."[45] Indian society is extremely hierarchical with many Indians ranked according to their caste, class, wealth and power.[46] These factors play a large part in determining the type of work that is appropriate for women. The idea that women are expected to be chaste and virtuous is widely held by most groups in India.[47] Many Indian women also go through gender socialisation at an early age.[48] Girls are educated on their familial responsibilities and obligations which upon marriage, transfer onto their future in-laws. Women in many ethnic and religious groups are perceived as cultural caretakers guarding their culture through cooking, nurturing, caretaking and homemaking. Women in STEM employment are still expected to fulfil domestic responsibilities.[49] As an Indian woman STEM professional explains, "my in-laws were very modern but made it clear to me that my career came second after my family. I was expected to cook dinner after I came home from work."[50] Indian women in STEM with familial responsibilities can also struggle to attend conferences or undergo professional training and face social backlash when they network with male employees in an informal manner[51] In 2017, only 5% of fellowships awarded by the Indian National

[45] N.S Nagar, *Women and Employment* (New Delhi: Vista International Publishing House, 2008), 53.
[46] Nagar, *Women and Employment,* 53.
[47] Nagar, *Women and Employment,* 53.
[48] Joshua C. Collins and Yogita Abichandani, "Change in the Face of Resistance: Positioning Hope for Women Returnees to the Indian Workforce", *Advances in Developing Human Resources* 18, no. 1 (February 2016): 13, https://doi.org/10.1177/1523422315614928.
[49] Subrahmanyan, "Women Scientists", 140.
[50] Namita Bhandare, "Why India's Most Educated Women Are Leaving Jobs Faster than Others", *Hindustan Times*, September 9, 2017, https://www.hindustantimes.com/india-news/why-india-s-most-educated-women-are-leaving-jobs-faster-than-others/story-9VqXXn511Xm3PyQZfIOzPN.html.
[51] Subrahmanyan, "Women Scientists", 141.

Science Academy, Indian Academy of Sciences and the National Academy of Agricultural Sciences were given to women.[52] Women who take career breaks are limited in the extent that they can return due to pervasive social expectations that insist that married women do not belong in the workplace.[53] In contrast to Chapter Two, however, the idea that Indian women are unable to grasp or understand STEM because of biological differences is not a relevant factor.[54] Best summarised by Collins and Abichandani, "Indian women's educational choices are constrained by physical, social, communal, and institutional access, which are enshrined as matters of familial and individual reputation and produce and sustain cultural gender bias."[55] These cultural forces present implications for girls and women wishing to pursue untraditional and socially undesirable career paths such as those in STEM.

Carol Mukhopadhyay's work on Indian family models and, in particular, the patrifocal model, provides deep insight into the complex challenges Indian women must contend with in order to pursue STEM education and occupations. Mukhopadhyay illustrates that decisions about the educational pathway of a student are not guided purely by their own interests and desires. Instead, decisions surrounding education are treated as family decisions because in many instances, the education of a child requires the investment of collective family resources.[56] In order to maximise their economic benefits, educational decisions are guided by collective family concerns. Going further, "they are like marriage decisions … the family and social consequences are too significant for them to be the

Subrahmanyan, "Women Scientists", 158.
[52] *The Times of India,* "Only 14% of Indian Researchers Are Women; Science Seen as Male Profession", *The Times of India,* April 2, 2018, https://timesofindia.indiatimes.com/india/there-are-too-few-women-in-science/articleshow/63575929.cms.
[53] Collins and Abichandani, "Change in the Face of Resistance", 12.
[54] Mukhopadhyay, "How Exportable are Western Theories", 158, 161.
[55] Collins and Abichandani, "Change in the Face of Resistance", 13.
[56] Mukhopadhyay, "How Exportable are Western Theories", 148.

sole province of the individuals most directly involved." [57] Under the patrifocal family model, Indian families treat a boy's education differently to a girl's. Investments in a son's education benefits the family directly. In contrast, a girl or daughter of the family is expected to marry. When she does, she assumes the responsibilities and obligations of her husband's family. A daughter's education is then, more likely to benefit her in-law's family more so than her own.[58] Given this context, families often choose to prioritise the education of a son over the daughter. According to Mukhopadhyay, the patrifocal family model consists of ideology that reinforces the collective family welfare by maintaining gendered distinctions between men and women.[59] For instance, the patrifocal family model emphasises the regulation of female sexuality through arranged marriages and through restricting interactions between men and women. This is done to ensure the purity of the patrilineal line. Indian women are prescribed a set of norms and practices that encourage to be obedient and selfless. This is considered to be conductive to family harmony. Notably, there are other Indian family models. However, Mukhopadhyay explains that the patrifocal model is one of the most prominent with many Indians exposed to its ideology. The model "provides a significant culturally-rooted conceptual and cogitative framework for thinking about and making educational decisions."[60]

The patrifocal family model also maintains strict social conditions that prevent women from engaging in STEM. The patrifocal family model has the embedded perception that education and employment is dangerous and unsuitable for women. For instance, in order to be educated, a girl must go into public spaces. These public spaces allow for the opportunity for girls to challenge familial and social behaviours, norms and ideas. Girls

[57] Mukhopadhyay, "How Exportable are Western Theories", 148.
[58] Mukhopadhyay, "How Exportable are Western Theories", 148.
[59] Mukhopadhyay, "How Exportable are Western Theories", 148.
[60] Mukhopadhyay, "How Exportable are Western Theories", 148-149.

may become more independent and engage with their male counterparts. As a result, the patrifocal family model suggests that girls should not be educated because it can spoil a girl's character and damage the reputation of her family. Pursuing STEM exacerbates the social dangers. Some STEM education and careers such as astronomy require women to be travelling, alone, or working after dark. The access to STEM courses can also be limited especially, in rural areas. Consequently, girls may need to relocate to girl's hostels or same-sex schools. This requires families to provide additional economic resources for their daughters to study STEM. Hostels can also be influenced by social and cultural influences. In one instance, a girls' institution required women to be back at the hostel by 7pm. Those undertaking laboratory work were permitted to stay out until 10pm. Consequently, Indian women in STEM may find it challenging to excel in STEM higher education and career pathways given that it requires them to behave and follow norms that are not culturally permissible for them to adhere to.[61]

STEM education and careers also undermine a woman's marriageability.[62] Lalita Subrahmanyan illustrates that there are two main social standards that mark a woman's prospects for marriage.[63] The first is that husbands should be older than their wives. The second consists of the ideal that a woman may only marry above her educational and social level. These standards reinforce and legitimise male superiority.[64] Marriage is a serious issue in India because of the belief that a woman is not 'settled' until she is married.[65] In contrast, an Indian male is considered 'settled' if he acquires employment. Higher education has the potential to severely undermine the marriage prospects of a

[61] Mukhopadhyay, "How Exportable are Western Theories", 148-151.
[62] Mukhopadhyay, "How Exportable are Western Theories", 149.
[63] Subrahmanyan, "Patrifocality", 86.
[64] Namrata Gupta and A.K. Sharma, "Patrifocal Concerns in the Lives of Women in Academic Science: Continuity of Tradition and Emerging Challenges", *Indian Journal of Gender Studies* 10, no. 2 (June 2003): 279–305, https://doi.org/10.1177/097152150301000205.
[65] Subrahmanyan, "Patrifocality ", 86.

female because of its association as a symbol of an individual's rise in social and economic mobility. While this attachment is beneficial for Indian males, for women, a higher education particularly, in STEM means that their marriage pool dwindles significantly.[66] An education in STEM is regarded as especially concerning for women because it is socially and culturally regarded as a prestigious area of study. Obtaining a STEM degree in India is incredibly competitive and expensive.[67] Prestigious institutes only permit a limited number of places and upon enrolment, courses are academically rigorous. Given this, STEM qualifications are regarded as superior to that of social science or humanities, areas more commonly studied by women.[68] Therefore, there are culturally significant issues when an Indian woman chooses to undertake STEM education. There may be challenges with finding a prospective partner and in some cases, families may need to pay more dowry for her to marry. In addition, STEM requires women to undertake more behaviour culturally deemed 'risky' than other knowledge areas.

Economic resources are an additional factor that significantly impacts a woman's ability to pursue STEM education and careers in India and one that is tied to the patrifocal model. A vast majority of Indian students do not have the necessary financial resources to attend school and particularly, university.[69] However, the Indian government has provided an educational loan scheme to offset the costs associated with undertaking professional and technical subjects at universities and colleges. Applying a gendered discursive policy framing analysis to this scheme reveals that it can be regarded as influenced by neoliberal beliefs given that it perceives that there are no additional issues that deter women from

[66] Gupta and Sharma, "Patrifocal Concerns in the Lives of Women", 290.
[67] Mukhopadhyay, "How Exportable are Western Theories", 149.
[68] Subrahmanyan, "Patrifocality ", 86.
[69] Mukhopadhyay, "How Exportable are Western Ideas", 148.

pursuing STEM education. The Ministry of Social Justice and Empowerment reveals that successful applicants are able to obtain a loan amount under the Education Loan Scheme that pays 90% of an approved course.[70] Many of the approved courses are STEM based. Indian women are able to apply for a 0.5% rebate on the annual interest rate of the loan.[71] However, scholars such as Jandhyala Tilak contend that educational loans encouraged private Indian education providers to increase the costs of subjects.[72] Moreover, individuals who undertake educational loans are expected to make repayments within six months of completing their course or obtaining employment.[73] For women, these requirements are an added complexity. As noted in the sections above, women may struggle to find employment quickly due to social and cultural influences and as such, may need to need to rely on their families for economic support. Families may regard this as an economic risk and may deter women from undertaking STEM higher education. Hence, government education loan schemes may not adequately address the economic implications of women undertaking STEM studies.

In her research, Mukhopadhyay explains that science degrees are generally a more expensive option than an arts or commerce degree. There may also be additional costs associated with a science degree, including costs associated with laboratory and safety equipment and textbooks. Following from Mukhopadhyay's patrifocal theory, families may find it harder to encourage their daughters to pursue STEM degrees given the expense and may believe that the expense should instead directed to helping their daughter fulfil a more gendered and socially acceptable practice, that is, marriage.[74]

[70] "Educational Loan Scheme", Ministry of Social Justice and Empowerment, accessed June 29, 2021, https://nsfdc.nic.in/en/educational-loan-scheme.
[71] Ministry of Social Justice and Empowerment, "Educational Loan Scheme".
[72] Jandhyala B. G Tilak, *Education and Development in India* (Singapore: Springer, 2018), 250, https://doi.org/10.1007/978-981-13-0250-3_7.
[73] Ministry of Social Justice and Empowerment, "Educational Loan Scheme".
[74] Mukhopadhyay and Seymour, *Women, Education, and Family Structure in India,* 103-34.

Notably, families particularly, those from the middle and upper classes face the pressure of spending large amounts of money on their daughter's wedding.[75] India's wedding industry is estimated to be worth $40 to $50 billion.[76] As characterised by Parul Bhandari, an Indian marriage "marks the coming together of two families, lineages, and at times, larger groups like whole villages or communities."[77] Marriage is regarded as an important rite of passage as it not only signals an individual's status but also their family's social, economic, and political status. Bhandari accentuates that this can attribute to higher wedding costs particularly, as families "attempt to achieve higher social status and respect within the wider community."[78] It is clear then, that economic factors have the potential to severely impact the participation rates of Indian women in STEM given that students and especially, families are more likely to choose degrees which are less costly and do not require a large amount of financial resources in order to prioritise socially and culturally accepted expenses associated with marriage.

In recent years, however, science and engineering degrees have grown in popularity with Indian families. The role of India's female engineers or more commonly, known as the 'rocket women of ISRO' may have played a large role in acknowledging women's contribution to science.[79] The belief that married Indian women can contribute to their husbands' STEM business has also been cited as an attractive prospect.[80] Additionally, the idea that earning daughters can help offset dowry demands and support themselves

[75] Subrahmanyan, "Patrifocality", 86.
[76] Manveena Suri, "Beyoncé, Couture and Palaces: India's Growing Taste for Mega-Weddings", *CNN Style*, February 3, 2019, https://www.cnn.com/style/article/india-wedding-culture/index.html.
[77] Suri, "Beyoncé, Couture and Palaces".
[78] Suri, "Beyoncé, Couture and Palaces".
[79] "Gender Equality in STEM Is Possible. These Countries Prove It", World Economic Forum, accessed July 9, 2019, https://www.weforum.org/agenda/2019/03/gender-equality-in-stem-is-possible/.
[80] Namrata Gupta and Arum K Sharma, "Women Academic Scientists in India", *Social Studies of Science* 32, no. 5/6 (2002): 903, https://www.jstor.org/stable/3183058.
Mukhopadhyay, "How Exportable are Western Theories", 153.

without utilising familial resources has gained traction.[81] Offsetting the expense associated with dowries is a key priority for many families with daughters because the rise of consumerism has led to greater dowry demands. The section below will illustrate how India's economic liberalisation policies during the 1980s did result in societal changes that led to many adopting a consumerist identity.[82]

The late 1980s and 1990s in India saw a range of changing economic and cultural ideas, practices and norms. As noted by Suchitra Shenoy-Packer, the Indian government under Rajiv Gandhi began to pursue policies in line with economic liberalisation.[83] Following Gandhi's assassination, subsequent governments also implemented an economic liberalisation policy which saw India opening its market to foreign investments, prioritisation and globalisation.[84] Subsequently, economic liberalisation resulted in a greater availability of consumer goods and as a result, many individuals and communities began to adopt consumerist identities.[85] Consumer goods and wealth were perceived as sign that an individual or rather, Indian household held a high status within their community. However, many young men during the 1990s were unemployed and could not obtain consumer products that were beginning to be seen as signs of status and wealth. As such, dowries soon became associated as a means for males in the lower and middle classes particularly, to obtain consumer goods and capital for investments or bribes to secure employment.[86] Conversely, Rajni Palriwala contends that globalisation sparked

[81] Mukhopadhyay, "How Exportable are Western Theories", 153.
[82] Patricia Jeffery, "Supply-and-Demand Demographics: Dowry, Daughter Aversion and Marriage Markets in Contemporary North India", *Contemporary South Asia* 22, no. 2 (April 2014): 181, https://www-tandfonline-com.proxy.library.adelaide.edu.au/doi/abs/10.1080/09584935.2014.899982.
[83] Shenoy-Packer, "India's Working Women", 12.
[84] Shenoy-Packer, "India's Working Women", 12.
[85] Jeffery, "Supply-and-Demand Demographics", 181.
[86] Palriwala, "The Spider's Web", 161. See also Porismita Borah, "Examining Media Content: A Case Study of Newspaper Coverage of Dowry in India, 1999–2006", *Asian Journal of Communication* 18, no. 4 (December 2008): 379–95, https://doi.org/10.1080/01292980802413110.

fears about losing their specific Indian identity and as such, dowry was reconstituted as a practice or rather, marker in which individuals and communities could reaffirm their cultural identity.[87] A dowry is now perceived by some as symbolic of the social and economic status of the bride-giving family. [88] A woman employed in a STEM occupation has the potential of further increasing the amount of dowry provided by a family thereby increasing the social and economic status of an Indian household. A dowry can consist of gold, clothes, utensils and consumer goods. [89] However, discussions around dowry can be complex and dependent on a multitude of factors including caste, religion, region, ethnicity, class and gender.[90] Borah illustrates that some families may demand dowries during ceremonies or rituals conducted after a marriage.[91] This means that families with daughters may be continually asked to provide money or goods. Families may go into debt trying to provide their daughter's dowry.[92] Women can suffer from domestic abuse or even be killed if they or their birth families refuse to accede to a dowry demand.[93] As such, educating a daughter in a STEM profession that offers a higher salary may be considered as economically advantageous for many families including those from low and middle class backgrounds. An educated daughter can save for dowry expenses whilst also contributing to her family's coffers. The ability to accumulate a higher dowry amount can also mean that a daughter educated in STEM is able to find attractive marriage partners can increase the amount of goods and wealth of her in-law family.

[87] Palriwala, "The Spider's Web", 161.
[88] Srinivasan and Lee, "The Dowry System", 1109.
[89] Borah, "Examining Media Content", 381.
[90] Jehan, "Heroes or Hondas?" 81.
[91] Borah, "Examining Media Content", 382.
[92] "9 Reasons Why Dowries Are Horrible for Women", Global Citizen, accessed July 5, 2021, https://www.globalcitizen.org/en/content/8-reasons-dowries-are-bad-for-women/.
[93] "Crime in India 2019", National Crime Records Bureau, accessed July 2, 2021, https://ncrb.gov.in/en/crime-india-2019-0. See 'Volume-1', 2-6.

Correspondingly, UNESCO contends that more Indian parents are encouraging their daughters into engineering fields because of the belief that they will have better employment prospects.[94] There is also the idea that engineering fields are more welcoming to females than other STEM disciplines such as computer science. The establishment of more respectable institutions such as girls' hostels and women's colleges for women in STEM has also made it possible for more women to be educated.[95] Despite the considerations outlined, there are still a number of barriers that impede on an Indian woman's STEM pathway as illustrated in this chapter. Further sections of this thesis, will determine the extent that Indian government policies and initiatives have made it easier for women to pursue STEM careers.

4.4 Indian Government Policies

Documents such as those produced by the 1959 National Committee on Women's Education as well as the 1970 Education of Women report suggest that the Indian government was made aware of concerns about the lack of Indian female participation in STEM at an early stage. In 1959, the National Committee on Women led by Durgabai Deshmukh published a report for the Ministry of Education that accentuated that Indian women were predominately undertaking subjects that were framed and constructed in a manner that solely focused on their pathway as a wife and mother. In contrast, boys were able to undertake subjects such as agriculture and commerce which provided more vocational pathway opportunities. Deshmukh was critical of the Indian government's Five Year Plans. Five Year Plans were developed by India's Planning Commission and aimed to provide an economical map by which India would achieve basic objectives. Deshmukh reflected that the plans did not make any attempts to bridge the education gaps

[94] UNESCO, "Women Still a Minority".
[95] UNESCO, "Women Still a Minority".

that existed between boys and girls. This was also a flaw identified in state plans. Deshmukh called for the government to implement scholarships for girls to undertake STEM education in commerce, agriculture or engineering fields. [96] Similarly, the 1970 Education of Women report advised the Indian government to increase female participation in science and mathematics subjects. Premlila Thackersey remarked that these STEM disciplines were vital for higher education and moreover, would liberate "women from domestic chores."[97] Despite these concerns, the Indian government did not make many attempts to encourage more girls and women to undertake STEM education or careers with the exception of medical professions. One of the main reasons why the central Indian government under prime ministers' Jawaharlal Nehru, Gulzarilal Nanda, Lal Bahadur Shastri and Indira Gandhi did not heavily push for STEM education policies for women was because Indian state governments had complete legislative authority over education. This was with the exception of technical and higher education institutes deemed of national importance. While the central government under Shastri did call for the Kothari Commission to assess the state of education in India, it was advised that state governments required autonomy to "craft policies suited to their diverse sociocultural contexts."[98] This framing suggests that policies and initiatives for women in STEM may not have been considered a key concern by states if prevailing sociocultural contexts suggested that an Indian's primary role was to be wife and mother. Akshay Mangla also notes that Indian state governments made very modest investments in education. In 1951, Indian states were only spending 0.6% of GDP on education. In 1970, this did increase

[96] "Report of the National Committee on Women's Education May 1958 to January 1959", Ministry of Education: Government of India, DSpace Repository, accessed July 4, 2019, https://dspace.gipe.ac.in/xmlui/handle/10973/47089. PDF available on webpage, 36, 38, 88, 91, 157.
[97] "Education of Women: A Key to Progress", DSpace Repository, accessed July 4, 2019, https://dspace.gipe.ac.in/xmlui/handle/10973/47239. PDF available on webpage, 44.
[98] Akshay Mangla, "Elite Strategies and Incremental Policy Change: The Expansion of Primary Education in India", *Governance* 31, no. 2 (April 2018): 383, https://doi.org/10.1111/gove.12299.

to 2%, however, this was not sufficient.[99] Consequently, this lack of investment in education meant that state governments were not implementing effective or long-term policies and programs for girls and women wishing to pursue STEM education and occupations. This may have attributed to a lack of female engagement in STEM.

Medical professions which as previously explained in an earlier section had been construed as a female area during India's colonial period continued to gain traction through the early 1970s, however. Indian states such as Punjab, Jammu and Kashmir, West Bengal, Rajasthan and Maharashtra saw female participation in medical professions increase.[100] It was not until the mid-1970s and 1980s that the Indian government began to place some interest in women in science and mathematics. This was due to international scrutiny as well as growing concerns from NGOs and activists.[101] It should also be acknowledged that in 1975 Indira Gandhi took steps to reduce the powers of state government that in turn, increased the legislative powers of the central government. Changes to the Indian Constitution under the 42nd Amendment meant state governments were no longer solely responsible for administering education policies.[102] Instead, education was a policy subjected to central and state joint jurisdiction. This change did not automatically create new education policies although, it did enable future central governments to implement more assertive education policies and programs.[103] Additionally, this may have attributed to future higher female participation rates in STEM

[99] Mangla, "Elite Strategies and Incremental Policy Change", 383.
[100] Asok Mitra, Lalit Pathak, and Shekhar Mukherji, *The Status of Women: Shifts in Occupational Participation 1961-71* (New Delhi: Abhinav Publications, 1980), 109.
[101] Saraswati Haider, "National Policy for Women in India 1996: A Critique", *Social Scientist* 25, no. 3/4 (1997): 38, https://doi.org/10.2307/3517642.
Basu, "A Century and a Half's Journey", 195-6.
[102] Mangla, "Elite Strategies and Incremental Policy Change", 384.
[103] Mangla, "Elite Strategies and Incremental Policy Change", 384.

education given that the central government could now advocate for women's participation in science and technology.

The 6th Five Year Plan (1980-85) was one of the first government documents that acknowledged that women's participation in science and technology was a key priority for the state.[104] Policy framing analysis suggests that Indira Gandhi's government may have been keen to increase the participation rates of girls and women in STEM in order to further India's science and development agenda. During Indira Gandhi's time in office, technological and scientific projects such as the launch of India's first satellite, the first national nuclear test and the establishment of the National Informatics Centre occurred.[105] Indian technological companies such as Infosys and TCS were also emerging. It seems likely then, that during this time, there was an interest in encouraging girls and women to undertake STEM given that they could potentially work on projects and in industries of national interest.

Subsequently, under Rajiv Gandhi's government, science and technology as well as education became key priorities. Notably, during his governance, India was in the process of liberalising telecommunications.[106] This meant that commercial enterprises were allowed to create telecom businesses as long as they complied with government regulations.[107] With this new emerging technological and economic landscape, the central government under Rajiv Gandhi formulated the National Policy on Education in 1986. Under the national policy, the government would place more emphasis on ensuring

[104] "6th Five Year Plan", Planning Commission: Government of India, accessed July 5, 2019, https://www.niti.gov.in/planningcommission.gov.in/docs/plans/planrel/fiveyr/index6.html. See 'Chapter 1 to 28' and '27. Women and Development'.
[105] Shivali Tukdeo, *India Goes to School: Education Policy and Cultural Politics* (New Delhi: Springer India, 2019), 85, https://doi.org/10.1007/978-81-322-3957-4_5.
[106] Tukdeo, *India Goes to School*, 85.
[107] "Telecoms Liberalization Guide – Second Edition", International Chamber of Commerce", accessed July 6, 2021, https://iccwbo.org/publication/telecoms-liberalization-guide-second-edition/.

women's participation in vocational, technical and professional education. Moreover, the government would "promote women's participation in non-traditional occupations, as well as in existing and emergent technologies."[108] It should be noted that Rajiv Gandhi and his Ministry of Resource Development did have conflicting ideas about what to prioritise in the 1986 National Policy on Education.[109] This may have had some implications for girls and women in STEM as some policymakers may have chosen to prioritise strengthening basic literacy and numeracy rates before undertaking work on increasing the participation rates of girls and women engaged in STEM. By 1987, the Indian government had committed more funding into primary education and as a result, programs such as Operation Blackboard ensured that every school had classrooms, teachers and instructional materials.[110] However, progress was limited because state governments were responsible for implementing policy changes. The 1988-2000 National Perspective Plan for Women also accentuated the need for better representation in STEM with regards to girls and women from vulnerable communities and those from scheduled castes and tribes.[111] This policy framing suggests that the government may have perceived STEM education as a way to modernise India and also enable women from vulnerable areas to increase their economic standing. A minor number of schemes for women in STEM were introduced, however, these have been sporadic.[112] It is clear then, that this time period saw the Indian government acknowledge that a lack of female representation in STEM was concerning, and that more action was required.

[108] Ministry of Human Resource Development: Government of India, *National Policy on Education – 1986* (New Delhi, May 1986), 6, http://psscive.ac.in/assets/documents/Policy_1986_eng.pdf.
[109] Mangla, "Elite Strategies and Incremental Policy Change", 384.
[110] Mangla, "Elite Strategies and Incremental Policy Change", 385.
[111] "National Perspective Plan For Women 1988-2000 A.D", Internet Archive, accessed July 12, 2019, https://archive.org/details/in.ernet.dli.2015.226927. Information found 74 on constructed document and 90 on slideshow.
[112] "Women Participation in Scientific Research and Development", Government of India: Press Information Bureau, accessed July 11, 2019, http://pib.nic.in/newsite/PrintRelease.aspx?relid=144893.

An analysis of Indian budgets from 1998-1999, 2000-2001 and 2001-2002 demonstrates that the Indian government under Atal Bihari Vajpayee may not have placed much or rather, any emphasis on increasing the participation of women in STEM.[113] Instead, some onus as noted in the 2002-2003 budget is placed on improving the conditions of women.[114] Budget documents from the prescribed period do not provide much insight into programs for women in STEM. However, the 2002-2003 budget reveals that the government under Atal Bihari Vajpayee began to allocate some funding to the Department of Agriculture that briefly mentions the training of women in agriculture.[115] The Department of Biotechnology also establishes a biotechnology based program for females, individuals in scheduled castes and tribes and those from rural communities.[116] The program is, however, focused on training women to undertake entrepreneurial pursuits in areas such as food processing, sericulture, mushroom cultivation and medicinal plant nurseries. Consequently, this program framing demonstrates that the neoliberal idea that women were largely responsible for their own economic independence continued to influence Indian policymakers. The only other initiative described by the department are awards for women.[117] While this is advantageous in increasing the visibility of female scientists, ultimately, only three women were able to benefit from the scheme. The decreased rates of women in STEM employment during

[113] "Previous Union Budgets", Ministry of Finance, accessed July 12 2019, https://www.indiabudget.gov.in/previous_union_budget.php.
[114] Ministry of Finance, *Demand No.68: Department of Science and Technology* (Notes on Demands for Grants, 2001-2002 Budget), 149, https://www.indiabudget.gov.in/budget_archive/ub2001-02/eb/sbe68.pdf.
[115] Ministry of Finance, *Demand No.1: Department of Agriculture and Cooperation* (Notes on Demands for Grants, 2002-2003), 5, https://www.indiabudget.gov.in/budget_archive/ub2002-03/eb/sbe1.pdf.
[116] Ministry of Finance, *Demand No.72: Department of Bio-Technology* (Notes on Demands for Grants, 2002-2003), 164, https://www.indiabudget.gov.in/budget_archive/ub2002-03/eb/sbe72.pdf.
[117] Ministry of Finance, *Demand No. 72,* 163.

this time can therefore, be attributed to few implemented government policies and programs.

The 8th Five Year Plan (1992-97), however, marked a shift in the government's efforts to aid Indian women. Under the governance of the Indian National Congress Party headed by PV Narasimha Rao, newer policies became more focused on women's empowerment rather than their development.[118] In order to understand this shift, Aradhana Sharma illustrates that feminist scholars and non-state actors began to promote a language of empowerment in the 1990s.[119] Influential non-state actors such as the World Bank began to establish the idea that empowering women was the most beneficial and cost efficient strategy in achieving development goals. Empowering women was also cited as a way in which states would economically and socially benefit. For instance, educating women was regarded as beneficial because it led to decreased birth rates which could spark economic growth as more women stayed in the workforce. Thus, the World Bank's President James Wolfensohn took steps to promote the idea that women were central to sustainable development, economic advance and social justice. Empowerment was also seen as a strategy that focused on empowering individuals to be the "producers of their own welfare and bounty, not the recipients of charity or aid."[120] This language of empowerment follows from the neoliberal doctrine that links a transformation of the self with a transformation of society. By providing women with economic empowerment through increased access to land, labour and credit markers women can lift themselves out of poverty and subsequently contribute to economic growth. Notably, this neoliberal idea is also prevalent in Australia where policymakers have contended that women are

[118] Rekha Pande, "The History of Feminism and Doing Gender in India", *Revista Estudos Feminista* 26, no.3 (2018): 11, https://doi.org/10.1590/1806-9584-2018v26n358567.
[119] Aradhana Sharma, *Logics of Empowerment: Development, Gender, and Governance in Neoliberal India* (Minnesota: Minnesota Press, 2008), 18-19).
[120] Sharma, *Logics of Empowerment,* 18-19.

largely responsible for their own economic standing. As such, poverty under neoliberalism is regarded as a symptom of individual failure rather than as a result of unequal political, economic and social forces. Subsequently, this change and framing of language meant that the World Bank, states and other institutions could position themselves as problem solvers focused on empowering rather than as actors who contributed to gendered and unfair policies, programs, practices, norms and policies.[121] The popularisation of empowerment strategies subsequently, had policy implications for women in STEM as it will be explored below. Notably, more policies and programs were centred on empowering Indian women. Few policies were directed at addressing structural, institutional, social, cultural and economic inequalities that impacted Indian women in STEM.

From the 1990s onwards, Indian government reports and documents began to frame policies for women within the context of empowerment. Major initiatives undertaken during the 8th Five Year Plan for women included Rashtriya Mahila Kosh which provided microcredit to poor and asset less women.[122] Its policy framing was heavily influenced by the neoliberal idea that women's empowerment could be fulfilled through entrepreneurship. Providing women with access to funding would enable them to independently lift themselves away from poverty which subsequently, would improve India's economic development.[123] This framing, however, had and continues to have, implications for women in STEM. As will be illustrated further in Chapter Six, neoliberal

[121] Sharma, *Logics of Empowerment,* 17, 19, 21.
[122] "Tenth Five Year Plan 2002-07", Planning Commission: Government of India, accessed July 13, 2019, https://www.niti.gov.in/planningcommission.gov.in/docs/plans/planrel/fiveyr/index6.html. See 'Volume II: Sectoral Policies and Programmes' PDF. Information about Rashtriya Mahila Kosh found 224.
[123] Andrea Cornwall, "Beyond "Empowerment Lite": Women's Empowerment, Neoliberal Development and Global Justice", *Cadernos Pagu*, no. 52 (2018): 3, https://doi.org/10.1590/18094449201800520002.

policies developed under the Modi government significantly neglect to address social, political, economic cultural and familial barriers.

Research and analysis into policies and initiatives created by Modi's government have found that neoliberal ideology has influenced the types of programs that are available to women and particularly, those in STEM. Many of the programs continue to underlie the fact that women are predominately responsible for their economic rise. This is apparent when examining the online marketing platform Mahila E-haat which was developed as a part of the 'Digital India' and 'Stand Up India' initiatives launched by Prime Minister Shri Narendra Modi.[124] The platform that enables Indian female entrepreneurs to showcase and sell products including bags, baskets, clothing, carpets, educational aids, jewellery and natural products.[125] The Minister of Women and Child Development, Maneka Sanjay Gandhi stated that the initiative "can prove to be a game changer since it will provide access to markets to thousands of women who make products and are spread all over the country but have little access to markets."[126] While this is factual to some extent, analysis of the initiative reveals that women are encouraged to sell products or provide services that are typically associated as appropriate work for women. The initiative also puts onus on women to sell their products themselves with the website only providing them with some visibility. In addition, the initiative omits the fact that women with more financial means can lower prices to products and services to a higher extent than women from poorer communities. Thus, while the program attempts to create a fairer market platform for women entrepreneurs, the Mahila E-haat scheme does little to

[124] "Govt Announces Online Ecommerce Platform Mahila E-Haat For Women Entrepreneurs", Inc42, accessed July 20, 2019, https://inc42.com/flash-feed/online-ecommerce-platform-mahila-e-haat.
[125] Inc42, "Govt Announces Online Ecommerce Platform Mahila E-Haat For Women Entrepreneurs".
[126] "Mahila E-Haat An Online Marketing Platform For Women Launched", TechSpirit, accessed July 20, 2019, http://techspirit.in/mahila-e-haat-online-marketing-platform-women-launched/.

address inequalities that can arise from markets which are structured by relations of power. The government under Modi has done little to address these issues.

Ideas arising from Hindu nationalism, which have been prominent under Modi's leadership also have the potential to deter women from STEM and result in poor policymaking According to the Hindu nationalist belief "if women do not perform their cultural role in a proper manner, then the family suffers and then the nation."[127] Henrik Berglund notes that historically, when Hindu nationalist parties attempted to encourage women to participate in civil society, this did not signal a change in gender norms, practices or beliefs.[128] Similarly, this can be perceived to be the case when examining STEM initiatives for women under the Modi government. Applying gender discursive policy framing analysis to initiatives such as the Mahila E-haat platform has indicated that while women have been construed as having a role to play in advancing India's economy, ultimately, their primary responsibility is to their family.[129] This adheres to the Hindu nationalist and patrifocal idea that women are responsible for performing their cultural duties. The emphasis on women's participation in entrepreneurial pursuits suggests that Modi's government is attempting to encourage women to undertake flexible working conditions in order to boost labour participation as well as ensure that their economic activities are compatible with their family responsibilities. Modi's government has merged aspects of Hindu nationalism with neoliberal ideas. Entrepreneurial careers enable women to adhere to Hindu nationalist and patrifocal expectations that reinforce

[127] Syed Hussain Shaheed Soherwordi, "Hindu Nationalism and the Political Role of Hindu Women: Ideology as a Factor", *South Asian Studies* 28, no.1 (2013): 43, http://proxy.library.adelaide.edu.au/login?url=https://www.proquest.com/scholarly-journals/hindu-nationalism-political-role-women-ideology/docview/1369670738/se-2?accountid=8203.
[128] Henrik Berglund, "Hindu Nationalism and Gender in the Indian Civil Society", *International Feminist Journal of Politics* 13, no. 1 (March 2011): 91, https://doi.org/10.1080/14616742.2011.534663.
[129] Thomas Blom Hansen, "Controlled Emancipation: Women and Hindu Nationalism", *The European Journal of Development Research* 6, no. 2 (December 1994): 88, https://doi.org/10.1080/09578819408426614.

their role as dutiful wives and daughters whilst also contributing to the wider economy.[130] Entrepreneurial work is considered as beneficial but secondary to the needs of families, husband and elders.[131] This discussion of entrepreneurialism is different to that of Chapter Six. However, this section provides additional insight into why the Modi government has encouraged women to pursue entrepreneurial ventures. Therefore, an entrepreneurial career is a strategy that enables women to adhere to Hindu nationalist ideology whilst also fulfilling neoliberal principles that see them positioned as market citizens who produce economic growth that in turn, sees them as contributors of nation-building.[132] This ideology and framing has implications for women in STEM who may undertake precarious and unsecure employment in order to adhere to not only patrifocal ideas but Hindu nationalist ones. Chapter Six will also go further in highlighting some of the negative outcomes that may arise from neoliberal policies that encourage women to undertake entrepreneurial careers. Nonetheless, Hindu nationalism combined with patrifocal ideas and neoliberalism has the potential to significantly undermine the chances of women in STEM obtaining secure employment as well as progressing into higher paid STEM positions.

Modi's government has also discursively framed the idea that women's participation in entrepreneurial pursuits will provide their economic independence. This, subsequently, means that the state will also benefit from their economic participation even if there are constraints to the extent that women can participate. In 2018, the government celebrated the fact that the Prime Minister's Employment Generation Programme had helped women

[130] Priya Chacko, "Gender and Authoritarian Populism: Empowerment, Protection, and the Politics of Resentful Aspiration in India", *Critical Asian Studies* 52, no. 2 (April 2020): 219, https://doi.org/10.1080/14672715.2020.1711789.
[131] Susan Seymour, "Family Structure, Marriage, Caste and Class, and Women's Education: Exploring the Linkages in an Indian Town", *Indian Journal of Gender Studies* 2, no. 1 (March 1995): 79-80, https://doi.org/10.1177/097152159500200104.
[132] Chacko, "Gender and Authoritarian Populism", 217.

entrepreneurs set up 30,437 projects from 2016 to 2018.[133] Additionally, Rs. 85,305 lakh had been raised. The section titled 'Women Entrepreneur Platform' will further illustrate the prominence of microcredit loans. Microcredit loans such as the Stree Shakti Package for Women Entrepreneurs have become increasingly prominent.[134] While they do provide some advantages for some women, microcredit loans epitomise the neoliberal focus on the individual while excusing the Indian state from its own policy failures.[135] Yet, Anitia Gurumurthy, Nandini Chami and Sanjana Thomas suggest that Modi's neoliberal developmental narrative which considers skilling women entrepreneurs as a way to national progress omits the fact that women's participation in the economy is also controlled by social and gender norms.[136] While initiatives that encourage women to undertake entrepreneurial opportunities provide an entry point for some women in STEM ultimately, Modi's promise of an IT Indian revolution "may concede some space for women, but only on its own terms, and only for some women."[137] Examining budgets from 2015 to 2017, reveals that Modi's government has increased funding to programs targeted at women in STEM. A vast majority of these initiatives have been established by the Department of Science and Technology. The 2011-2012 Gender Budget headed by Manmohan Singh reveals that the department was instrumental in developing some of the earliest programs for women in STEM.[138] Accordingly, the 2015-2016 budget states

[133] "PMEGP Helps More Than 30,000 Women Entrepreneurs", Government of India: Press Information Bureau, accessed July 11, 2019, https://pib.gov.in/newsite/PrintRelease.aspx?relid=181192.
[134] Shifa Khan, "9 Schemes For Women Entrepreneurs in India", *News18*, September 19, 2017, https://www.news18.com/news/indiwo/work-and-career-9-schemes-for-women-entrepreneurs-in-india-1522125.html.
[135] Kalpana Wilson, "Towards A Radical Re-Appropriation: Gender, Development and Neoliberal Feminism", *Development and Change* 46, no. 4 (2015): 809, https://doi.org/10.1111/dech.12176.
[136] Anita Gurumurthy, Nandini Chami, and Sanjana Thomas, "Unpacking Digital India: A Feminist Commentary on Policy Agendas in the Digital Moment", *Journal of Information Policy* 6 (2016): 371-402, https://doi.org/10.5325/jinfopoli.6.2016.0371.
[137] Gurumurthy, Chami, and Thomas, "Unpacking Digital India", 391.
[138] Ministry of Finance, *Expenditure Budget Vol.1, 2011-2012: Gender Budget* (Part A – 100% Women Specific Programmes), 68-79, https://www.indiabudget.gov.in/budget2011-2012/ub2011-12/eb/stat20.pdf.

that Modi's government allocated 53.00 (in crore) to the Department of Science and Technology women's centric programs.[139] The Department of Biotechnology which established programs for women was provided 5.00. Notably, this is an increase from 2016-2017.[140] Similarly to other budgets, the government also awarded funding to programs that were available to all Indians. However, 30% of places were allocated for women. In assessing the gender budget from 2016-2017, the Indian government under Modi allocated a higher amount of funding to the Department of Science and Technology. The department received 60.00 (in crore) from the Indian government.[141] Other programs from differing government agencies had the provision that 30% of participants are females. A notable addition is that the Department of Biotechnology featured a program for women that was allocated 4.00.[142] This can be considered a small amount of funding and notably, this program was not funded in 2019. Therefore, from 2015 onwards the Modi government began to increase the amount of funding allocated to programs and initiatives established by the Department of Science and Technology.

In recent years, the Indian government has continued attempts to increase the participation rates of women in STEM. Modi's government provided steady funding for the Department of Science and Technology's programs and initiatives for women in STEM as noted in the 2019-2020 Indian Gender Budget.[143] The 2017-2018 funding allocation to the department was at 74.95 (in crores) and, subsequent budget estimates through 2018 to 2019 have listed funding at 75.00 (in crores).[144] This can be considered

[139] Ministry of Finance, *Expenditure Budget Vol.1, 2015-2016: Gender Budget* (Part A – 100% Women Specific Programmes), 89, https://www.indiabudget.gov.in/budget2015-2016/ub2015-16/eb/stat20.pdf.
[140] Ministry of Finance, *Expenditure Budget Vol.1, 2015-2016,* 89.
[141] Ministry of Finance, *Expenditure Budget Vol.1, 2016-2017: Gender Budget* (Part A – 100% Women Specific Programmes), 100, https://www.indiabudget.gov.in/budget2016-2017/ub2016-17/eb/stat20.pdf.
[142] Ministry of Finance, *Expenditure Budget Vol.1, 2016-2017,* 100.
[143]Ministry of Finance, *Expenditure Profile 2019-2020: Gender Budget*, 131, https://www.indiabudget.gov.in/budget2019-20(I)/ub2019-20/eb/stat13.pdf.
[144]Ministry of Finance, *Expenditure Profile 2019-2020*, 131.

a substantial amount and suggests that the Indian government wishes to increase the amount of women in STEM. However, the Department of Science and Technology is the only government agency which has programs directly targeted at women in STEM. Moreover, the programs did not appear to be heavily advertised by the Minister of Finance, Nirmala Sitharaman. Sitharaman instead promoted programs targeted at increasing the rates of female entrepreneurs.[145] Other projects such as the Department of Higher Education's M Tech Programme Teaching Assistantship and the Ministry of Earth Sciences' Research, Education and Training Outreach initiative have the provision that women occupy 30% of the allocated spaces.[146] The 2019 Gender Budget features a substantial list on programs that include this provision.[147] Yet, while this provision is beneficial, it is unknown how many women are successful in obtaining entry into these programs. The programs may not feature additional resources to address challenges that are specific to women in STEM such as flexible schedules or caretaking responsibilities. As such, it is challenging to determine the extent that women are able to pursue STEM education and careers through the programs. Subsequent sections of this chapter will apply gendered discursive policy framing analysis to examine whether the policies, programs and initiatives for women in STEM adequately deal with barriers identified by the wider literature.

4.5 Indian Government Policies, Initiatives and Programs for Women in STEM

This thesis will now examine key Indian government policies, initiatives and programs designed for increasing the participation rates of Indian girls and women in STEM. Many

[145] Ministry of Finance, *Budget 2019-2020 Speech of Nirmala Sitharaman* (July 5, 2019), 18, https://www.indiabudget.gov.in/doc/bspeech/bs201920.pdf.
[146] Ministry of Finance, *Expenditure Profile 2019-2020*, 132.
[147] See Ministry of Finance, *Expenditure Profile 2019-2020*, 132-141.

of the policies and indicatives examined were active as of February 2022 with most being implemented under the political leadership of the Bharatiya Janata Party (BJP) headed by Prime Minister Narendra Modi. While some of the explored initiatives are not directly aimed at women in STEM, they have the potential to significantly impact the number of women who choose to pursue STEM education and careers. An example is the Working Women Hostels scheme which funds the development or expansion of hostels for women.[148] The scheme provides all women including, those in STEM with the means to find suitable accommodation when they are required to travel to conferences or for work. Other initiatives such as the Scheme of National Overseas Scholarships for Scheduled Tribe Candidates from 2017-18 to 2019-20 provide provisions for individuals seeking to undertake STEM graduate degrees.[149] While women from scheduled tribes can apply, the initiative is not exclusive to them. As such, it is important to note that schemes not directly relevant to working women in STEM still have the potential to address their issues. Moreover, as previously stated, the thesis will not provide a detailed discussion on India's educational policies and curriculum. However, it should be acknowledged that the 2023-24 national Indian government budget has invested more funding to the vocational education and skills sector with the Ministry of Skills Development and Entrepreneurship allocated INR 35.2 billion which is an 85% increase on the previous budget's revised estimate.[150] A further point to note is that in 2019, the Modi government stated its plans to increase female participation in STEM disciplines such as IT by streamlining and fast-tracking patents by women innovators. While this has the potential to be abused by start-

[148] "Working Women Hostel", Ministry of Women & Child Development, accessed July, 14, 2019, https://wcd.nic.in/schemes/working-women-hostel. See 'About the Scheme' PDF, 2.
[149] Government of India: Ministry of Tribal Affairs, *The Scheme of National Overseas Scholarships For Scheduled Tribe Candidates From 2017-18 To 2019-20,* 7-8, https://tribal.nic.in/DivisionsFiles/Education/RevisedGuidelinesNOSST1718.pdf.
[150] Sandeepa Sahay, "India's National Education Budget for 2023-24", *British Council*, 16 February 2023, https://opportunities-insight.britishcouncil.org/blog/india%E2%80%99s-national-education-budget-2023-24.

ups who may hire women solely for this purpose, the policy does suggest that the government is still examining ways to aid women in STEM and increase their workplace participation. Fast-tracking patents may mean that women innovators face fewer financial repercussions and can progress further in their start-ups.[151] A further consideration is that some policies and programs for Indian women are not prominently advertised on government mediums. For instance, information about the Department of Biotechnology's Career Advancement & Re-Orientation Program (BioCARe) and Janaki-Ammal National Women Bioscientist Award are limited to a single webpage whilst program outcomes lack detailed insight.[152] This chapter will now further examine policy flaws while assessing the main policies and initiatives that aim to increase the participation rates of girls and women in STEM.

4.5.1 The Equal Remuneration Act (1976)

This thesis is examining the Equal Remuneration Act (1976) within the context of working women in STEM because Indian women in STEM have a higher pay gap than their male counterparts.[153] The Equal Remuneration Act is the only legislation that provides a legal mechanism by which women in STEM can contest inequitable

---

[151] *The Economic Times*, "Faster Patents for Women, Small Business", *The Economic Times*, December 26, 2018, https://economictimes.indiatimes.com/small-biz/sme-sector/faster-patents-for-women-small-business/articleshow/67252078.cms.
The Economic Times, "120 Startups Get Patents Under Expedited Examination Process: DPIIT Secy", *The Economic Times*, April 26, 2019, https://economictimes.indiatimes.com/small-biz/startups/newsbuzz/120-startups-get-patents-under-expedited-examination-process-dpiit-secy/articleshow/69057960.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst.

[152] "Biotechnology Career Advancement & Re-Orientation Programme (BioCARe)", Department of Biotechnology: Ministry of Science & Technology, accessed November 25, 2021, https://dbtindia.gov.in/schemes-programmes/special-programmes/biotechnology-career-advancement-re-orientation-programme.
"Janaki Ammal- National Women Bioscientist Award", Department of Biotechnology: Ministry of Science & Technology, accessed November 25, 2021, https://dbtindia.gov.in/schemes-programmes/building-capacities/awards/national-women-bio-scientist-awards.

[153] Prerna Sindwani, "India Tops the World in Producing Female Graduates in STEM But Ranks 19th in Employing Them", *Business Insider India*, February 28, 2020, https://www.businessinsider.in/careers/news/india-tops-the-world-in-producing-female-graduates-in-stem-but-ranks-19th-in-employing-them/articleshow/74117413.cms.

conditions. According to article 4, the act ensures that there is equal remuneration between men and women employees for the same work or work of a similar nature.[154] Article 5 also provides legal protections for men and women while employers are recruiting them.[155] Mediratta cites the Equal Remuneration Act as India's first step in recognising women's economic value as well as their potential to contribute to the wider Indian economy.[156]

While India's Equal Remuneration Act does provide women in STEM with some means of addressing unequal pay disparities, there are a number of problematic flaws. The process by which women contest pay disparities is incredibly cumbersome and complex. Sonal Nerurkar illustrates that the act is dependent on the affected individual reporting on discriminatory acts.[157] This can be considerably risky because the employee can be identified. The company may then choose to penalise or dismiss the complainant. There can also be significant financial and social repercussions. Businesses can choose to omit information relating to pay disparities and also choose not to identity when a female is performing work of a similar nature to their male counterpart.[158] It is also difficult to evaluate whether discrimination occurs at the recruitment stage because there may be insufficient evidence or a lack of a definitive paper trail.

These issues are in turn, compounded because of a severe lack of resources committed to detecting pay discrimination. The lack of commitment to increasing resources suggests

[154] "Equal Remuneration Acts and Rules, 1976", Government of India: Ministry of Labour & Employment, accessed July 28, 2019, https://labour.gov.in/womenlabour/equal-remuneration-acts-and-rules-1976. See PDF titled 'Equal Remuneration Act', 3.
[155] Ministry of Labour & Employment, "Equal Remuneration Acts and Rules, 1976", 4.
[156] Surinder Mediratta, *Handbook of Law, Women, and Employment: Policies, Issues, Legislation and Case Law* (New Delhi: Oxford University Press, 2009), 41.
[157] Sonal Nerurkar, "Building a Case for Equal Pay", *Mint,* September 2, 2021, https://www.livemint.com/news/business-of-life/building-a-case-for-equal-pay-1541869869183.html
[158] Mediratta, *Handbook of Law, Women, and Employment*, 47.

that the government is influenced by neoliberal ideology. Neoliberal ideology maintains that governments should not heavily regulate or interfere in the economic labour market. Suresh Srivastava suggests that labour inspectors are often tasked with enforcing and implementing a large number of acts.[159] As a result, this means that legislation relating to women is often considered to be a low priority. Aditi Kavarana affirms this noting that labour inspectors are responsible for enforcing 30 labour laws in India.[160] This can be considered an exhausting duty particularly, as many must inspect the conditions of factories, inspect payment documents and follow up on various complaints and violations submitted by Indian workers. An additional factor compounding this issue is that in some states there are limited numbers of labour inspectors. For instance, the then-Assistant Labour Commissioner in Delhi, Mr Arya explained that there are only 60 inspectors in Delhi.[161] As such, inspectors choose to prioritise certain labour laws such as the Minimum Wages Act, Sexual Harassment of Women at the Workplace Act, Factories Act and Employees State Insurance Act over the Equal Remuneration Act.[162] Mr Arya summarises the issue thusly, "how can we give importance [to] cases where women are paid less than men, if they are both being paid wages above the declared minimum wage level [?]."[163] A lack of sufficient government resources then, has the potential to severely undermine women in STEM who wish to report instances of gendered pay inequalities especially, when there is an uncompliant employer or there is a lack of evidence.

An additional challenge and one that compounds the issue of challenging unfair pay disparities is that India does not have a national minimum wage. The International Labour

[159] Suresh Srivastava, "Equal Remuneration For Men and Women", *Journal of the Indian Law Institute* 32, no.1 (January 1990): 86, https://www.jstor.org/stable/43951301.
[160] Aditi Kavarana, "Equal Remuneration Act", *Centre for Civil Society*, July 20, 2013, https://ccs.in/equal-remuneration-act.
[161] Kavarana, "Equal Remuneration For Men and Women".
[162] Kavarana, "Equal Remuneration For Men and Women".
[163] Kavarana, "Equal Remuneration For Men and Women".

Organisation considers India to have one of the most complicated systems of minimum wage. The central government has 45 categories while the state governments have 1709 categories with regards to minimum wages.[164] Due to the fact that state governments are responsible for setting the minimum wage, there is no consistency. This means that the minimum wage for identical positions can vary and is dependent on where employees live. In some cases, there are sectors that do not have a reported minimum wage. Attempts to improve legislation and to develop a minimum wage framework have been limited. In 2021, Modi's government proclaimed that it would create a committee to suggest recommendations on the minimum wage.[165] However, the committee only has a tenure of three years. This limits its effectiveness and moreover, suggests that the government under Modi is not entirely committed to maintaining a clear and efficient minimum wage framework. Therefore, future generations of Indian women in STEM may be deterred from pursuing unfair pay practices given the challenges faced by previous generations.

A lack of consensus surrounding the minimum wage may also be attributed to the fact that the Indian government adopted a pro-business strategy which initially developed in the 1980s under Indira Gandhi. Gandhi's policies in the 1980s moved away from redistribution and began to shift to a pro-business phase. Similarly, Rajiv Gandhi also adopted pro-business strategies. One of the sectors to benefit from such policies, and moreover one that demonstrates that the Indian government was pursuing a pro-business stance, was IT. India's computer and technology industry benefited from reduced regulations and were provided with supportive government assistance through much of

[164] International Labour Organization, *India Wage Report: Wage Policies for Decent Work and Inclusive Growth,* (Office for India, 2018), 77, 81, 84, 88, https://www.ilo.org/wcmsp5/groups/public/---asia/---ro-bangkok/---sro-new_delhi/documents/publication/wcms_638305.pdf.
[165] K.R Shyam Sundar, "India's Expert Committee on Minimum Wages – A Questionable Exercise?" *The Wire*, June 5, 2021, https://thewire.in/labour/indias-expert-committee-on-minimum-wages-a-questionable-exercise.

the 1980s and 1990s. The government may not have committed much assistance to aiding women in STEM given that they were keen to establish closer relations with IT businesses. Governments after Rajiv Gandhi have also sought to adopt a pro-business stance and have subsequently, sought to "tame labour."[166] Thus, challenging unfair and gendered practices may have undermined their attempts to garner a closer relationship. This has affected the process mechanisms by which women in STEM can dispute instances of pay inequalities in the current day. Previous Indian governments as well as Modi's government can be regarded as reluctant to challenge labour laws given that they wish to maintain their close ties with private businesses. It is clear then, that the factors discussed above have contributed to fewer reports of wage discrimination which subsequently, has meant that India's gender pay gap has not been adequately addressed as a possible key issue of concern for women in STEM.

In his work, Mediratta cites the case *A.N. Rajamma v. State of Kerala.* The High Court Judge noted that case law regarding the discrimination of women is scarce. Yet, he clarified that this did not indicate that discriminatory acts are not occurring but rather, that "women were reluctant to come up to the courts to vindicate their rights."[167] This has presented difficulties for future generations of women particularly, those in areas of STEM who wish to challenge unfair pay disparities. Available statistics found that between 1982 and 1986, there were only 834 prosecutions and 305 convictions with regards to cases related to violations of the Equal Remuneration Act.[168] Current statistics on the numbers of women who have sought help from the Ministry of Labour and Employment is hindered by the fact that annual reports do not distinguish grievances

[166] Atul Kohli, "State, Business, and Economic Growth in India", *Studies in Comparative International Development* 42 (2007): 107-108, https://doi.org/10.1007/s12116-007-9001-9.
[167] Mediratta, *Handbook of Law, Women, and Employment,* 58.
[168] Srivastava, "Equal Remuneration For Men and Women", 86.

relating to wage discrimination.[169] Consequently, this has the potential to impact policy development as issues relating to wage discrimination and women in STEM have not been addressed because they are not recognised due to a lack of information and statistical data. Scholar Flavia Agnes contends that "if people don't come with cases of wage discrimination, reports of widening wage gap will continue to surface."[170] However, the above analysis proves that contesting unfair payments is a complex process that can have significant consequences for working women in STEM.

4.5.2 The Maternity Benefit Act (1961)

The Maternity Benefit Act (1961) can be considered as one of the key pieces of policy that aims to promote the social and economic wellbeing of women in the workplace. While the policy is not solely designed for women in STEM, the act enables women in STEM to apply for maternity benefits and also provides additional provisions that are beneficial to working women and particularly, those in STEM industries. This will be explored further below. The Maternity Benefit Act ensures that women's employment is legally protected while they are away on maternity leave. [171] According to the Maternity Benefit Act, women are entitled to a maximum of 12 weeks maternity leave.[172] Women are also able to claim a medical bonus of 250 rupees if their employer does not provide

[169] Ministry of Labour & Employment: Government of India, *Annual Report 2017-18,* 33, https://labour.gov.in/sites/default/files/ANNUAL_REPORT_2017-18-ENGLISH.pdf.
[170] *Business Standard*, "Equal Pay for Equal Work Still a Distant Dream for Indian Women (March 8 Is International Women's Day)", *Business Standard,* March 8, 2018, https://www.business-standard.com/article/news-ians/equal-pay-for-equal-work-still-a-distant-dream-for-indian-women-march-8-is-international-women-s-day-118030800572_1.html.
[171] International Labour Organization, *The Maternity Benefit Act, 1961,* 8-9.
[172] International Labour Organization, *The Maternity Benefit Act, 1961: Act No. 53 of 1961* (December 12, 1961), 5, https://www.ilo.org/dyn/travail/docs/678/maternitybenefitsact1961.pdf.

pre-natal confinement and post-natal care free of charge.[173] The Maternity Benefit Act also ensures that women are able to have nursing breaks following their return to work.[174]

However, there are significant policy flaws with regards to India's Maternity Benefit Act which have the potential to severely impact women's participation in STEM employment. For instance, an employer can dismiss a female employee for "any prescribed gross misconduct."[175] This would release the employer from fulfilling their legal obligations. BBC journalist, Divya Arya uncovered that between 2008 and 2012, more than 900 complaints about the rejection of maternity benefits had been lodged in India's labour courts.[176] While women can appeal to an authority department, it is not known whether there are economic repercussions to the appeal process. However, in one instance of illegal termination, it took three years before a woman was able to claim her job position back with her back wages.[177] In such cases, it is clear why some women choose not to challenge illegal terminations given that the court process is lengthy and can lead to financial strain.

A further point of contention is that not all women are legally protected by the Maternity Benefit Act. Indian women must have worked in their workplace for a minimum period of 80 days.[178] This raises concerns for women in STEM especially, those working on short-term projects and are on a contract basis. Women working in India's informal economy in positions such as street vendors, domestic workers and agricultural workers are also not legally protected by the act. This is due to the fact that the informal economy

[173] International Labour Organization, *The Maternity Benefit Act, 1961,* 7.
[174] International Labour Organization, *The Maternity Benefit Act, 1961,* 8.
[175] International Labour Organization, *The Maternity Benefit Act, 1961,* 8-9.
[176] Divya Arya, "Why Motherhood Makes Women Quit Their Jobs", *BBC News,* April 23, 2015, https://www.bbc.com/news/world-asia-india-32377275.
[177] Arya, "Why Motherhood Makes Women Quit Their Jobs".
[178] International Labour Organization, *The Maternity Benefit Act, 1961,* 5.

or grey economy is not within the purview of India's labour laws.[179] As such, many women in the informal economy have no legal means to combat labour discrimination, pay inequalities and unsafe working conditions.[180] This issue is also compounded by the fact that more than 80% of South Asian women in non-agricultural employment are in informal employment.[181] It is clear then, that a vast majority of Indian women are unable to claim the legal entitlements expressed in the Maternity Benefit Act. This policy flaw has the potential to severely impact young Indian women who belong to low socio-economic communities. For instance, these women may find it harder to pursue STEM education because of unfair working environments that not only condone pervasive pay inequalities but also stop them from balancing their familial responsibilities with other commitments such as undertaking STEM studies.

Challenges surrounding India's maternity leave scheme also raise the issue of India's welfare regime. In her work, Louise Tillin illustrates that the central Indian government does not commit much expenditure on social sectors.[182] Indian state governments are also held responsible for developing and maintaining social security including maternity benefits. However, states can differ in how they approach social welfare schemes. They are prone to advocate for policies that are popular with particular groups within their borders.[183] This has implications for women in STEM. Women residing in certain states may find it easier to access schemes like maternity leave. This may persuade them to

[179] "Women in the Changing World of Work: Facts You Should Know", UN Women, accessed May 2, 2019, https://interactive.unwomen.org/multimedia/infographic/changingworldofwork/en/index.html. See 'Informal Work'.
[180] For more knowledge on the issues faced by women in the informal economy, see Elizabeth Hill, *Worker Identity, Agency and Economic Development: Women's Empowerment in the Indian Informal Economy* (Oxon: Routledge, 2010), 58-72.
[181] "Women in Informal Economy", UN Women, accessed May 2, 2019, http://www.unwomen.org/en/news/in-focus/csw61/women-in-informal-economy.
[182] Louise Tillin, "Does India Have Subnational Welfare Regimes? The Role of State Governments in Shaping Social Policy", *Territory, Politics, Governance* (June 2021): 1, https://doi.org/10.1080/21622671.2021.1928541.
[183] Tillin, "Does India Have Subnational Welfare Regimes?" 2, 7.

continue in their STEM careers. In contrast, others may find that their state does not place much emphasis on enforcing their right to maternity leave. Consequently, they may be deterred from challenging unfair and gendered practices that occur in STEM industries. It is likely that they choose to leave their STEM profession.

As illustrated by the United Nations Research Institute for Social Development (UNRISD), the liberalisation of the Indian economy has also seen the Indian government gradually move away from providing welfare schemes.[184] Instead, it has advocated for the private sector to implement and take responsibility for providing social services. Notably, government employees are one of the few that benefit from effective and fair maternity leave schemes.[185] In contrast, female employees from private businesses are often forced to contend with unfair and gendered practices with little state assistance. An additional factor to consider and one that has been explored above, is that labour laws are not heavily enforced. This is due to a lack of resources and human personal such as labour inspectors. UNRISD suggests that the government's reluctance to increase enforcement has an underlying reason. Namely, UNRISD believes that ensuring compliance of existing laws such as those than guarantee the right of maternity leave are perceived to be a hindrance to economic growth.[186] Going further, it is believed that imposing heavily on private businesses via checking their compliance to labour laws has the potential of undermining the state and market relationship. It is also perceived as undermining the government's attempts to maintain a pro-business stance that prioritises economic

[184] Rajni Palriwala and N Neetha, *India Research Report 3-The Care Diamond: State Social Policy and the Market* (February 2009), UNRISD, 4, https://www.unrisd.org/80256B3C005BCCF9/(httpAuxPages)/4177D0C917369239C1257566002EA0C7/$file/IndiaRR3.pdf.
[185] Palriwala and Neetha, *India Research Report 3,* 14.
[186] Palriwala and Neetha, *India Research Report 3,* 16.

growth. As such, India's welfare regime comes at the detriment of social welfare schemes and subsequently, women in STEM.

4.5.3 Amendment 2017

In 2017, the Indian government chose to include additional provisions to the Maternity Benefit Act of 1961. The Maternity Benefit (Amendment) Act of 2017 increases the maternity benefit from 12 to 26 weeks for working women with less than 2 surviving children.[187] The act also ensures that there are provisions for nursing mothers who wish to work from home. This inclusion may reflect the fact that the Indian government is examining alternative ways that women can contribute to their workplace and thus, participate in the wider Indian economy. The addition of the provision also suggests that the Indian government has acknowledged some of the challenges that working women face. This provision has the potential to aid women in STEM because it provides them with a means to work whilst fulfilling their familial responsibilities. A further notable amendment to the act is a mandatory provision that ensures that businesses with more than 50 employees have a crèche in their workplace.[188] As noted in Chapter Two, a significant barrier for women in STEM is the inability to balance familial and work responsibilities. As such, this amendment provision does address that barrier and may provide women in STEM with the means to advance higher in their STEM career. The establishment of a crèche means that women in STEM could access and attend training and leadership courses while their children are looked after. The decision to amend the Maternity Act arose mainly out of the recommendations from the 44th, 45th and 46th Session of Indian Labour Conference.[189] The amendments have received some praise.

[187] Ministry of Labour & Employment: Government of India, *Subject: The Maternity Benefit (Amendment) Act, 2017* (August 28, 2017), 2, https://labour.gov.in/sites/default/files/Advisory.pdf.
[188] Ministry of Labour & Employment, *Subject: The Maternity Benefit*, 2.
[189] Ministry of Labour & Employment, *Subject: The Maternity Benefit*, 2.

Legal groups such as Indian law firm, Nishith Desai and Pillsbury Law have deemed India to be ahead of most developed countries including Australia, France, Japan and the US with regards to maternity benefits for women.[190] India's Prime Minister, Narendra Modi claimed the amendment is "a landmark moment in (India's) efforts towards women-led development."[191]

Despite the advantages of the amendments, a vast number of scholars and agency groups have voiced their concerns about the 2017 amendments. Nyshka Chandran suggests that only 1.8 million women will benefit from the new amendments.[192] This is a low figure considering that India has a population of an estimated 645,221,566 females.[193] This low statistic can be attributed to the fact that Indian women's participation in the economy is mostly limited to informal work.[194] While India's Labour Minister, Bandaru Dattatreya has claimed that the central government will attempt to aid women in the informal sector, as of 2021, the government has not clearly outlined the extent that informal employees will be able to benefit from the act or its amendments.[195]

---

[190] Nyshka Chandran, "India Becomes a Leader in Maternity Leave at Its Own Expense", *CNBC,* April 6, 2017, https://www.cnbc.com/2017/03/30/india-maternity-leave-increase.html.
Sajai Singh, Lakshmi Ramachandran and Craig A de Ridder, "Indian Maternity Benefit (Amendment) Act, 2017", *Pillsbury,* February 22, 2018, https://www.pillsburylaw.com/en/news-and-insights/indian-maternity-benefit-amendment-act-2017.html.
[191] "PM Lauds Passage of Maternity Benefit Amendment Bill in Lok Sabha", Press Information Bureau: Government of India, accessed July 28, 2019, http://pib.nic.in/newsite/PrintRelease.aspx?relid=159057.
[192] Chandran, "India Becomes a Leader in Maternity Leave at Its Own Expense".
Sajai Singh, Lakshmi Ramachandran and Craig A de Ridder, "Indian Maternity Benefit (Amendment) Act, 2017", *Pillsbury,* February 22, 2018, https://www.pillsburylaw.com/en/news-and-insights/indian-maternity-benefit-amendment-act-2017.html.
[193] "Population, Female – India", The World Bank, accessed July 29, 2019, https://data.worldbank.org/indicator/SP.POP.TOTL.FE.IN?end=2017&locations=IN&start=1960&view=chart.
[194] UN Women, "Women in Informal Economy".
[195] *DNA India,* "'Women's Day Gift': Parliament Passes Bill to Raise Maternity Leave to 26 Weeks", *DNA India,* March 9, 2017, https://www.dnaindia.com/india/report-par-passes-bill-to-raise-maternity-leave-to-26-weeks-2347889.

One of the most prominent concerns is the fact that India's Maternity Benefit Act and its amendments emphasise that the employer or business is solely responsible for the costs associated with the longer maternity benefit amount as well as the creation of crèches.[196] As illustrated above, this is in line with the Indian government's aim of shifting the responsibilities of social welfare schemes to businesses and also reflects neoliberal ideology.[197] This enables the government under Modi to offset the cost associated with providing the scheme. Rituparna Chakraborty and Manish Sabharwal illustrate that while large businesses will be able to offset the costs, ultimately, micro, small, and medium start-ups and enterprises may find it harder to afford the expenditures.[198] This has the potential to impact women's participation in STEM workplaces because there have been substantial increases in the number of start-ups in India. Notably, many of them utilise STEM knowledge and technology such as artificial intelligence and virtual reality.[199] In a recent survey, approximately 35% of Indian respondents believed that the new changes would have a negative impact on their business with regards to costs and profitability.[200] Moreover, 26% of respondents confessed that they would prioritise male applicants over female ones. While an estimated 40% of respondents maintained that they would recruit women, they also explained that they would need to consider whether the female candidates would be worth the extra costs.[201] Consequently, working women in STEM may face pay higher level inequalities as companies compensate for the higher costs

[196] *Times of India,* "Government Must Review Maternity Act", *Times of India,* June 26, 2018, https://timesofindia.indiatimes.com/blogs/toi-editorials/government-must-review-maternity-act/.
[197] Palriwala and Neetha, *India Research Report 3,* 4.
[198] Rituparna Chakraborty and Manish Sabharwal, "Maternity Benefit Act: The New Amendments Might Cause Some Pangs in the Short Run", *The Economic Times,* July 1, 2018, https://economictimes.indiatimes.com/news/politics-and-nation/maternity-benefit-act-the-new-amendments-might-cause-some-pangs-in-the-short-run/articleshow/64809703.cms.
[199] Meha Agarwal, "Startup Watchlist: Top Indian Edtech Startups To Look Out For In 2019", *Inc42,* February 18, 2019, https://inc42.com/features/startup-watchlist-top-indian-edtech-startups-to-look-out-for-in-2019.
[200] Claire Zillman, "India's Extraordinary New Maternity Leave Could Work Against Women", *Fortune,* March 31, 2017, http://fortune.com/2017/03/30/us-maternity-leave-india-downside/.
[201] Zillman, "India's Extraordinary New Maternity Leave".

associated with the obligations of the Maternity Act.[202] This suggests that female applicants would need to fulfil a higher criteria than their male counterparts. As such, it is evident that the costs associated with the longer maternity benefit period as well as the maintaining of crèches have the unintended potential to severely undermine women's participation in the workforce and particularly, in STEM industries where there is a higher presence of start-up businesses.

Research has also uncovered the extent to which policymakers are influenced by gendered beliefs, practices and norms, and have framed India's Maternity Benefit Act and its amendment bill to reflect this. The Maternity Benefit Act and its amendment do not consider fathers to be major caregivers of children. Instead, women remain the sole primary caregiver of children. As remarked upon by the Indian National Commission for Women, the Maternity Benefit Act "does not make an adequate effort in the struggle towards a gender-balanced approach to care-giving and unpaid domestic work."[203] Notably, the Indian Commission for Women produced a report in 2014 that analysed the effects of the Maternity Benefit Act. The commission acknowledged that paternity leave should be included into the Maternity Benefit Act as its omission neglects the fact that fathers are also responsible for nurturing children and supporting wives.[204] The recommendation that paternity benefits be included into legislation and policy was not addressed and omitted by policymakers in the 2017 amendments bill. This demonstrates that the policy framing of this act still identifies the mother as the sole caregiver of children. This is especially evident given that India's Labour Minister, Bandaru

[202] Chandran, "India Becomes a Leader in Maternity Leave".
[203] Centre for Social Research, *Analysis on Effectiveness of the Implementation of the Maternity Benefit Act, 1961* (Supported by National Commission for Women: Govt. of India, May 2014, New Delhi), 42, http://ncw.nic.in/sites/default/files/NCWMaternityBenefitStudy.pdf.
[204] Centre for Social Research, *Analysis on Effectiveness of the Implementation of the Maternity Benefit Act,* 42.

Dattatreya stated that the progressive amendments "would have a 'positive impact' on women's participation and 'improve their work-life balance'."[205] This statement does omit the participation of men in domestic work.

As such, policy changes including the provision of crèches provide some advantages to women in STEM. However, the costs associated with the creation and maintaining of crèches may severely undermine female participation in STEM companies particularly, small businesses and start-ups. In addition, the omission of paternal leave indicates that Indian policy makers are influenced by social and cultural norms that instil the idea that appropriate work for women is solely based in the home. The section below will now analyse Indian programs and schemes that aim to increase women's participation in STEM education and careers.

4.5.4 Knowledge Involvement in Research Advancement through Nurturing

Knowledge Involvement in Research Advancement through Nurturing (KIRAN) was developed in 2014 when the Department of Science & Technology collated all women specific programs to scheme. Previously, the Department of Science and Technology had made some attempts to develop initiatives exclusively for women in STEM. However, as illustrated by the department, these attempts were sporadic and resulted in a lack of women participating in mainstream science. As a result, the department began to initiate more programs for women. These initiatives were listed as under the Disha Programme for Women in Science. However, by 2014, analysis into the challenges women in STEM faced urged the department to restructure the programs and list them under KIRAN.[206] KIRAN is aimed at addressing issues faced by women scientists and providing

[205] DNA India, "'Women's Day Gift'".
[206] Press Information Bureau: Government of India, "Women Participation in Scientific Research and Development".

opportunities in research, entrepreneurship, science and communication and technology development. As such, programs developed by the Department of Science and address KIRAN's aims are listed as part of the overarching scheme. Notably, KIRAN is largely focused on providing support to women scientists and as such, is limited in its ability to support women employed in private STEM companies or industries. This chapter will now examine the programs under the KIRAN scheme and identify the key policy flaws.

4.5.5 Women Scientists Scheme (WOS)

Established during 2002-2003, the Women Scientists Scheme (WOS) is an initiative headed by the Indian Department of Science and Technology. The WOS was developed because of the growing realisation that women were being left out of science and technology projects due to challenges arising from familial responsibilities. In many instances, Indian women would take a break from science and technology fields due to motherhood and caretaking duties. As such, the WOS aims to address this issue by providing fellowships and research grants to women wishing to return to the science and technology workforce. The WOS has three fellowship categories for Indian women scientists. WOS-A is aimed at women wishing to pursue research in basic or applied sciences. WOS-B focuses on projects that can provide societal benefit. WOS-C aims to trains women with qualifications in areas including science, engineering or medicine in intellectual property rights (IPRs). Unemployed women from the ages of 27 to 57 are eligible to apply for scheme. However, there is an age relaxation of 5 years for women who belong to a scheduled caste (SC), scheduled tribe (ST), and other backward class

(OBC) groups. In addition, women with physical disabilities can apply for an age relaxation.[207]

Using a gendered discursive policy framing analysis approach, this thesis argues that the Women Scientist Schemes (WOS-A, WOS-B and WOS-C) can be considered as beneficial because they provide women returning from a career break with an entry back into STEM employment. The schemes address an identified flaw, that is, women in STEM face barriers when they attempt to re-enter the workplace. The WOS also accommodates younger women wishing to enter STEM industries and older experienced women seeking to return to STEM research-based careers. The program also provides economic relief to women undertaking the schemes. For instance, PhD holders are given Rs.55,000 a month while some master's degree holders are awarded with Rs.40,000 a month.[208] These varying amounts can help women in STEM offset the costs associated with childcare or domestic expenses on a long-term basis. A further advantage is that the program has been able to aid more women interested in STEM careers. The Department of Science and Technology estimates that more than 2100 women scientists have been able to return to their scientific career paths through the WOS-A, WOS-B and WOS-C programs.[209] Similarly, the Women in Science and Technology in Asia report uncovered that the WOS have generated a high level of interest from females in STEM. The report found that in the first three years of WOS-A, 3160 proposals were received with 425 sanctioned.[210] This also demonstrates that the WOS have a high level of visibility. The

[207] "Women Scientists Programs", Department of Science and Technology, accessed July 11, 2019, http://www.dst.gov.in/scientific-programmes/scientific-engineering-research/women-scientists-programs.
[208] Department of Science and Technology, "Women Scientists Programs".
[209] "KIRAN Scheme of DST Lights Up S&T Paths of Thousands of Women Scientists", Department of Science and Technology, accessed December 31, 2021, https://dst.gov.in/pressrelease/kiran-scheme-dst-lights-st-paths-thousands-women-scientists.
[210] The Association of Academies and Societies of Sciences in Asia, *Women in Science and Technology in Asia*, (The Korean Academy of Science and Technology, 2015), 78, https://nassl.org/wp-content/uploads/2016/01/AASSA_Report_Women_in_S_T_in_Asia.pdf.

scheme has also been successful in getting continued funding from the Indian government under Modi. The 2019 Indian budget has continued the scheme in the hope that in 2019-2020, 600 women in STEM will benefit from WOS-A, 120 from WOS-B and 100 from WOS-C.[211]

A large flaw with the WOS lies in the fact that information about the outcomes of the program is cited differently in government documents and reports. For instance, the Department of Science and Technology cites that during 2016-2017, 262 projects were awarded WOS-A fellowships.[212] Yet, examining a document published by the Indian government estimates the number of projects in the 2016-2017 period as over 300.[213] In contrast, a report from the Association of Academies and Societies of Sciences in Asia (AASSA) mentions that 425 projects were sanctioned by the department.[214] These differing statistics may have the potential to impact policy development for women in STEM given that there is no clear evidence on the amount of women who have benefited from the schemes. It also means that the department is unable to determine if there have been increases or decreases in the interest rate as well as success rate of applications.

Additionally, there is a significant lack of information relating to the number of women from SC, ST or OBC backgrounds. This can be considered a significant oversight because it may mean that the program is not effectively aiding women in STEM from

[211] "Union Budget 2019-2020", Ministry of Finance: Government of India, accessed December 31, 2021, https://www.indiabudget.gov.in/budget2019-20/outcomebudget.php. See 'Output Outcome Framework for Schemes 2018-2019' PDF, 213-214.
[212] Department of Science and Technology, *List of Projects Under Women Scientists Scheme-A (WOS-A) During 2016-17*, accessed December 31, 2021, http://dst.gov.in/sites/default/files/WOS-A%20Projects%202016-17.pdf.
[213] India International Science Festival, *DST's Initiatives for Women Scientists & Technologists*, (Department of Science and Technology, 2017), 10, https://scienceindiafest.org/wp-content/uploads/2018/05/Dr.VandanaSingh-DST-WSE.pdf.
[214] The Association of Academies and Societies of Sciences in Asia, *Women in Science and Technology in Asia*, 78.

disadvantaged communities. This can also result in future generations of women from disadvantaged communities choosing not to pursue STEM, particularly, as they see the generations before them fail. There is also little insight into whether the fellowships equally aid women from differing age groups. Moreover, it is unknown as to the extent that successful applicants are able to pursue other STEM opportunities following the completion of the WOS-A and WOS-B fellowships. Notably, the 2017-2018 Annual Report from the Department of Science and Technology does estimate that 50% of WOS-C beneficiaries have been able to find employment.[215] The employment rate for women participants in WOS-A and WOS-B schemes is unknown. The report does not identify any policy flaws with the WOS-A, WOS-B and WOS-C programs. As such, it is clear that inconstant statistical information regarding the number of applicants awarded projects and fellowships as well as the severe lack of accessible data relating to the background of successful applicants can limit the extent to which India's policy evidence base on women in STEM is accurate. This in turn, has the potential to impact policy development for women in STEM particularly, those from vulnerable communities and castes.

4.5.6 Mobility Scheme

Listed under the KIRAN program, the Mobility Scheme aims to aid women scientists when they experience challenges associated with relocation.[216] Women will be awarded a consolidated amount of salary per month as well as a research grant of Rs.5.00 lac yearly to undertake a project of their expertise.[217] The scheme arose out of the identified

[215] "Annual Report 2017-18 (New)", Department of Science and Technology, accessed December 31, 2021, https://dst.gov.in/document/annual-reports/annual-report-2017-18-new. PDF available on webpage, 7.
[216] Department of Science and Technology, "Women Scientists Programs".
[217] Ministry of Science and Technology: Department of Science and Technology, *Mobility Scheme (Addressing Relocation Issue of Women Scientists)*, 2, http://dst.gov.in/sites/default/files/ADVERTISEMENT-Mobility.pdf.

challenge that women scientists were often forced to relocate. Many were also forced to leave their positions following marriage, or due to their husbands' moving to another position.[218] Others moved to attend to elderly family members or to accompany their children to colleges and universities. These findings align with Subrahmanyan's work that illustrates that some Indian women are expected to move if their husband's receive work in another city.[219] The Department of Science and Technology states that only women working in a permanent position at a government institution, research and development lab or university are eligible to apply for the mobility scheme.[220] Women must either have resigned from their permanent position or take a long leave to receive the mobility scheme. In addition, the women are expected to return to their original position following completion of the scheme.

Analysing the Mobility Scheme has uncovered that it provides women in STEM with a means to continue to maintain their research skills and moreover, enables them to conduct research into an area of their choice. Women may also be able to benefit from developing new networks in their new location particularly, if their work enables them to utilise university spaces and laboratories. In addition, the scheme provides them with long-term financial stability for a period of five years. As such, it is clear that the scheme does address some concerns expressed by women in STEM as well those examined in this chapter. It should also be acknowledged that the Mobility Scheme does seek to counter challenges that arise from families that adhere to patrifocal ideology. Women are provided with an entry back into their profession and moreover, are encouraged to return to their STEM career.

[218] Department of Science and Technology, "Women Scientists Programs".
[219] Subrahmanyan "Women Scientists", 150.
[220] Ministry of Science and Technology: Department of Science and Technology, *Mobility Scheme,* 1.

Further analysis has revealed that the Mobility Scheme does not challenge or contest the social expectation that women should resign from their positions following marriage, when their husbands relocate or to look after children and elderly family members. Instead, the scheme is to a certain extent, discursively framed in a manner which reinforces a woman's social and cultural obligations to her husband, familial relatives and children. This suggests that this scheme is influenced by patrifocal ideology that reinforces that a woman's main responsibility is to their home. According to the eligibility criteria, women who undertake the program are expected to return to their primary work position. This is somewhat problematic for women who are forced to resign as their workplace may choose not to rehire them. Their workplace may also instead, offer them part-time alternatives or work on a contractual basis. Subsequently, women would be unable to reach higher positions and may face financial repercussions due to their changing work hours. Furthermore, the application documentation reveals that female applicants do need to have listed ten publications as well as any patents.[221] This suggests that women still establishing their STEM careers may be omitted from the scheme. Notably, research was unable to uncover how many women benefit from the scheme and whether women in their early stages of their career have been successful in receiving funding from the scheme. As a result, it is evident that this lack of information means the policy may not be aiding women from all stages of their STEM career.

4.5.7 Indo-US Fellowship for Women in STEMM

A notable feature under the KIRAN program is the Indo-US Fellowship for Women in STEMM that enables women in STEMM (medicine included) to undertake international

[221] Department of Science and Technology, *Mobility Award*, 1-2, http://www.dst.gov.in/sites/default/files/Application%20Format-Mobility.pdf.

collaborative research in the US.[222] The Indo-US Fellowship for Women in STEMM comprises of two schemes. The first is the Women Overseas Student Internship. The Department of Science and Technology explains that the program enables Indian women to gain international exposure as well as encourage and motivate them to continue research in STEM. The second scheme under the Indo-US Fellowship for Women in STEM program is the Women Overseas Fellowship. The fellowship enables successful females to undertake a fellowship in the US for three to six months. Indian women who are successful in obtaining a Women Overseas Student Internship or Women Overseas Fellowship are also granted with a monthly stipend, return airfare, health insurance, contingency and conference allowances.[223]

One of the advantages of the Indo-US Fellowship is that Indian women in STEM can gain a career advantage by demonstrating that they have international experience. By encompassing two schemes, the Indo-US Fellowship is targeted at early female STEM researchers as well as older experienced researchers. The fellowship also enables Indian women to develop networks and contacts from the US. This is also beneficial for older women in STEM. For instance, researchers may be able to form collaborative relationships with other academics in the US. The provision of financial aid in the form of a monthly stipend as well as airfare and conference funding mean that women from vulnerable communities and castes are able to offset some expenses associated with the fellowship.

[222] Department of Science and Technology, "Women Scientists Programs".
[223] Indo-US Science and Technology Forum, *The Indo-U.S. Fellowship for Women in Science, Technology, Engineering, Mathematics and Medicine (WISTEMM) Program 2018 Call Awards* (Department of Science and Technology), https://iusstf.org/assets/sitesfile/image/download_links/pdf/pdf_1795169527.pdf.

However, the Indo-US Fellowship does have some limitations. One of the biggest concerns is that few Indian women could be benefiting from the scheme. For instance, the 2019 Indian budget only provides funding for 20 women to take part in the fellowship.[224] An Indian government document reveals that during 2018, only 20 women were successful in obtaining the Women Overseas Student Internship and Women Overseas Fellowship Module.[225] Similarly to other schemes under the KIRAN initiative, the Indo-US Fellowship does not provide any data or information on the success rate of Indian women from vulnerable communities and castes. It is also unknown as to whether the successful applicants progress to a STEM career. These findings suggest that the scheme is highly competitive and is therefore, limited in scope. Consequently, the Indo-US Fellowship is not influencing a large number of Indian women to undertake or continue their STEM careers.

4.5.8 The Vigyan Jyoti Scheme

Announced in the 2017 budget, the Vigyan Jyoti scheme is a program that aims to encourage school girls and particularly, those from rural communities to pursue careers in STEM. [226] Through the program, girls from year 9, 10 and 11 and selected on a merit basis, meet with women scientists and representatives from STEM institutions such as the Indian Institute of Science Education.[227] An announcement by IIT Bhubaneswar suggests that the female applicants are also provided with trips to planetariums, science

[224] Ministry of Finance: Government of India, "Union Budget 2019-2020". See 'Output Outcome Framework for Schemes 2018-2019' PDF, 213.
[225] Indo-US Science and Technology Forum, *The Indo-U.S. Fellowship for Women in Science, Technology, Engineering, Mathematics and Medicine (WISTEMM) Program 2018 Call Awards.*
[226] T.V Padma, "A Year Since Launch of Govt Scheme to Get Girls Into Science, What's Happened?" *The Wire,* September 5, 2018, https://thewire.in/the-sciences/a-year-since-launch-of-govt-scheme-for-women-in-science-what-has-happened.
"DST Support Empowering Women Scientists", Department of Science and Technology, accessed July 14, 2019, https://dst.gov.in/dst-support-empowering-women-scientists.
[227] Padma, "A Year Since Launch of Govt Scheme".

labs, research centres and historic sites.[228] Girls are also able to interact with NASA scientists and Indian army personnel.[229] Selected girls are required to stay in the chosen residential hostel of the respective institution. The program's duration is a minimum of two weeks with approximately 30 girls selected. Successful female applicants are provided with one stipend of Rs.5000 and are fully financially supported with regards to travel, boarding and lodging.[230] Information obtained from T.V Padma reveals that most girls who undertook the program were enthusiastic about a STEM career.[231]

However, the duration of the program raises questions over whether it can effectively counter years of social, cultural and familial influences. Moreover, only 30 girls are selected for the program. This indicates the program is limited in scope and means that only girls who meet a certain merit criterion are able to benefit from the program. This suggests a level of competitiveness that has implications for girls who are unconfident or unsure about their ability to succeed in STEM education and careers. In addition, it is unknown as to whether girls from rural communities are informed on the types of initiatives and programs that can aid them or provide them financial support to achieve a career in STEM. Correspondingly Padma notes that the Vigyan Jyoti framework does not challenge or work to improve the "hostile working conditions of women in science" and consequently, "risks becoming superficial."[232] This issue is compounded because it is difficult to determine the effectiveness of the program due to the fact that the Department of Science and Technology has not released any public data. Information on the Vigyan

[228] Department of Science and Technology, *Vigyan Jyoti: An Initiation to Promote Interest in Science and Technology Amongst Girl Students* (June 4-24, 2018), 2, https://www.iitbbs.ac.in/documents/VJ_PR.pdf.
[229]"Vigyan Jyoti Encourages Science Uptake Among Rural Girls", Department of Science and Technology, accessed July 14, 2019, http://www.dst.gov.in/news/vigyan-jyoti-encourages-science-uptake-among-rural-girls.
[230] "About Vigyan Jyoti", Indian Institute of Technology Guwahati, accessed July 14, 2019, https://www.iitg.ac.in/vigyanjyoti/.
[231] Padma, "A Year Since Launch of Govt Scheme"
[232] Padma, "A Year Since Launch of Govt Scheme".

Jyoti website has not been updated.[233] However, information from the Department of Science and Technology suggests that the program is expected to continue into 2021-22 with a planned expansion to 50 Jawahar Navodaya Vidyalayas (JNV). JNV refers to a system of central schools predominately in rural areas.[234] Nonetheless, issues around how information is shared remains a concern given that it can undermine how and when Indian girls can participate in the program.

4.5.9 Recent Developments (2019-2021)

From 2019 to 2021, the Indian government has implemented further initiatives for Indian girls and women in STEM. However, this thesis is unable to assess these recent schemes further due to a lack of publicly available information. In 2020, the Indian Department of Science and Technology announced that it would develop and pilot a Gender Advancement for Transforming Institutions (GATI) framework. Working with UK Athena SWAN (Scientific Women's Academic Network), GATI would be a self-assessment and accreditation model that ensures that signed participants are providing equal participation to Indian women in STEMM.[235] The Science and Technology Minister Harsh Vardhan also launched the Science and Engineering Research Board – Promoting Opportunities for Women in Exploratory Research (SERB-POWER) schemes

[233] Department of Science and Technology, *Vigyan Jyoti: An Initiation to Promote Interest in Science and Technology Amongst Girl Students*, 1-2.
[234] "Vigyan Jyoti, Programme Spreads to 100 Districts in 2nd Phase Initiated on International Day of Women & Girls in Science", Ministry of Science and Technology, accessed November 25, 2021, https://dst.gov.in/vigyan-jyoti-programme-spreads-100-districts-2nd-phase-initiated-international-day-women-girls.
[235] Department of Science and Technology, *Call for Expression of Interest to Participate in the Pilot of GATI,* (Gender Advancement for Transforming Institutions (GATI), KIRAN Division), 1, https://dst.gov.in/sites/default/files/Gati%20detailed%20advertisement_0.pdf.

in 2020.[236] The SERB-POWER schemes comprise of a fellowship and research grants.[237] The Indian government has not provided information on how many women will be able to benefit from the scheme nor has it indicated whether there will be additional measures to assist women from disadvantaged backgrounds. In 2021, the Indian government also created a one-time Women Excellence Award under the SERB scheme in celebration of the International Day of Women and Girls in Science.[238]

The Indian government has also expanded on an older initiative for women in STEM. In 2008-09, the Indian Department of Science and Technology created the Consolidation of University Research for Innovation & Excellence in Women Universities (CURIE). The CURIE scheme sought improve R&D infrastructure and enhance research facilities in women universities. In 2019, women universities under the CURIE scheme were provided with artificial intelligence labs. The labs would expose women students to Artificial Intelligence technology whilst also preparing them for employment in the Artificial Intelligence sector. In 2020, the Department of Science and Technology announced that CURIE had been extended to almost 9 Indian women universities.[239] The department also believed that CURIE had resulted in more enrolments and increases in journal publications. However, a lack of publicly available data makes it challenging to validate this statement.

---

[236] *The Economic Times,* "DST Launches Schemes for Women Scientists, Researchers in Science and Engineering", *The Economic Times,* October 29, 2020, https://economictimes.indiatimes.com/news/science/dst-launches-schemes-for-women-scientists-researchers-in-science-and-engineering/articleshow/78931290.cms?from=mdr.

[237] "SERB POWER", Science and Engineering Research Board, accessed October 21, 2021, http://serb.gov.in/serb_power.php.

[238] "SERB Announces Women Excellence Award 2021 on the International Day of Women and Girls in Science", Department of Science and Technology, accessed October 21, 2021, https://dst.gov.in/serb-announces-women-excellence-award-2021-international-day-women-and-girls-science.

[239] "CURIE Initiative of DST Enhancing Research Facilities in Women Universities", Department of Science and Technology, accessed October 21, 2021, https://dst.gov.in/pressrelease/curie-initiative-dst-enhancing-research-facilities-women-universities.

4.6 Conclusion

Drawing from the work of Indian scholars and researchers, this chapter has explored challenges arising from a patrifocal ideological framing which can undermine a woman's ability to pursue a STEM education and career. The chapter has analysed policy discourse such as press releases, reports, websites and government material to examine how governments' preceding Modi's have placed much onus on improving the general well-being of women rather than examining the benefits associated with increasing women's engagement in STEM. An additional factor is that Indian governments from both persuasions have been, and continue to be, influenced by a neoliberal ideological framing that discursively constructs women as largely individually responsible for their own economic empowerment. The popularisation of entrepreneurial ventures as well as the prominence of microcredit schemes have been constructed and discursively framed to fit within this ideology.

Nonetheless, programs such as those under the KIRAN scheme demonstrate that the Modi government is committed to tackling barriers that prevent women from pursing and/or maintaining a STEM education and career. However, flaws within policies and initiatives indicate that the Indian government is still influenced by social, cultural and economic framing influences that maintain the ideology that the government should not overly intervene in the economic market and that a woman's primary focus should be on her husband, children and family. These influences can have policy framing implications for women in STEM and result in government policies failing to address many of the barriers to women's participation in STEM that were identified in Chapter Two. For instance, the Maternity Benefit Act makes it clear that the workplace is solely responsible for the costs associated with the operation and maintenance of the crèche. Another policy

flaw identified in this chapter is around the lack of publicly available evidence-bases. Analysing the Vigyan Jyoti scheme revealed that a lack of an evidence base cannot sufficiently inform policymakers as to whether the program, does in fact, succeed in increasing the participation rates of girls in STEM. A lack of an evaluating mechanism also means that policymakers are unable to determine flaws in programs and may develop short-term projects that do not adequately deal with all the challenges faced by women in STEM. The Conclusion of this thesis will summarise the findings made in this chapter. It will be argued that policies and programs for women in STEM under the Modi government continue to be influenced by neoliberal and patrifocal ideology that influences policy framing. Chapter Five will now examine Singaporean policies, programs and initiatives for women in STEM.

Chapter 5: Singapore

5.1 Introduction

As explained in Chapter One, one of the reasons this thesis has chosen Singapore as a feminist comparative policy case study is because it seeks to highlight how the government has implemented policies and initiatives that have the potential to significantly increase the participation rates of women in STEM. Additionally, using a feminist comparative policy approach coupled with a gendered discursive policy framing analysis approach will enable the thesis to address the key questions outlined in Chapter One. This chapter argues that the Singaporean government under Lee Hsien Loong has established a number of worthwhile policies and programs for women in STEM. However, the Singaporean government's policy framing of women's participation in STEM has been influenced by historical, political, and cultural factors that have impacted on the effectiveness of policies and programs. For instance, further sections of this chapter will highlight how historically STEM knowledge has been considered as instrumental in developing Singapore as an economic powerhouse. During this time, the PAP government's meritocratic and gender-blind approach enabled more girls to undertake STEM education. However, this chapter will highlight how a gender-blind and meritocratic approach has disadvantaged women wishing to pursue or advance in STEM careers. While the Singaporean government has been influenced by neoliberalism, it has also been prepared to take on more interventionist policy positions and approaches. Analysing policy discourse such as political statements, press releases and government material will enable the chapter to illustrate how the PAP under the governance of Lee Kuan Yew, Goh Chok Tong and Lee Hsien Loong has historically been contradictory in its approach to tackling participation rates of Singaporean girls' women in STEM. The

chapter will then illustrate how one of the biggest challenges for women in STEM is the Singaporean government's shifting ideas and discursive framing surrounding the role of women. The government wishes for women to conform to traditional roles particularly, because the state has one of the lowest fertility rates in the world. At the same time, women are also regarded as significant contributors to the Singaporean economy.[1] These dual expectations have policy implications for Singaporean girls and women in STEM. Notably, this chapter will examine government approaches from the Lee Kuan Yew, Goh Chok Tong and Lee Hsien Loong governments. Singapore has a dominant one-party system.[2] Since being elected to govern in 1959, the PAP has successfully won every subsequent election.[3] The PAP is considered to be one of the world's longest surviving dominant parties.[4] As such, this thesis will only explore policies and programs from PAP governments.

5.2 The Historical Presence of Singaporean Women in STEM

This chapter will briefly examine the historical presence of Singaporean women in STEM in order to demonstrate the extent to which STEM was construed as an appropriate area of study and employment for them. Notably, the Singapore Nation is comprised of four main ethnic groups. These include Chinese, Malay, Indian and other.[5] Other can refer to

---

[1] *The Economist*, "Baby Strike", *The Economist*, May 25, 2019, https://www.proquest.com/docview/2229868174/abstract/252CC517BBE24C6CPQ/1?parentSessionId=R68TZEcgqnV5gOoxS9pPkYR1j98DTSq4YH1efYqiDJA%3D&accountid=8203.
Afifah Drarke, "Number of Babies Born in Singapore Falls to Lowest In 8 Years", *Channel News Asia*, July 2019, https://www.channelnewsasia.com/singapore/number-babies-born-singapore-falls-lowest-8-years-873201.

[2] Diane K Mauzy and Robert Stephen Milne, *Singapore Politics Under the People's Action Party* (London: Routledge, 2002), 38.

[3] Mauzy and Milne, *Singapore Politics*, 38.
Oliver Holmes, "Singapore's Ruling Party Batters Opposition in Huge Election Win", *The Guardian*, September 11, 2015, https://www.theguardian.com/world/2015/sep/11/singapore-election-early-count-shows-ruling-party-in-strong-position.

[4] Mauzy and Milne, *Singapore Politics*, 38.

[5] "Faces of Singapore", Singapore Tourism Board, accessed November 24, 2021, https://www.visitsingapore.com/en_au/travel-guide-tips/about-singapore/people-of-singapore/.

individuals from a Eurasian community, Peranakan culture or western background. As such, the experiences of Singaporean women vary depending on the cultural, ethnic and social community they belong to. A section of this chapter will examine whether the Singaporean government and organisations have sufficiently explored challenges faced by Singaporean women from differing ethnic groups.

It is important to note that historical information regarding Singaporean women's participation in STEM is limited. Nevertheless, Singapore's leading women's rights and gender equality group, AWARE and academics such as Kho Ee Moi and Karen Teoh have analysed the ways in which STEM was historically constructed as a viable area of study for women. This section and subsequent parts of this chapter will examine the extent that the Singaporean government has been contradictory in its advocacy of roles for women. This section will also illustrate how historically, women did derive some benefits from the government's decision to implement gender-blind and meritocratic policies, despite it being problematic as future sections will explore. It will also be demonstrated that the PAP government has historically prioritised women's education and employment when it was regarded as necessary and vital to economic development and advancement. In other instances, the PAP government has implemented policies that emphasise the importance of women becoming mothers and fulfilling their social and cultural responsibilities. Such discursive framing can be attributed to Singapore's low birth rate which has been an issue for decades and continues into the present day.

Prior to Singapore's self-governance and the pre-war period, most women were not educated with many being financially dependent on their male relatives.[6] Going further, Kho Ee Moi contends that Singapore's "largely migrant community had brought with it

[6] Moi, "Construction of Femininity", 36.

and preserved a cultural package of polygamy and (a) preference for sons."[7] Social and cultural ideology instilled the idea that education was of no benefit to daughters given that their primary responsibilities were to marry and produce children. Under British colonial rule, the introduction of girls' schools did provide some young women with the means to receive an education. However, it was conservative despite the British belief that the introduction of girls' schools in Singapore was a "manifestation of social progressiveness."[8] Girls' schools were primarily run by church organisations and government affiliated individuals and groups. These male-dominated actors continued to maintain patriarchal beliefs, attitudes, norms and practices that maintain that a home and family were a woman's foremost priorities.[9] Singaporean women wishing to pursue employment were limited to socially appropriate professions. This included teaching and nursing which were the type of roles that similarly schools in Britain were training women in. Stephanie Spencer found that British schools favoured nursing and teaching courses.[10] Such roles were identified as suitable for women because they required intrinsic caring qualities which were perceived as feminine and could be integrated with family responsibilities.[11] As such, the British schooling system affected Singaporean women who were also limited to professions that aligned with their domestic and familial responsibilities. The pre-war period did allow Singaporean women to work given that their wages were essential in providing basic necessities to their families.[12] Women could

[7] Moi, "Construction of Femininity", 36.
[8] Karen M. Teoh, *Schooling Diaspora: Women, Education, and the Overseas Chinese in British Malaya and Singapore, 1850s-1960s* (Oxford Scholarship Online, 2018), 14, https://www-oxfordscholarship-com.proxy.library.adelaide.edu.au/view/10.1093/oso/9780190495619.001.0001/oso-9780190495619-chapter-7.
[9] Teoh, *Schooling Diaspora*, 1-2.
[10] Stephanie Spencer, *Gender, Work and Education in Britain in the 1950s* (Houndmills: Palgrave Macmillan, 2005), 93.
[11] Spencer, *Gender, Work and Education*, 101.
[12] Audrey Chin and Constance Singam, "At Work", in *Singapore Women Re-Presented* (Singapore: Landmark Books, 2004), 172.

be employed as domestic workers, rubber workers, seamstresses, nurses and teachers.[13] Industries including food, tourism and rubber also featured female employees. Yet, other than teaching and nursing professions, most women did not engage in STEM education nor were they employed in other STEM careers.

Following Singapore's transition into a self-governed state in 1959, the PAP began to show support for women's rights. This was politically and economically motivated. Kho Ee Moi cites factors including the automatic registration of voters, the introduction of compulsory voting and the 1957 citizenship ordinance greatly enlarged the electorate.[14] Women now comprised half of the electorate and consequently, their political support was regarded as critical for the 1959 Singaporean Legislative Assembly elections for a self-governing state. Women's organisations and particularly, the Singapore Council of Women were also instrumental in persuading the PAP to create and adopt legislation that would aid women. One of the council's primary goals was to criminalise polygamy and ensure that legislative measures would be enacted in order to protect the civil rights of women in Singapore.[15] An additional motivation was that the PAP were keen to undertake industrialisation and they realised that women would be needed to make up Singapore's labour force.[16] As a result, the PAP did promise to make legislative changes for women if it was successful in the 1959 elections.[17] This had, and continues to have, significant implications for women.

---

[13] Chin and Singam, "At Work", 174-178.
[14] Kho Ee Moi, "Economic Pragmatism and the "Schooling" of Girls in Singapore", *HSSE Online: Research and Practice in Humanities & Social Studies Education* 4, no. 2 (2015): 64, https://hsseonline.nie.edu.sg/sites/default/files/uploaded/journal_articles/khoem.pdf.
[15] Phyllis Ghim Lian Chew, "The Singapore Council of Women and the Women's Movement", *Journal of Southeast Asian Studies* 25, no. 1 (1994): 114.
Jean Lee, Kathleen Campbell and Audrey Chia, *The 3 Paradoxes: Working Women in Singapore* (Singapore: Association of Women for Action and Research, 1999), 38.
[16] AWARE, "Education".
[17] AWARE, "Education".

Subsequently, after the 1959 elections, the government headed by PAP leader by Lee Kuan Yew began to focus heavily on education. The PAP perceived that educating Singaporeans was key to developing Singapore's economy and maintaining social cohesion and this discursive framing had a major policy influence.[18] The PAP government made provisions which ensured that all children from the ages of six and regardless of race, language, sex, wealth or status were offered the opportunity to be educated. During the early 1960s, the Ministry of Education (MOE) emphasised STEM subjects such as math and science. The ministry also adopted a gender-blind approach.[19] This had implications for girls in STEM who were heavily encouraged to pursue STEM and technical subjects in order to participate in the economy. However, girls were not provided with other resources or specialised courses to prepare them for their education or for courses in STEM. In addition, the Ministry of Education did not seek to address social, cultural and familial challenges that were faced by girls and women.[20] In spite of these limitations, Singapore's adoption of a gender-blind discursive framing approach had some advantages for women wishing to pursue STEM. STEM was not heavily regarded as being a masculine area of study or employment. While patriarchal ideology continued to influence women's roles, Singaporean policymakers were more motivated in educating and creating a skilled workforce. Combined with this was the fact that Singapore did not have natural resources and needed to increase the skills of its workforce in order to further its economic standing.[21] A skilled workforce would mean that Singapore could take greater steps in achieving economic prosperity. An additional consideration to note is that Singapore had at the time a relatively low population rate.

[18] AWARE, "Education".
[19] AWARE, "Education".
[20] AWARE, "Education".
[21] Jon Quah, "Singapore: Towards a National Identity", *Southeast Asian Affairs* (1977): 209-210, https://www-jstor-org.proxy.library.adelaide.edu.au/stable/27908317?seq=1#metadata_info_tab_contents.

Statistics from 1957 show that Singapore only had a population of 1,445,929.[22] In 1967, this increased to 1,955,600.[23] However, this was still a relatively low population and policymakers may have been significantly influenced by the belief that all citizens needed to play a role in national development. As Andrea Dugo remarks, economicism "became synonymous with survivalism. For Singapore to survive, all societal efforts needed to be directed towards fostering economic growth".[24] As will be noted below, this reflects the fact that Singapore was influenced by a neoliberal discursive framing agenda but one that allowed a more interventionist role to achieve economic growth. As a result, girls and women were encouraged to undertake education including STEM courses in order to become a part of Singapore's labour force and were not significantly impacted by gendered government policies at this time. This is best illustrated in a 1968 speech in which the Minister for Law and National Development E.W Barker emphasised that girls must "work as hard as the boys, and become not just good housewives but economic assets as well."[25] This particular discursive framing highlights that the government was heavily influenced by economic and political influences, however, it is clear that girls were expected to not forgo being 'good housewives'. The 1968 curriculum made it compulsory for all boys and 50% of girls to undertake technical subjects.[26] Yet, domestic science continued to remain a compulsory subject for all girls.[27] Girls who enrolled in technical subjects were not subjected to domestic science examinations but were nonetheless, required to attend the classes. It is clear then, that the Singaporean government was contradictory in the way it appropriated roles for Singaporean women.

[22] Saw Swee-Hock, "Population Trends in Singapore, 1819-1967", *Journal of Southeast Asian History* 10, no. 1 (1969): 39, https://www-jstor-org.proxy.library.adelaide.edu.au/stable/20067730?sid=primo.
[23] Swee-Hock "Population Trends in Singapore", 39.
[24] Andrea Dugo, "Neoliberal Singapore: Nation-State and Global City" in *Singapore's First Year of COVID-19*, ed. Kenneth Paul Tan (Singapore: Palgrave Macmillan, 2022), 27-28.
[25] Moi, "Economic Pragmatism", 66.
[26] Moi, "Economic Pragmatism", 66-67.
[27] Moi, "Economic Pragmatism", 68.

On one hand, women were expected to raise families and on the other, they had economic value and a STEM education would enable them to "contribute towards sustaining national development."[28] In times where the government required women to fulfil both requirements, Singaporean women were expected to combine their domestic responsibilities with paid work and continue working after childbirth. Work from the Lee Kuan Yew School of Public Policy revealed that the government introduced foreign domestic workers to Singapore to ensure that Singaporean women could continue to work in high-growth industries such as textiles and electronics.[29] Foreign domestic workers from countries such as the Philippines, Burma, India, Thailand, Sri Lanka, Bangladesh and Indonesia were perceived to be capable of relieving the amount of domestic labour undertaken by Singaporean women.[30] This demonstrates that the PAP government advocated for policies that supported Singaporean women to undertake STEM education or employment when it perceived that there was a clear economic motive to do so.

The early 1970s saw some social and political change for women. At this stage, the PAP government had introduced the Stop At Two policy that aimed to stop families from having more than two children due to an increasing population. [31] The government began to suggest that boys and girls were of equal value to families.[32] The government and particularly, the Ministry of Education also suggested that the educational policy granting girls the same access to education meant that they too could contribute to their family's finances. Changes to the curriculum also made it possible for girls to choose between

[28] Moi, "Economic Pragmatism", 66.
[29] "Foreign Domestic Workers in Singapore: Social and Historical Perspectives", The Lee Kuan Yew School of Public Policy, accessed November 8, 2019, 4, https://lkyspp.nus.edu.sg/docs/default-source/case-studies/fdws_in_singapore.pdf?sfvrsn=2ac5960b_2.
[30] The Lee Kuan Yew School of Public Policy, "Foreign Domestic Workers in Singapore", 4.
[31] AWARE, "Education".
[32] AWARE, "Education".

undertaking technical subjects or home economics.[33] The government may have also perceived that educating girls in STEM would help mitigate labour shortages.[34] Policymakers worked under the belief that all citizens irrespective of gender were necessary to Singapore's economic development and this has influenced the discursive framing of policies that place Singapore's economic standing as the foremost priority. Women were thus, encouraged to study and work. These factors can be considered as very beneficial to girls and young women wishing to pursue STEM. The government's promotion of the belief that educating daughters in STEM was advantageous to their families may have changed cultural conditions surrounding what could be constituted as an appropriate area of study and employment for women. AWARE notes that the 1970s saw greater numbers of women joining the workforce.[35] Correspondingly, by 1980, 51% of girls were enrolled in secondary and pre-university schools.[36] In comparison, approximately 39% of girls were enrolled in secondary and pre-university schools in 1960.[37] Thus, Singapore's education policy did contribute to higher levels of female participation in STEM. However, government campaigns to increase female participation in the workforce, cultural and societal norms, beliefs and practices continued to instil the belief that women were responsible for the home. This continues to the current day as further sections of this chapter will illustrate. In many instances, these prevalent beliefs did impact the extent that Singaporean women could advance in their STEM careers.

By the latter half of the 1970s, Singapore's crude birth rate had started to significantly decline. The latter half of the 1970s and the early parts of the 1980s saw the crude birth

[33] Moi, "Economic Pragmatism", 66-67.
[34] AWARE, "Education".
[35] AWARE, "Education".
[36] AWARE, "Education".
[37] AWARE, "Education".

rate drop below 20.0.[38] The Singaporean government under Lee Kuan Yew at this time, chose to re-prioritise maternal roles for women given that they wanted to ensure Singapore's workforce would be maintained in the years ahead. Notably, the 1980 population census had also revealed an "increasing trend of singlehood among graduate women."[39] Thus, in 1979, the Singaporean government under Lee Kuan Yew restricted the number of female medical students.[40] Females would only make up a third of total intake. This quota restriction continued until 2003, however, research institutions such as the National University of Singapore did ignore the restriction when there was a lack of male candidates in 1999 and 2001.[41] The Singaporean government defended the quota restriction by explaining that the attrition rate for women doctors was at 15% to 20%. Subsequently, the PAP government believed that training women's doctors was a loss of investment given that their familial duties would prevent them from fully engaging in the profession.[42] The amount of time required to train doctors may have also played a contributing factor as women training to become doctors may have decided to delay or forgo having children. The government may have perceived this as undermining its attempts to increase the fertility rate. This change in discursive policy framing now

[38] "Births and Fertility: Visualising Data", Department of Statistics Singapore, accessed August 5, 2021, http://www.singstat.gov.sg/find-data/search-by-theme/population/births-and-fertility/visualising-data. See 'Crude Birth Rate PDF.

[39] Kelvin Seah Kah Cheng, "Commentary: Government Matchmaking Programmes Need a Rethink to Get Singles to Mingle", *Channel News Asia*, October 28, 2018, https://www.channelnewsasia.com/commentary/sdu-singles-singapore-dating-total-fertility-rate-marriage-791931.

[40] Luh Luh Lan and Jean Lee, "Force-field Analysis on Policies Affecting Working Women in Singapore", *Journal of Management Development* 16, no. 1 (1 February 1997): 46, https://doi.org/10.1108/02621719710155472.

[41] Ministry of Health Singapore, "Changes to the Medical Registration Act Schedule", accessed August 24, 2018, https://www.moh.gov.sg/content/moh_web/home/pressRoom/pressRoomItemRelease/2002/changes_to_the_Medical_Registration_act_schedule.html.
Samena Chaudhry, "Women Medical Students Exceed Quota in Singapore", Student BMJ, accessed November 5, 2019, https://www.proquest.com/docview/1786249235?OpenUrlRefId=info:xri/sid:primo&accountid=8203&parentSessionId=jTClGrLGIynvIqCClvGgVndj39t1%2FyblXi3s1F%2Fbxnk%3D.

[42] Luh Luh Lan and Jean Lee, "Force-field Analysis on Policies", 46.

prioritised the need for more women to take on maternal roles and this meant that women were deterred from pursuing STEM occupations such as medicine. A further point of consideration raised by Dugo is that the Singaporean government had also framed the issue of declining birthrates as a survivalist narrative which supported a combination of authoritarian rule and neoliberalism. The decision to restrict the number of women doctors demonstrates this. Policymakers influenced by the neoliberal ideal of bringing "all human action into the domain of the market" may have believed that without intervening, Singapore's future economic progress was at risk if low birth rates continued.[43]

Notably, Singapore's first Prime Minister, Lee Kuan Yew was also hesitant to challenge gendered cultural norms, beliefs and practices. At the 1975 National Trades Union Congress, Prime Minister Lee Kuan Yew noted that encouraging greater female participation in the workforce should not be at the cost of damaging the traditional family framework. By 1983, Lee Kuan Yew voiced his belief that the PAP government's education policy as well as equal career opportunities for women had "affected their traditional role as mothers."[44] Moreover, Lee Kuan Yew stated that women "just can't be doing a full-time heavy job like that of doctor or engineer and run a home and bring up children."[45] Lee Kwan Yew did suggest that government policies would push women into careers that were more suitable for them and would, importantly enable them to fulfil their roles of marriage and motherhood. This discursive policy framing may have had significant implications for women wishing to pursue STEM careers with few policies available to support them in their careers or address barriers. The political factors did

[43] Dugo, "Neoliberal Singapore: Nation-State and Global City", 28.
[44] AWARE, "Education".
[45] AWARE, "Education".

have substantial implications for girls in STEM. Girls wishing to pursue STEM in 1985 encountered political challenges when the PAP government made it compulsory for all lower secondary schools' girls to undertake home economics and removed the option of undertaking technical studies. Girls were "steered towards more 'feminine' interests like music, ballet, art and literature."[46] By examining Singapore's crude birth rates, this change in education policy may have contributed to a higher number of births with 1988 reporting a crude birth rate of 19.8.[47] This suggests that government policies as well as the way they were discursively framed may have successfully played a large part in pushing women away from pursuing STEM education, instead re-emphasising their familial and social roles as mothers. However, as will be explored below, the 1980s and 1990s saw the PAP government under Goh Chok Tong again change its roles for women.

In the 1980s and 1990s, Singapore faced significant labour shortages in STEM professions. It is probable that deterring women from STEM professions in the past had created a shortfall in Singapore's workforce. A shortage of engineers in the 1980s led the Straits Times to state that female students should be allowed to pursue STEM "if Singapore (was) to succeed in the world of high-tech industries."[48] Public discourse highlighted the economic benefits of working women and this motivation may have influenced policymaking. Singaporean society had acknowledged that STEM was a culturally and economically viable area of appropriate study and work for women. Women's participation at universities again grew and by 1991 an estimated 75.6% of female university graduates transitioned into and remained in the workforce. In 1994, Lee Kuan Yew's belief that his government was "young, ignorant and idealistic when it gave

[46] AWARE, "Education".
[47] Department of Statistics Singapore, "Births and Fertility: Visualising Data".
[48] AWARE, "Education".

women equal education rights" again provoked public debate.[49] However, the government under Goh Chok Tong announced that home economics as well as design and technology would be compulsory for all secondary school students in 1994. As AWARE notes, this was formal recognition by the government that both men and women had shared responsibility of the home.[50] However, as further sections of this chapter will demonstrate, the government's meritocratic and gender-blind approach has meant that issues faced by women attempting to balance work responsibilities with familial and social expectations have not been adequately addressed. This has implications for women in STEM.

By utilising a gendered discursive policy framing analysis and drawing from government materials, it can be found that historically, the Singaporean government has been inconsistent in its commitment to increase the participation rates of girls and women in STEM. Women have been encouraged to undertake STEM education and careers when there is a clear economic imperative to do so, however, they are also impacted by political factors that at times, choose to prioritise their traditional domestic responsibilities over their participation in the workforce. While a gender-blind and meritocratic approach did enable more women to pursue STEM education and occupations, little was done to actively address their challenges. The next section of this thesis will examine issues and challenges faced by Singaporean women in STEM.

5.3 Singaporean Women in STEM

Singapore's female participation rate in STEM education is significantly high especially, when compared to the rates of Australia. Available statistics from the Department of

[49] AWARE, "Education".
[50] AWARE, "Education".

Statistics indicate that in 2018, almost 60% of science degree students were women.[51] Singaporean women also accounted for 26.7% of engineering degrees.[52] An estimated 36.3% of graduates in computing and IT degrees were female.[53] MasterCard uncovered that an estimated 54% of Singaporean girls choose to pursue a STEM education while seven in ten girls indicated an interest in progressing into higher education.[54] These participation rates suggest that the PAP government's meritocratic and gender-blind approach towards schooling may have encouraged more girls to undertake STEM education. Moreover, a 2016 survey from MasterCard found that more than half of the girl respondents had parents or siblings in STEM occupations or education.[55] These influences may have reduced social challenges and helped maintain the perception that STEM education is a gender-neutral area of study.[56] With regards to Singapore's labour force, women's share of professionals, managers, executives and technicians increased to 45.6% in 2020.[57] Singaporean women made up 30% of IT professionals and 29.4% of scientists and engineers in 2018.[58] In 2021, it was claimed that women accounted for 41% of the tech workforce in Singapore.[59] This figure is higher than those from Australia. The

[51] Department of Statistics Singapore, *Yearbook of Statistics Singapore 2019*, 307.
[52] "Education & Training: University - Engineering", Ministry of Social and Family Development, accessed August 28, 2018, https://www.msf.gov.sg/research-and-data/Research-and-Statistics/Pages/Education-Training-University-Engineering.aspx.
[53] Ministry of Social and Family Development, "Education & Training: University - Computing/Information Technology".
[54] This figure may take into account girls interested in pursuing a health-related STEM education.
"Eight in Ten Female First-Jobbers in Singapore Pursue a Career in STEM: Mastercard Research, Mastercard, accessed October 14, 2019, https://www.mastercard.com/news/ap/en/newsroom/press-releases/en/2018/february/eight-in-ten-female-first-jobbers-in-singapore-pursue-a-career-in-stem-mastercard-research/.
[55] Mastercard, "Low Confidence Limits Number of Girls Pursuing STEM Careers".
[56] Tang Wee Teo and Leck Yeo, "Gender Studies of Science and Science Education in Singapore", *Asian Women* 33 (1 September 2017): 16, https://doi.org/10.14431/aw.2017.09.33.3.1.
[57] Singapore Ministry for Manpower, "Oral Answer to PQ on Emerging Trends for Female Professions".
[58] "Labour Force and the Economy: IT Professionals", Singapore Ministry of Social and Family Development, accessed October 14, 2019, https://www.msf.gov.sg/research-and-data/Research-and-Statistics/Pages/Labour-Force-and-the-Economy-IT-Professionals.aspx.
"Labour Force and the Economy: Research Scientists & Engineers", Singapore Ministry of Social and Family Development, accessed October 14, 2019, https://www.msf.gov.sg/research-and-data/Research-and-Statistics/Pages/Labour-Force-and-the-Economy-Research-Scientists-Engineers.aspx.
[59] Singapore Ministry of Communications and Information, "Transcript of Parliamentary Secretary for Communications and Information Rahayu Mahzam".

above statistics demonstrate that women's participation in STEM industries such as IT is increasing. However, as previously raised, this figure may include women with non-technology backgrounds. There are also indications that Singaporean women are pursuing emerging STEM fields and high-growth occupations, including cloud computing, engineering and artificial intelligence. However, the rates of female participation in these sectors vary with reports estimating a rate of 9% to 29%.[60] Correspondingly, 66% of Singaporean women entering the workforce for the first time were more likely to remain in STEM throughout their careers.[61] The employment rate for women wishing to pursue a STEM career is high with three in four female STEM majors able to find a position within six months of graduation.[62] Despite this, a 2021 study from the Nanyang Technological University revealed that only 58% of women who graduate with a STEM degree or diploma pursue a STEM related career. This is in comparison to 70% of Singaporean men who work in a STEM related field. Future parts of this section will explain some of the contributing factors as to why Singaporean women may be deterred from pursuing or advancing in a STEM career. However, the wider academic literature does not feature much research on the issues that are specific to Singaporean women in STEM. In their research, Jean Lee, Kathleen Campbell and Audrey Chia have uncovered that working women in Singapore share similar concerns as to those examined in Chapter Two.[63]

One challenge faced by Singaporean women is that social and cultural beliefs continue to maintain the idea that women must fulfil their traditional roles as wives, mothers and

[60] Suhaila Zainal Shah, "Overcoming the Challenges Women Face in the Wake of Covid-19 and Digital Disruption", *TODAY Online*, March 8, 2021, https://www.todayonline.com/commentary/overcoming-challenges-women-face-wake-covid-19-and-digital-disruption.
[61] Mastercard, "Eight in Ten Female First-Jobbers in Singapore".
[62] Mastercard, "Eight in Ten Female First-Jobbers in Singapore".
[63] Lee, Campbell and Chia, *The 3 Paradoxes*, 257-278.

daughters in addition to pursuing a career. Consequently, Singaporean women undertake more caregiving and home-based duties than their male counterparts.[64] This is alongside the government's expectation that women continue to participate in the economy. Research indicates that Singaporean women do have challenges with balancing family life and employment which has only intensified with challenges arising from the COVID-19 pandemic.[65] In their research, McKinsey Global Institute revealed that a major factor in decreasing labour participation rates is women's role in childcare. An estimated 41.77% of women cited that family responsibilities did deter them from full-time work participation.[66] Subsequently, many Singaporean women choose to pursue flexible working arrangements to accommodate their familial responsibilities. Notably, Singapore's female labour force participation rate is unusual given that while there is parity for women from the ages of 25 and 29, the gender gap in labour force participation widens when women age over 30.[67] However, this finding can be attributed to the fact that Singaporean women tend to have children later in life.[68] Therefore, it can be presumed that Singaporean women choose flexible working arrangements as they not only get older but as they begin motherhood and assume caring roles.[69] Singaporean women make up 63.8% of all part-time employees.[70] There are implications for

[64] Shah, "Overcoming the Challenges Women Face".
[65] "The Power of Parity: Advancing Women's Equality in Asia Pacific", McKinsey Global Institute, April 23, 2018, https://www.mckinsey.com/featured-insights/gender-equality/the-power-of-parity-advancing-womens-equality-in-asia-pacific. Report available on webpage, 192.
Shah, "Overcoming the Challenges Women Face".
[66] Jerene Ang, "Is Singapore Doing Enough for Gender Parity?" *Human Resources Online*, April 24, 2018, https://www.humanresourcesonline.net/is-singapore-doing-enough-for-gender-parity/.
[67] Tang See Kit, "Narrowing Gender Gap Can Add S$26b to Singapore's GDP by 2025: Report", *Channel News Asia*, April 24, 2018, https://www.channelnewsasia.com/news/singapore/narrowing-gender-gap-can-add-s-26b-to-singapore-s-gdp-by-2025-10170686.
[68] Eveline Gan, "More Women in Singapore Giving Birth in Their 40s", *The Straits Times*, December 27, 2016,
https://www.straitstimes.com/singapore/health/more-women-in-singapore-giving-birth-in-their-40s.
[69] "Labour Force and the Economy: Part Time Workforce", Ministry of Social and Family Development, accessed November 2019, https://www.msf.gov.sg/research-and-data/Research-and-Statistics/Pages/Labour-Force-and-the-Economy-Part-Time-Workforce.aspx.
[70] Ministry of Social and Family Development, "Labour Force and the Economy: Part Time Workforce".

Singaporean women who choose to undertake STEM occupations at a casual or part-time rate as it is contractual and the pay is lower. Moreover, these lower-paying jobs do not utilise their existing STEM skills and knowledge. Women may also be employed in lower-growth industries which "leaves them vulnerable to automation."[71] Noeleen Heyzer explains that this leaves Singaporean working mothers susceptible to unemployment and under-employment.[72] Singaporean women in STEM can be perceived as not heavily career-minded due to social beliefs that maintain that they have a role to play in the home.[73] Singaporean women in STEM may also choose not to pursue large projects or leadership positions out of the fear that it may conflict with their family priorities.[74] This results in less female representation at the higher levels of STEM occupations. A lack of women leaders in STEM industries could mean that barriers are not addressed by STEM businesses and industries. This may be the reason only 47% of Singaporean employers have flexible working arrangement policies.[75] Though it is unknown how many STEM businesses have flexible working arrangements in place. Subsequently, this may mean that women in STEM leave their professions or have intermittent patterns of work because of a lack of awareness around issues that impact them[76]

Drawing and analysing a broad range of literature, the thesis has identified an additional issue that impacts the types of policies and programs available to Singaporean women in

[71] Ang, "Is Singapore Doing Enough for Gender Parity?"
[72] Seow Bei Yi, "Women in Singapore Earn 13% Less than Men as Gender Wage Gap Persists: Glassdoor", *The Straits Times*, March 27, 2019, https://www.straitstimes.com/business/economy/women-in-singapore-earning-13-less-than-men-as-gender-wage-gap-persists-glassdoor.
[73] Dutta, "Women's Discourses of Leadership", 240.
[74] Debalina Dutta, "Women's Discourses of Leadership in STEM Organizations in Singapore: Negotiating Sociocultural and Organizational Norms", *Management Communication Quarterly* 32, no. 2 (1 May 2018): 237-241, https://doi.org/10.1177/0893318917731537.
[75] Ang, "Is Singapore Doing Enough for Gender Parity?"
[76] Yi, "Women in Singapore Earn 13% Less than Men".

STEM is a lack of data and knowledge. Correspondingly, the Singaporean PAP government has not implemented many studies that examine the issues faced by women in STEM. There is a lack of publicly available reports that focus on women in STEM. This has also meant that there is little information available to determine whether Singaporean women from particular ethnic groups are affected by additional challenges. Moreover, the Department of Statistics Singapore does not provide publicly available data on the number of women from diverse ethnic groups who are employed in STEM industries.[77] Singapore's 2020 Census provides little information detailing the rates of Singaporean women from ethnic groups who obtain STEM higher education.[78] Other organisations such as the Society of Women Engineers have been unable to provide insight into the participation rates of Singaporean women from racial groups.[79] Subsequently, the Singaporean government's lack of research into challenges faced by women in STEM from diverse racial groups can lead to policymakers often neglecting to identity and address prevailing issues. A lack of publicly available information can also mean that there is a lack of organisational and institutional awareness about possible factors that deter women from diverse racial groups from pursuing STEM education and employment. This thesis argues that the Singaporean government could be doing more to further assess potential issues that deter women from certain racial groups from engaging in STEM.

[77] "SingStat Table Builder – Employed Female Residents Aged 15 Years And Over By Industry And Age Group", Department of Statistics Singapore, November 25, 2021, https://tablebuilder.singstat.gov.sg/table/TS/M182151.

[78] '"Singapore Census of Population 2020, Statistical Release 1: Demographic Characteristics, Education, Language and Religion", Department of Statistics Singapore, accessed November 25, 2021, http://www.singstat.gov.sg/publications/reference/cop2020/cop2020-sr1/census20_stat_release1. PDF available on website. Titled 'Key Findings', 18-22.
See also "Education Statistics Digest", Ministry of Education Singapore, accessed November 25, 2021, http://www.moe.gov.sg/about-us/publications/education-statistics-digest.

[79] "Singapore Research Scientists and Engineers", Society of Women Engineers, accessed November 25, 2021, https://swe.org/research/2021/singapore-research-scientists-and-engineers/.

A further issue that has the potential to impact Singaporean women in STEM is the fact that Singaporean political leaders and policymakers have shaped a narrative that promotes the idea that Asian family values are vital in safeguarding Singaporean society. While the Singaporean governments under Lee Kwan Yew, Goh Chok Tong and Lee Hsien Loong have urged women to pursue employment particularly, in times of economic strife, ultimately, fertility policies have continued to urge them to play custodian and caregiver roles.[80] This is especially, the case when Singapore's fertility rate decreases. In her article, Karlien Strijbosch states that "the family as an anchor of society is situated in Singapore's national development narrative."[81] This is due the fact that Asian family values that are influenced by Confucianism encourage filial piety, loyalty toward family and deference to authority. The promotion of these values is beneficial to policymakers because it enforces the idea of the nuclear family which subsequently, encourages higher fertility rates that increases the labour force. Ideology around Asian family values also enables policymakers to further stress the importance of women's traditional roles as well as position women as cultural bearers and defenders of the family.[82] Notably, policymakers such as the then-Minister for National Development Khaw Boon Wan continue to place a heavy emphasis on Asian family values. In a 2015 speech, Khaw Boon Wan stated that "strong family values and relationships are foundations of a stable society."[83] This has implications for women in STEM because the idea of Asian family values does heavily encourage women to conform to traditional expectations. These expectations include the raising of children and looking after husbands. Yet, as explained

[80] Youyenn Teo, "Gender Disarmed", 534.
[81] Strijbosch, 'Single and the City", 1110.
[82] Brenda Yeoh, Shirlena Huang, and Katie Willis, 'Global Cities, Transnational Flows and Gender Dimensions: The View from Singapore', *Tijdschrift Voor Economische En Sociale Geografie* 91, no. 2 (May 2000): 153, https://doi.org/10.1111/1467-9663.00102.
[83] "COS 2015 - Speech by Minister Khaw Boon Wan "Family Matters: A Tale of Five Families", Ministry of National Development, March 10, 2015, https://www.mnd.gov.sg/newsroom/speeches/view/cos-2015---speech-by-minister-khaw-boon-wan-family-matters-a-tale-of-five-families.

in previous sections of this chapter, Singaporean women are also expected by the government to work. Most struggle to balance work and family demands. Subsequently, many Singaporean women choose to undertake work in industries which are less competitive but pay less. This leads to a lowered female participation rate in STEM industries. Coupled with this issue, is that the Singaporean government's gender-blind approach means that there are fewer mechanisms in place to address issues women have when they work. There is also a lack of government encouragement to pursue higher leadership positions. Women who choose to work in less competitive STEM roles are less likely to be encouraged to pursue higher career positions due to the government's reluctance in moving away from the idea that Asian family values are vital. Strijbosch notes that government pro-marriage and pro-natal policies have also "shaped norms and ideals around marriage, childbearing and caregiving practices."[84] Thus, as Youyenn Teo remarks, while women's "life trajectories increasingly lead them down paths similar to those of their male counterparts in terms of the importance of employment-both for material survival and symbolic worth – the so-called traditional demands on them do not subside."[85] This has the potential to significantly impact the extent that Singaporean women in STEM can progress through the career ladder.

It can be argued that Singaporean women in STEM face a number of political, economic, familial, and cultural barriers that can prevent them from pursuing or excelling in STEM careers. The Singaporean government urges women to fulfil domestic responsibilities whilst also affirming their importance to the national economy. Some women struggle to balance both demands and subsequently, many choose to pursue flexible working arrangements. Others may leave their STEM profession to pursue positions that that

[84] Strijbosch, "Single and the City", 1110.
[85] Teo, "Gender Disarmed", 534.

require less responsibility in order to accommodate their familial duties. In both instances, women are paid less and may have insecure employment. These issues contribute to a lowered female representation rate in STEM industries. A further issue is that the Singaporean government has not implemented much research into the disparities between men and women in STEM. It is also unknown as to whether there are unique and diverse challenges faced by women in STEM who belong to Singaporean Indian and Malay communities. The Singaporean government's promotion of Asian family values and gender-blind approach also means that there are few measures in place to sufficiently facilitate the career advancement of women in STEM occupations. Using a gendered discursive policy framing analysis approach, subsequent sections of this chapter will now examine government materials, including Singaporean policies, programs and initiatives for girls and women in STEM.

5.4 Singapore Government Policies

Scholars such as Andrea Dugo have suggested that Singaporean politicians and policymakers have been, and arguably continue to be influenced by neoliberalism to achieve economic growth. Since the start of Singapore's independence, Singaporean politicians have been influenced by neoliberal ideas with a chief one being "economy first".[86] By adopting a survivalist discursive framing which positions Singapore as a vulnerable nation which relies on its citizens to support economic growth, politicians have crafted the idea that policymaking and by extension, policies and programs are 'pragmatic'. It has also tied national identity to economic profitability.[87] However, as outlined by Dugo, Singapore's pragmatism is very much influenced by neoliberal ideas. For instance, as outlined in previous sections, the government has typically intervened in

[86] Dugo, "Neoliberal Singapore: Nation-State and Global City", 28.
[87] Dugo, "Neoliberal Singapore: Nation-State and Global City", 34.

public policy when birth rates have declined or when it has identified a need for an increased workforce.[88] Nationalist and neoliberal discourses have also been used by the Singaporean government to "structure education and shape identities for the purposes of economic growth and political control".[89] For example, the Singaporean government has through policies, encouraged girls and women to undertake STEM subjects when it perceived that there was an economic imperative to do so.[90] Women were seen as contributors to nation building. Conversely, the government has also intervened and limited opportunities for women to succeed in STEM professions. This has occurred when the government has perceived that women have a familial role to play.[91] Notably, this intervention distinguishes Singapore's version of neoliberalism from that of other western countries which has seen governments limit their interference.[92] Dugo remarks that Singapore's version to neoliberalism has seen the government managing to "substantially preserve its central role in the economy while, at the same time, letting the entrepreneurial energies of local and international capitalism run rampant".[93]

Dugo also notes that the Singaporean government governs in a managerial fashion and frames discourse through the language of business. In this sense, "aspects of policymaking are rigorously examined with a neoliberal lens and the bottom line remains the primary, sometimes only, guiding principle behind government action".[94] As subsequent sections of this chapter will explore, this approach and subsequent framing has had an impact on policies and initiatives which seek to address the

[88] AWARE, "Education".
[89] Roberto Santiago de Roock and Mark Baildon, "MySkillsFuture for Students, STEM Learning, and the Design of Neoliberal Citizenship in Singapore", *Cognition and Instruction* 37, no. 3 (3 July 2019): 288, https://doi.org/10.1080/07370008.2019.1624545.
[90] AWARE, "Education".
[91] AWARE, "Education".
[92] Dugo, "Neoliberal Singapore: Nation-State and Global City", 31.
[93] Dugo, "Neoliberal Singapore: Nation-State and Global City", 32.
[94] Dugo, "Neoliberal Singapore: Nation-State and Global City", 34.

underrepresentation of Singaporean women in STEM. For instance, government programs such as SkillsFuture have been framed by the government as gender-neutral and underpinned by meritocracy. This discursive framing can be considered as influenced by the neoliberal idea that women are largely responsible for their own economic and social standing. As such, some programs are unlikely to support issues and barriers that are specific to Singaporean women.

An analysis of Singaporean budgets has found that the PAP government has not placed much emphasis on creating or developing programs and initiatives for working women in STEM and girls interested in pursuing STEM education. Budget documents from 2008 to 2021 demonstrate that the PAP government headed by Lee Hsien Loong has not featured many initiatives for working women and particularly, those employed in STEM industries.[95] This reflects the fact that policymakers have framed the idea that Singapore's system is underpinned by meritocracy.[96] This has meant that policies are directed at all Singaporean citizens rather, than a selected group or in this case, gender. Analysing the budgets also found that the PAP government focuses mainly on programs which are related to the well-being of families. As illustrated before, this can be attributed to the fact that Singapore's has the lowest fertility rate in the world. This demonstrates that the government has encouraged fertility policies over policies relating to STEM participation. Policies such as the Foreign Domestic Worker Levy Concession and childcare subsidies which are beneficial in aiding women with their domestic

[95] "Budget Archives", Ministry of Finance, accessed November 7, 2019, https://www.mof.gov.sg/singapore-budget/budget-archives. Singapore Budgets from 2002-2020 available. "Budget Speech 2021", Ministry of Finance, accessed November 8, 2021, https://www.mof.gov.sg/singaporebudget/budget-2021/budget-speech.

[96] "Parliamentary Replies: Gender Budgeting to Determine Effect of Policies on Women", Ministry of Finance, May 8, 2017, https://www.mof.gov.sg/news-publications/parliamentary-replies/Gender-Budgeting-to-Determine-Effect-of-Policies-on-Women.

responsibilities are also marketed wholly to families.[97] This discursive policy framing has meant that policies for women are placed in areas which associate them primarily as mothers. Furthermore, policies for women tend to be a part of, or rather are confined to, policy areas that concern marriage, parenthood and family. This is illustrated in the 2008 budget which features the Family Development Programme.[98] There is no mention of women's policies in other sectors such as science, defence and employment. Thus, policies that have the potential to impact women continue to be confined to policy areas that concern households and this continues into the present day when examining budget documents with a gendered lens.

In recent years, some Singaporean politicians have attempted to raise awareness on the challenges faced by women. In 2017, the Singapore parliament discussed a motion concerning the aspirations of women, which PAP politician Lim Biow Chuan described as the first time the Singaporean parliament had done so.[99] Many of these were related to issues regarding balancing work and familial responsibilities as well as Singapore's gender equality ranking. Concerns over gendered practices, beliefs and norms as well as the lack of women in STEM were also bought to attention during the parliamentary debate. Politicians such as MP Kok Heng discussed how women continued to be identified by their familial responsibilities rather than their working roles. She cited that in Singapore's last two general elections, female candidates were relegated to their motherhood roles with newspapers introducing a woman entrepreneur as a 'mother of

[97] Ministry of Finance, "Budget Summary Slide 2018", slide 20, accessed November 7, 2019, https://www.singaporebudget.gov.sg/data/budget_2018/download/FY2018_Budget_Summary_Slide_ENG.pdf.
[98] Ministry of Finance, "Budget Archives". See Singapore Budget 2008. Folder titled 'Revenue and Expenditure'. File named 'MCYS_AEE2008', 237.
[99] "Aspirations of Singapore Women (Motion) Volume 94, Sitting No 44", Parliament of Singapore, accessed November 7, 2019, https://sprs.parl.gov.sg/search/sprs3topic?reportid=motion-959.

two'.[100] Conversely, male candidates were introduced by their professions. Correspondingly, MP Jessica Tan Soon Neo indicated that labour shortages in STEM areas such as data science could be filled by women who would benefit from being employed in STEM industries with the most economic growth.[101] She also urged the PAP government to "take an active role and commit resources to attract more women in tertiary education to STEM education and training".[102] Neo argued that scholarships, internships and career coaching initiatives would aid girls and women in STEM. Additionally, she acknowledged that developing goals and tracking the participation rates of girls from such initiatives would be advantageous.[103] The 2017 parliamentary address demonstrated that Singaporean politicians were aware of the lack of measures and initiatives for working women. Moreover, they perceived it important for the government to encourage greater numbers of women to undertake STEM employment. Politicians at this time, were growing concerned that women would be significantly impacted by technological disruption. Consequently, they urged the government to "encourage women to undergo technology and skills training and be prepared for the new digital era."[104] However, as it will be discussed further, the Singaporean PAP government under Lee Hsien Loong has not implemented many measures to aid working women in STEM.

Throughout 2018, Singaporean political leaders such as MP K Thanaletchimi and Singapore's first President, Halimah Yacob attempted to push for more policies and

[100] "Parliamentary Debates Singapore – Official Report Thirteenth Parliament: First Session Volume 94, No 45", Parliament of Singapore, accessed November 8, 2019, https://sprs.parl.gov.sg/search/fullreport?sittingdate=04-04-2017.
[101] Parliament of Singapore, "Aspirations of Singapore Women (Motion)".
[102] Parliament of Singapore, "Aspirations of Singapore Women (Motion)".
[103] Parliament of Singapore, "Aspirations of Singapore Women (Motion)".
[104] "Parliamentary Debates Singapore - Official Report Thirteenth Parliament: First Session Volume 94, No 44", Parliament of Singapore, accessed November 8, 2019, https://sprs.parl.gov.sg/search/fullreport?sittingdate=03-04-2017.

programs for women wishing to pursue STEM.[105] Despite this, the 2019 budget did not implement any programs or initiatives for women in STEM. The Singaporean Minister for Finance, Heng Swee Keat contended in the 2019 round up budget speech that "many of the government's "existing schemes do benefit women more."[106] Yet, as noted above, schemes are listed and categorised under family and children portfolios. The implication then is that these schemes are more relevant for women because they participate more in familial and child caregiving. The then-Minister for Finance, Heng Swee Keat, also noted in 2019 that excluding the Women's Charter, other laws benefit women. However, the laws which are designed to be gender-neutral may unintentionally penalise women or do not adequately address their concerns.[107] This thesis contends that Singapore's neutral approach is perceived to be addressing the needs of the population. The approach does not entirely address the specific needs of groups such as women as it seeks to apply to all individuals regardless of standing. While a gender-neutral approach towards education policy has assisted women in STEM as illustrated above, there are some implications. A gender-neutral approach can adopt unacknowledged male norms, practices and beliefs that consequently lead to the perception that the male citizen is the universal citizen. The same levels of challenges faced by Singaporean men are then believed to be applied across to all citizens. While women in STEM are encouraged to participate in the economy, they are not provided with policies and programs to facilitate their career advancement potentially because it would lead to friction with their familial

[105] "Debate on Annual Budget Statement: Volume 94, Sitting No 61", Parliament of Singapore, accessed November 8, 2019, https://sprs.parl.gov.sg/search/sprs3topic?reportid=budget-867.
"Debate on President's Address: Volume 94, Sitting No 73", Parliament of Singapore, accessed November 8, 2019, https://sprs.parl.gov.sg/search/sprs3topic?reportid=president-address-25.
"Speech by President Halimah Yacob at Women's Forum Singapore", President of the Republic of Singapore, accessed October 14, 2019, https://www.istana.gov.sg/Newsroom/Speeches/2018/09/12/HY-at-Womens-Forum-Singapore.
[106] Ministry of Finance, "Budget Archives". See Singapore Budget 2019. PDF titled 'Budget Debate Round-Up Speech, 15.
[107] Ministry of Finance, "Parliamentary Replies: Gender Budgeting to Determine Effect of Policies on Women".

responsibilities. Compounding this issue is that Singapore's meritocratic approach also omits the impact of factors such as wealth and circumstances of birth. For instance, women from wealthier backgrounds are capable of utilising childcare facilities or domestic foreign workers to aid them with the raising of children and the care of elderly family members. This means that is more likely for them to undertake higher leadership positions that come with higher pays and thus, advance higher in their STEM careers. [108] In contrast, women from lower or middle class backgrounds have a reduced capacity to financially afford childcare or domestic foreign workers. As such, they may be more likely to forgo leadership roles or full-time work. The government's reluctance to change its demands on women as well as its gender-blind and meritocratic approach then, has the potential to significantly widen the inequalities that exist for some women. Moreover, it means that the issues affecting women are unlikely to be addressed leading to the potential of a lowered STEM participation rate.

Despite a lack of support in implementing policies and initiatives to increase the participation rates of women in STEM careers, September 2020, saw the government choosing to understand some of the challenges faced by Singaporean women. Studies from the Lee Kuan Yew School of Public Policy found that women were less satisfied in their marriages during and after the COVID-19 pandemic lockdowns.[109] Many shouldered a larger proportion of household responsibilities. Singaporean politicians may have perceived that younger generations of women may be deterred from having children due to the amount of responsibilities required. Consequently, in 2020, Singapore's

[108] Ong Ye Kung, "Dealing with Two Paradoxes of Singapore's Education System", *TODAY Online*, July 11, 2018, https://www.todayonline.com/commentary/broad-agreement-meritocracy-and-inequality-key-developing-better-education-system.

[109] Theresa Tan, "Marital Satisfaction for Women Fell during Circuit Breaker: Study", *The New Paper*, May 27, 2021, https://www.tnp.sg/news/singapore/marital-satisfaction-women-fell-during-circuit-breaker-study.

Ministry of Social and Family Development announced that it would be launching a series of engagement sessions.[110] These engagement sessions titled 'Conversations on Singapore Women's Development' would allow Singaporean citizens to participate in discussions on issues that affect women at home, in schools, workplaces and the community. The December 2020 and January 2021 sessions revealed that increasing the representation of women in male-dominated industries as well as raising the number of women in leadership positions was a key discussion topic.[111] In 2021, the PAP government announced that it would organise more engagement sessions after the 2020 discussions attracted a large amount of participants.[112] Publicly available information reveals that over 5700 participants have attended 160 sessions.[113] The Home Affairs and Law Minister, K Shanmugam also stated that a White Paper would be created. It would summarise the discussions and be released later in the year.[114] It should be acknowledged that, in the wake of the engagement sessions, Singapore has implemented stronger laws and protections to aid victims of sexual crimes.[115] Moreover, political correspondent Linette Lai notes that the engagement sessions may have also contributed to the changing education curriculum.[116] Singapore's curriculum now reinforces respect for both genders while also reducing stereotypes. In 2021, the Singaporean government continued to

[110] "Conversations on Women Development", Ministry of Social and Family Development', September 20, 2020, https://www.msf.gov.sg/media-room/Pages/Conversations-on-Women-Development.aspx.
[111] "Conversations on Singapore Women's Development", Reach: Government Feedback Unit, accessed July 23, 2021, https://www.reach.gov.sg/participate/conversations-on-singapore-womens-development. PDF document titled 'Summary for December 2020 and January 2021'.
[112] Yuen-C Tham, "Review on Women's Issues to Be Extended for More Input", *The Straits Times*, January 17, 2021, https://www.straitstimes.com/singapore/politics/review-on-womens-issues-to-be-extended-for-more-input.
[113] Linette Lai, "No Let Up in Efforts by Govt to Improve Lives of Singapore Women, Says Sun Xueling", *The Straits Times*, August 3, 2021, https://www.straitstimes.com/singapore/community/no-let-up-in-efforts-by-govt-to-improve-lives-of-singapore-women-says-sun.
[114] Tham, "Review on Women's Issues to Be Extended for More Input".
[115] Lai, "No Let Up in Efforts by Govt to Improve Lives of Singapore Women".
[116] Lai, "No Let Up in Efforts by Govt to Improve Lives of Singapore Women".

discuss additional policies to support Singaporean women. PAP politician Tin Pei Ling noted that more focus would be on empowering women to undertake STEM education.[117]

Despite these changes, it is unknown as to whether the discussion sessions will be able to spur the development of policies and programs that address barriers as identified in this chapter or significantly change the current discursive policy framing for women interested in pursuing or advancing in STEM careers. Minister Shanmugam acknowledged that gender equality was unlikely to be enshrined in the Constitution. Going further, he stated that while it would be considered in the inter-ministerial government process, "I'll be frank, there are different considerations and trade-offs to be considered."[118] Instead of widespread legislative change, Shanmugam proposed that the sessions would help promote a cultural change on values such as gender equality and respect for women.[119] The illustrated changes in the above paragraph do seem to reflect this view. Correspondingly, the Minister for Social and Family Development and Minister for State Sun Xueling placed an onus on people and private sectors to empower Singaporean women.[120] This emphasis on supporting private sectors suggests that the government will encourage the private sector to create more initiatives for working women. It is also clear that the PAP government will also emphasise the importance of sharing household responsibilities between mothers and fathers through encouraging flexible working arrangements and online information services.[121] This suggests that the government will not increase or implement measures to aid working women in STEM

[117] "Empowering Women (Motion) Volume 95, Sitting No 36", Parliament of Singapore, accessed 30 November 2021, https://sprs.parl.gov.sg/search/sprs3topic?reportid=motion-1734.
[118] Tham, "Review on Women's Issues to Be Extended for More Input".
[119] Tham, "Review on Women's Issues to Be Extended for More Input".
[120] Ministry of Social and Family Development, "Conversations on Women Development".
[121] "Support for Women and How Men Can Take On More Household Responsibilities", Ministry of Social and Family Development, accessed August 12, 2021, https://www.msf.gov.sg/media-room/Pages/Support-for-Women-and-How-Men-Can-Take-On-More-Household-Responsibilities-.aspx.

and also indicates the influence of neoliberalism. The PAP government will continue to place a heavy emphasis on measures and strategies that increase Singapore's birth rate over ones that aim to aid working women in STEM.[122]

This approach is in line with Michelle Lazar's theory of strategic egalitarianism. She defines strategic egalitarianism has the "granting of equality to women that is contingent upon meeting particular pragmatic nationalist objectives."[123] In this sense, Singaporean policymakers believe that the provision of certain rights and opportunities to women are granted to women only when there is a pragmatic motive to do so. Yet, Lazar also contends that Confucian ideology continues to play an ideological role in informing the government's attitude toward gender relations.[124] The two ideologies work together to promote the idea that it is both practical and culturally reasonable for women to both work and become mothers. Although, Singaporean policymakers tend to rank women's roles of motherhood above their employment aspirations especially in instances, when the fertility rate is threatened. As summarised best by Lazar, "the prioritisation of motherhood as women's primary and ultimate identity has meant the prioritisation of the nation's, men's and children's interests at the expense of women's own aspirations and life choices."[125] Similarly, Kho Ee Moi notes that most government policies and initiatives related to girls and women tended to either emphasise women's role in the workforce or in the home. This fluctuates depending on whether there are low or increased rates of female fertility in Singapore.[126] Thus, as Kho Ee Moi remarks, the concern has never been about how the nation can emancipate and empower women but

[122] Jon Emont, "Singapore Isn't Kidding When It Comes to Fostering Fertility", *Wall Street Journal*, February 22, 2020, https://www.wsj.com/articles/singapore-isnt-kidding-when-it-comes-to-fostering-fertility-11582376400.
[123] Lazar, "For the Good of The Nation", 59.
[124] Lazar, "For the Good of The Nation", 61-62.
[125] Lazar, "For the Good of the Nation", 172.
[126] Moi, "Economic Pragmatism", 73.

rather it is about 'how women can best serve 'the nation''.[127] In applying these ideas to the above findings, the Singaporean government under Lee Hsien Loong may have taken the step of examining challenges faced by working women out of the belief that, such challenges would contribute to a decreasing fertility rate and/or a lowered workforce participation rate. As such, it is evident that while the PAP government under Lee Hsien Loong has made some attempts to address challenges faced by women, it is unlikely that the government will significantly change their overall gender-blind and meritocratic approach unless it is a matter of national concern.

5.5 Singapore Government Policies and Programs for Women in STEM

In contrast to Australia and India, this section will analyse a number of policies that are not directly aimed at Singaporean girls and women in STEM. This is due to the fact that the Singaporean government headed by the PAP regards its system as one that is "underpinned by meritocracy" and as such, policies are discursively framed in a manner that supports all individuals regardless of gender.[128] Consequently, departments such as the Defence Science & Technology Agency (DSTA) make it known in internship, scholarship and program eligibility requirements that individuals regardless of gender are able to apply.[129] In 2003, the then-Division Manager of DSTA, outlined that "the job scope is determined by capability, rather than gender. It's all about finding the right

[127] Moi, "Economic Pragmatism" 63.
[128] "Gender Budgeting to Determine Effect of Policies on Women: Volume 94, Sitting No 46", Parliament of Singapore, accessed November 20, 2019, https://sprs.parl.gov.sg/search/sprs3topic?reportid=written-answer-3572.
[129] "DSTA Internships", Defence Science & Technology Agency, accessed October 15, 2019, https://www.dsta.gov.sg/join-us/student/internship/internship-programme/.
"DSTA Scholarships", Defence Science & Technology Agency, accessed October 15, 2019, https://www.dsta.gov.sg/join-us/student/scholarships-awards/.
"DSTA Young Defence Scientists Programme", Defence Science & Technology Agency, accessed October 15, 2019, https://www.dsta.gov.sg/join-us/student/young-defence-scientists-programme/.

person for the right job."[130] During this time, DSTA also emphasised an article which showcased the experiences of women employees and maintained that "it's a level playing field as far as their job scope and career prospects are concerned."[131] The article also mentioned that DSTA female employees like Gayle Chan are "the perfect all-rounder – able to keep up the conversation about weapons engineering and other macho stuff, yet able to soothe the heart with artistic pursuits like poetry" [132] This example of discourse demonstrates that the influence of gendered ideology. Similarly, in other STEM areas such as the Singaporean Ministry of Communications and Information, there are no identifiable programs or initiatives for women in STEM.[133] The Ministry of Communications and Information oversees the development of information technology, cyber security and media sectors.[134] A lack of current statistical data means that how many women applicants are successful in entering these programs is unknown. Information obtained from speeches in 2003 by the then-Permanent Secretary (Defence) and Chairman, Peter Ho have revealed that out of 64 accepted applicants, 17 were women.[135] This was a small increase when compared with 2002. A speech by the then-Second Permanent Secretary (Defence) and Chairman reported that out of 54 accepted applicants, 11 were female.[136] It has been difficult to ascertain recent numbers relating to women's employment at DSTA past the prescribed years. Research does suggest that

[130] "The Business Times, Page 16- Thursday, 7 March, 2003", Defence Science & Technology Agency, accessed October 15, 2019, https://dsta.gov.sg/latest-news/in-the-news/dsta-in-the-news/the-business-times-page-16-thursday-7-march-2003.
[131] Defence Science & Technology Agency, "The Business Times".
[132] Defence Science & Technology Agency, "The Business Times".
[133] "Scholarship", Ministry of Communications and Information, accessed October 19, 2019, http://www.mci.gov.sg/careers-grants/scholarship.
[134] "Who We Are", Ministry of Communications and Information, accessed October 19, 2019, http://www.mci.gov.sg/about-us.
[135] "DSTA Scholarship Award Ceremony 2003", Defence Science & Technology Agency, accessed October 15, 2019, https://www.dsta.gov.sg/latest-news/speeches/speeches-2003/welcome-address-by-mr-peter-ho-permanent-secretary-defence-and-chairman-dsta-at-the-dsta-scholarship-award-ceremony-2003-a.
[136] "Investing in Talent for the Nation's Defence", Defence Science & Technology Agency, accessed October 15 2019, https://dsta.gov.sg/latest-news/speeches/speeches-2002/investing-in-talent-for-the-nations-defence.

Singaporean higher education institutes do have initiatives for women interested in STEM.[137] However, there is little information to indicate whether the Singaporean government is involved. Other schemes such as the Infocomm Media Development Authority's SG Women in Tech provide outdated information on its website indicating that it is not currently being utilised.[138] Available data about the scheme is publicly scarce with informational sources limited to a parliamentary meeting citing that it had engaged more than 117,000 people.[139] As argued in this thesis, a lack of current and available data has the ability to compound concerns regarding the lack of female representation in STEM industries.

Notably, while the Singaporean government has not implemented many policies or programs for women in STEM, researchers have found that policies focusing on women's ability to balance family responsibilities and work have been successful to some extent. McKinsey & Company have contributed policies such as paid maternity leave, paid and unpaid childcare leave, increased tax relief, tax rebates, childcare subsidies and the Foreign Domestic Servant Scheme as efficient in increasing the labour force participation rate of women.[140] These measures aim to decrease the economic costs of having children and ensure that domestic housework can be delegated to domestic workers. Some of these policies may have implications for women in STEM and will be explored in further sections of this chapter. Similarly, Diane Mauzy and R.S Milne contend that the government under Goh Chok Tong was keen to develop programs for women which

[137] "Mechanobiology Institute Outreach", Mechanobiology Institute: National University of Singapore, accessed 3, November 2020, https://www.mbi.nus.edu.sg/education/outreach/.
[138] "Mentor Connect", SG Women in Tech, accessed November 25, 2021, https://www.sgwomenintech.sg/community/mentor-connect/.
[139] "Empowering Women (Motion) Volume 95, Sitting No 36", Parliament of Singapore, accessed November 12, 2021, https://sprs.parl.gov.sg/search/sprs3topic?reportid=motion-1738.
[140] McKinsey Global Institute, "The Power of Parity", 16.

advocate for higher fertility rates whilst also reaffirming their place as employees.[141] This has continued with Lee Hsien Loong's government. Singaporean women are eligible for 16 weeks of government maternity leave while men are entitled to 2 weeks of paternity leave.[142] Working fathers can apply to share up to four weeks of their wife's paternity leave.[143] While this does encourage men to take greater domestic responsibilities, the longer duration for working women demonstrates that Singaporean women, including those in STEM fields are still considered and expected to be the primary caregivers of children. Other measures such as the Working Mother's Relief scheme provide tax relief to working women.[144] While this is an incentive for women to remain in work, it does not address institutional, political or social issues relating to women in STEM.

Notably, the Singaporean government has also implemented initiatives for individuals to up-skill themselves in order to remain their employability status. The Workfare Skills Support Scheme provides eligible Singaporeans over the age of 35 and above with training allowances.[145] Eligible participants can receive cash rewards for completing achievements.[146] Individuals can choose from skills training courses from higher education providers such as SkillsFuture Singapore, the Singapore Workforce Skills Qualifications program, the Institute of Technical Education and five local

[141] Mauzy and Milne, *Singapore Politics*, 188-189.
[142] "Maternity Leave Eligibility and Entitlement", Ministry of Manpower, accessed November 8, 2019, https://www.mom.gov.sg/employment-practices/leave/maternity-leave/eligibility-and-entitlement.
"Paternity Leave", Ministry of Manpower, accessed November 8, 2019, https://www.mom.gov.sg/employment-practices/leave/paternity-leave.
[143] "Shared Parental Leave", Ministry of Manpower, accessed November 8, 2019, https://www.mom.gov.sg/employment-practices/leave/shared-parental-leave.
[144] "Working Mother's Child Relief (WMCR)", Inland Revenue Authority of Singapore, accessed August 24, 2018, https://www.iras.gov.sg/IRASHome/Individuals/Locals/Working-Out-Your-Taxes/Deductions-for-Individuals/Working-Mother-s-Child-Relief--WMCR-/.
[145] "Workfare Skills Support (WSS) Scheme", Workforce Singapore, accessed December 12, 2021, https://www.wsg.gov.sg/programmes-and-initiatives/workfare-skills-support-scheme-individuals.html.
[146] Workforce Singapore, "Workfare Skills Support (WSS) Scheme".

polytechnics.[147] Both SkillsFuture Singapore and the Singapore Workforce Skills Qualifications program focus intensely on the development of STEM skills. [148] Notably, while there is a lack of publicly available information regarding the participation rates of women in the Workfare Skills Support Scheme, the initiative has the potential to be significantly beneficial in aiding returning women from STEM industries. As illustrated above, Singaporean women tend to leave the workforce at the ages of 30 and above. As such, the Workfare Skills Support Scheme can ensure that they are able to re-skills themselves and maintain their existing STEM skills and knowledge. The scheme can also be advantageous to women wishing to pursue STEM employment but are deterred due to the economic costs associated with STEM education.

Other schemes that have the potential to increase the participation rates of females in STEM employment but are not directly aimed at women include the A*STAR Graduate Scholarships. The A*STAR Graduate Scholarship programs are a part of the Agency for Science and Technology and Research also abbreviated as A*STAR. The agency has numerous scholarships, awards, programs and fellowships available to school students, undergraduates, PhDs and post doctorates.[149] Schemes such as the A*STAR Graduate Scholarship provide awardees with a large amount of financial support.[150] Thus, A*STAR scholarships have the ability to aid young women wishing to pursue STEM researcher paths. In addition, the high level of economic support suggests that women

[147] "Courses", MySkillsFuture, accessed December 12, 2021, https://www.myskillsfuture.gov.sg/content/portal/en/training-exchange/course-directory.html?fq=Course_Supp_Period_To_1%3A%5B2021-12-18T00%3A00%3A00Z%20TO%20*%5D&fq=IsValid%3Atrue&q=Tags%3A%22Workfare_Training%20Commitment%22&start=21 .

[148] "Singapore Workforce Skills Qualifications (WSQ), SkillsFuture, accessed November 8, 2019, https://www.ssg.gov.sg/wsq/wsq-for-individuals.html.

[149] "About A*STAR Scholarships", Agency for Science, Technology and Research, accessed November 8, 2019, https://www.a-star.edu.sg/Scholarships/Overview#201505-post-doc.

[150] "A*STAR Graduate Scholarship", Agency for Science, Technology and Research, accessed November 8, 2019, https://www.a-star.edu.sg/Scholarships/For-Graduate-Studies/A-STAR-Graduate-Scholarship-Singapore#2016874-service-commitment.

from low economic backgrounds can benefit from the programs. It is also notable that A*STAR has numerous schemes for younger age groups. This does suggest that schoolgirls can benefit and further their interest in STEM. Furthermore, A*STAR has attempted to increase the visibility of women in STEM. Department articles highlight successful female A*STAR graduates and employees. The articles ask female awardees and employees about their motivations as well as advice for younger generations of girls.[151]

However, in assessing many of the described programs and initiatives, a lack of statistical information surrounding the participation rates of women means that it is difficult to establish if Singaporean women in STEM are participating. In addition, the lack of direct programs for women in STEM suggests that institutional, social, cultural and political challenges are not adequately addressed. A further policy flaw lies in the fact that the Singapore government has not developed a centralised portal or website for working women. It may be time-consuming and challenging for women in STEM to find information about how to pursue STEM employment or return to work. Subsequent sections of this thesis will now seek to address a key research question, that being, have policies and initiatives been effective and if not, what are the key policy flaws and causes for them? As outlined above, the chapter will examine key policies, programs and initiatives that have the potential to aid girls and women in STEM.

[151] "Faces of A*STAR", Agency for Science, Technology and Research, accessed March 7, 2019, https://www.a-star.edu.sg/News-and-Events/faces-of-a-star/2.
"Mother's Day: Balancing Parenting, Work, Play, and Self-Care", Agency for Science, Technology and Research, accessed November 8, 2019, https://www.a-star.edu.sg/News-and-Events/faces-of-a-star/faces/faces/mother-s-day--balancing-parenting--work--play--and-self-care.

5.5.1 Women's Charter

Established in 1961, the Women's Charter has been described by Lee, Campbell and Chia as the only piece of legislation that relates directly to women in Singapore.[152] The Women's Charter was an election promise by the PAP headed Lee Kuan Yew. Around the time of its enactment, the then-Minister for Labour and Law, Kenneth Michael Byne proposed that that the charter was "something outside the ordinary stream of legislation that we consider it to be, in the real sense of the word, a Charter for women of our State."[153] Notably, the Women's Charter was primarily created in order to address issues surrounding marriage and polygamy.[154] However, Leong Wai Kum notes that the charter did ensure that women were granted the same legal status as their male counterpart. Under part forty-six of the charter, Singaporean women "have the right to separately to engage in any trade or profession or in social activities."[155] The charter also contends that "the husband and the wife shall have equal rights in the running of the matrimonial household."[156] The latter is an interesting inclusion because it suggests that men should also be responsible for household duties. The charter does not relate directly to women in STEM workplaces. However, this thesis has chosen to examine Singapore's Women's Charter in order to identify policy flaws and the extent that they may impact women in STEM.

---

[152] Lee, Campbell and Chia, *The 3 Paradoxes*, 42.
[153] Wai Kum Leong, "Fifty Years and More of the Women's Charter of Singapore", *Singapore Journal of Legal Studies* (July 2008): 5, https://heinonline-org.proxy.library.adelaide.edu.au/HOL/Page?handle=hein.journals/sjls2008&id=3&collection=journals&index=journals/sjls.
[154] Kanwaljit Soin, "Keynote Address", in *Singapore Women's Charter: Roles, Responsibilities and Rights in Marriage*, ed. Theresa W Devasahayam (Singapore: ISEAS Publishing, 2011), xiv.
[155] "Women's Charter: Rights and Duties 46", Singapore Statutes Online, accessed November 20, 2019, https://sso.agc.gov.sg/Act/WC1961?ProvIds=pr46-.
[156] Singapore Statutes Online, "Women's Chapter: Rights and Duties 46".

One of the largest issues with Singapore's Women's Charter is that it does not adequately address issues that impact women and their ability to participate in civil, political and economic activities. The Women's Charter is instead, focused on issues surrounding marriage, divorce, maintenance and sexual offences.[157] This concern is also shared by women's advocacy group, AWARE who note that the charter does not sufficiently cover other areas of women's rights.[158] The Association of Women for Action and Research contend that a more apt name for the Women's Charter is Family Charter because it addresses family issues rather than those experienced predominately by Singaporean women.[159] Similarly, Kanwaljit Soin remarks that the 1996 amendments to the Women's Charter were in areas such as family violence, divorce, maintenance of matrimonial assets and transgender marriage.[160] This was also the case in 2011 when the government chose to include provisions to mitigate the impact of divorces as well as to strengthen the enforcement of maintenance orders.[161] During a 2016 parliamentary hearing, most Singaporean MPs including Tan Chuan-Jin, Sun Xueling and Lily Neo discussed the charter and only examined it in terms of the provisions relating to marriage and divorce.[162] While some MPs such as Jessica Tan Soon Neo contended that the Women's Act is still relevant in today's climate, it can be argued that it does not aid current women who face institutional, cultural, political and economic challenges in the workplace. Moreover, the charter does state that men and women have equal responsibility in the running of their home, however, as illustrated above, policies and programs continue to

[157] "Women's Chapter: Bill No. 126/1961", Singapore Statutes Online, accessed May 11, 2018, https://sso.agc.gov.sg/Bills-Supp/126-1961/Published/19610303?DocDate=19610303.
[158] AWARE, "Education".
[159] Tan, Jolene, "Women's Charter Should Be Family Charter", *The Straits Times*, May 8, 2018, https://www.straitstimes.com/forum/letters-on-the-web/womens-charter-should-be-family-charter.
[160] Soin, "Keynote Address", xv.
[161] "Women's Charter", Singapore Council of Women's Organisations, accessed May 11, 2018, http://www.scwo.org.sg/resources/womens-charter/.
[162] "Women's Charter (Amendment) Bill: Volume 94, Sitting No 7", Parliament of Singapore, accessed November 8, 2019, https://sprs.parl.gov.sg/search/email/link/?id=021_20160229_S0003_T0001&fullContentFlag=false.

be framed in a matter that suggests that women are the primary caretakers of the home. This has significant repercussions for women in STEM because it means that issues around their participation in the workforce are not being adequately protected by the charter. This is also illustrated in a 1961 speech at the Legislative Assembly by Chan Choy Siong who explained that the charter "will not provide for equal pay among men and women, it will however make them fully realise their political, educational, cultural and economic equality in society".[163] Subsequently, the Singaporean government continues to avoid committing to legislation that would grant women with the right to be free from discrimination on the grounds of gender within the employment context.[164]

This has had, and continues to have, implications for women in STEM. While the charter does grant them the right to participate in STEM workplaces, it does not seek to address gendered inequalities or discrimination that may occur in the workplace. As a result, women in STEM have little legislative power to challenge unequal or unfair pay differences.

5.5.2 SkillsFuture

Developed in the latter part of 2015, the SkillsFuture platform is a government initiative that enables individuals to undertake programmes and courses that are regarded or identified as highly in demand by the Singaporean government. It aims to prepare graduates for the workforce, encourage life-long learning in experienced employees and re-skill older individuals wishing to return to the workforce.[165] Most of the programs are

[163] Lee, Campbell and Chia, *The 3 Paradoxes*, 41.
[164] "Work & Economy", AWARE: Women's Action, accessed July 20, 2019, http://www.womensaction.sg/article/work.
[165] "About SkillsFuture", SkillsFuture, accessed November 8, 2019, https://www.skillsfuture.sg/AboutSkillsFuture.
There is also a SkillsFuture program for Singaporean students. See Roberto Santiago de Roock and Mark Baildon, "MySkillsFuture for Students, STEM Learning, and the Design of Neoliberal Citizenship in

STEM-based.[166] Under the scheme, individuals above the age of 25 are provided with $500 credit to use on courses advertised on the SkillsFuture platform.[167] Notably, individuals over the age of 40, can be eligible for the SkillsFuture Mid-Career Enhanced Subsidy which allows for a 90% course subsidy.[168]

The SkillsFuture program has been successful in increasing the participation rates of individuals engaging in STEM. Available information from a 2017 parliamentary debate found that an estimated 55% of all participants in the program were women in 2016.[169] Information obtained from The Straits Times uncovered that since 2016, 285,000 individuals have used their SkillsFuture credit to take part in courses while 4,900 individuals have undertaken the SkillsFuture Series courses.[170] As of 2019, no other statistical information has been uncovered. The SkillsFuture Series courses are designed to educate individuals on STEM areas including data analytics, finance, tech-enabled services, digital media, cybersecurity, entrepreneurship, urban solutions and advanced manufacturing.[171] Individuals have the option of choosing from three proficiency levels. This is beneficial for women in STEM and particularly, those new to STEM education as will be discussed below. In addition, the SkillsFuture platform enables users to rate and evaluate programs.[172] This can be considered very beneficial particularly, as some programs still require individuals to pay a certain amount of course fees. This also has

Singapore", *Cognition and Instruction* 37, no. 3 (3 July 2019): 285–305, https://doi.org/10.1080/07370008.2019.1624545.

[166] "SkillsFuture Series", SkillsFuture, accessed October 10, 2019, https://www.skillsfuture.sg/series#whoisitfor.

[167] "SkillsFuture Credit", SkillsFuture, accessed August 24, 2018, https://www.skillsfuture.gov.sg/credit.

[168] "SkillsFuture Mid-Career Enhanced Subsidy", accessed August 24, 2018, https://www.skillsfuture.gov.sg/enhancedsubsidy.

[169] Parliament of Singapore, "Parliamentary Debates Singapore - Official Report Thirteenth Parliament: First Session Volume 94, No 44".

[170] Amelia Teng, "SkillsFuture, Four Years On", *The Straits Times*, July 2, 2018, https://www.straitstimes.com/singapore/education/skillsfuture-four-years-on.

[171] SkillsFuture, "SkillsFuture Series".

[172] MySkillsFuture, "Courses".

the potential for women to document their views on the program and listen to other experiences. It is also advantageous that SkillsFuture features courses from nationally recognised institutions as well as companies, community clubs and organisations.[173] This suggests that women may be able to connect with STEM businesses to a greater extent. It can also be found that courses from national universities and polytechnics can provide women in STEM with early pathways into STEM degrees should they wish to pursue STEM researcher careers.

A further advantage to the SkillsFuture platform is that it identifies and ensures that individuals with differing levels of IT or STEM competency can assess courses that suit their level of understanding.[174] This has a number of benefits for women wishing to pursue STEM particularly, as it caters to women unfamiliar with STEM concepts and mid-career women seeking to re-skill themselves. An additional feature is that SkillsFuture also provides part-time and full-time courses.[175] This can be regarded as helpful to women with familial responsibilities. Other components of the SkillsFuture initiative such as the SkillsFuture Mid-Career Enhanced Subsidy enable women past the age of 40 to undertake STEM courses even at the post-graduate level. This could be highly beneficial to women especially, those returning from career breaks. Women utilising the Mid-Career Enhanced Subsidy can choose to undertake STEM courses or postgraduate programs that allow them to increase their employment options as they learn specialist knowledge and become aware of industry trends.[176] The scheme may also provide women with a way to extend their professional networks. Programs such as the SkillsFuture Work-Study Degree Programmes also enable students to transition from

[173] MySkillsFuture, “Courses”.
[174] SkillsFuture, "SkillsFuture Series".
[175] MySkillsFuture, “Courses”.
[176] “The Benefits of Postgraduate Study”, Australian Catholic University, accessed November 8, 2019, https://www.impact.acu.edu.au/study/the-benefits-of-postgraduate-study.

universities into workplaces following graduation.[177] Students can be partnered with state bodies such as the Ministry of Defence, Government Technology Agency and the Defence Science and Technology Agency.[178] They can also be partnered with Singaporean STEM businesses. This has the potential to be particularly, advantageous to women in STEM who can be partnered with agencies that can offer them employment or valuable working experience.[179] In addition, women successful in the program could receive financial support. As such, it can be demonstrated that the framing of the SkillsFuture program has the potential to significantly impact the number of females engaged in STEM employment. This is due to the fact that the program caters to women of all ages, and addresses economic barriers associated with pursuing STEM education.

One of the biggest disadvantages of the SkillsFuture program, and an issue that has been raised throughout this chapter, is that it is not sufficiently tailored for women interested in pursuing STEM education and careers. A gender-blind approach towards measures has meant that issues that are likely to impact a woman's ability to undertake courses are not adequately addressed. As a result, a gender-blind approach has meant that SkillsFuture does not accommodate young mothers who may need lactation rooms, mothers requiring childcare leave or working women requiring flexible working arrangements.[180] In a 2015 press release, the PAP Women's Wing explained that SkillsFuture had the potential to disadvantage women with familial or caretaking responsibilities because some courses were not time flexible and many were undertaken on weekdays.[181] By 2017, issues

[177] "SkillsFuture Work-Study Programmes", SkillsFuture, accessed November 8, 2019, https://www.skillsfuture.gov.sg/workstudy.
[178] 'SkillsFuture, "SkillsFuture Work-Study Programmes".
[179] 'SkillsFuture, "SkillsFuture Work-Study Programmes".
[180] Julia Chan, "How Can Singapore Be A More Gender-Inclusive Place to Work?" *The New Savvy*, April 16, 2018, https://thenewsavvy.com/career/gender-inclusive-work-singapore/.
[181] "Budget 2015 Is "Pro-Woman", Timely Recognition for International Women's Day 2015", People's Action Party: Women's Wing, accessed October 21, 2019, https://www.pap.org.sg/womens-wing/thought-

surrounding the SkillsFuture program were again highlighted in a 2017 parliament sitting. The then-Deputy Speaker, Lim Biow Chuan explained the need for a SkillsFuture scheme specifically for women. He stated that the PAP government could begin to increase female participation in STEM by creating a "SkillsFuture Package for Back-to-Work Women encompassing modules in IT literacy and basic programming."[182] Notably, Chuan suggests that digital literacy and by extension, STEM knowledge would enable women to participate in the workplace thereby allowing Singapore to be "future-ready, having smart women for a smart nation."[183] This policy framing reflects neoliberal ideas and also associates women in STEM as being markers of a 'smart nation'. MP Darryl David also proposed that SkillsFuture would further aid women if there were dedicated programs for them. To a large extent, it can be argued that these concerns are warranted. Analysis into the SkillsFuture initiative has uncovered that women do not have any programs directly marketed for them.

A further point of concern is that while SkillsFuture does provide some economic aid for women wishing to participate in the initiative, it does not completely offset the costs associated with undertaking courses. In 2015, the PAP Women's Wing hinted that SkillsFuture could do more to help women from low economic backgrounds and who required additional funding aid to register for classes.[184] Subsequently, the PAP Women's Wing illustrated that the program could be further improved if it allowed family members to transfer un-used credit to stay-at-home mums. Correspondingly, during the 2017 parliamentary sitting, MP Joan Pereira reiterated that some women did not have the means to afford courses even with the established subsidies offered by the SkillsFuture

leadership/budget-2015-is-pro-woman-timely-recognition-for-international-womens-day-2015.PDF available on website.
[182] Parliament of Singapore, "Aspirations of Singapore Women (Motion) Volume 94, Sitting No 44".
[183] Parliament of Singapore, "Aspirations of Singapore Women (Motion) Volume 94, Sitting No 44".
[184] People's Action Party: Women's Wing, "Budget 2015 Is "Pro-Woman"".

initiative.[185] Pereira suggested that women could be provided with additional subsidies. Darryl David also hinted that increasing the credit available to women may also enable them to participate more in the program.[186] The costs associated with participating in the program could be a deterrent for women in STEM who may have to undertake STEM courses that are higher in cost. In addition, increasing the credits available to women may enable more to participate in year-long courses which may further their STEM interest. An additional disadvantage is that while the platform enables individuals to rate specific courses, there is no feature or evaluation process that examines whether the programs address women-specific concerns. These concerns can include whether they allow for flexible studying conditions. As such, the SkillsFuture program does have the potential to aid many Singaporean women in STEM with programs catering to individuals of all backgrounds, however, a lack of women centric programs as well as issues surrounding the costs of programs may deter some women from pursuing the initiative.

5.5.3 Flexible Working Arrangements

In recent years, the PAP Singaporean government has worked to promote the adoption of flexible working arrangements which have the potential to benefit women in STEM. Schemes such as the Enhanced Work-Life Grant for Flexible Working Arrangements provide companies with incentives to adopt flexible working arrangement practices or to support job sharing arrangements.[187] Flexible working arrangements include flexi-load, flexi-place and flexi-time. Under the grant, companies can receive up to $70,000 over two years for adopting flexible working arrangement practices while those that support

[185] Parliament of Singapore. "Parliamentary Debates Singapore - Official Report Thirteenth Parliament: First Session Volume 94, Sitting No 44".
[186] Parliament of Singapore. "Parliamentary Debates Singapore - Official Report Thirteenth Parliament: First Session Volume 94, Sitting No 44".
[187] "Enhanced Work-Life Grant for Flexible Work Arrangements", Ministry of Manpower, accessed November 8, 2019, https://www.mom.gov.sg/employment-practices/good-work-practices/work-life-grant.

job sharing arrangements can receive up to $35,000 over two years.[188] Only permanent or staff on a minimum contract term of 12 months are covered by the grant.

Flexible working arrangements have the potential to be beneficial for Singaporean women in STEM because some may find it easier to balance work and familial responsibilities. A 2018 Ministry of Manpower study uncovered that flexible working arrangements have contributed to greater levels of staff retention.[189] Nidhi Singh notes that flexible working arrangements reduce the likelihood of employees resigning.[190] Moreover, flexible arrangements had resulted "in better employee engagement, reduced employee turnover and increased productivity".[191] However, there is little detailed information on the amount of women who apply for the scheme as well as information about how long they can apply for leave and what industries they are employed in. Despite this, the Singaporean Minister for Manpower, Josephine Teo, revealed that seven in ten "employees in Singapore now work in companies that offer at least one formal flexi-work arrangement".[192] Tellingly, Teo explained that "for employees, FWA's allow them to better manage their obligations at work and their personal needs such as caregiving."[193] This policy framing does suggest that women are more inclined to use the measure.

[188] Ministry of Manpower, "Enhanced Work-Life Grant for Flexible Work Arrangements".
[189] Joanna Seow, "More Workers Can Opt for Flexible Work Arrangements: MOM Report", *The Strait Times,* January 28, 2019, https://www.straitstimes.com/singapore/manpower/more-workers-can-opt-for-flexible-work-arrangements-mom-report.
[190] Nidhi Singh, "Why It's Time to Embrace Workplace Flexibility", *Entrepreneur,* January 16, 2019, https://www.entrepreneur.com/article/326431.
[191] "Flexi-Work "More Common" in Singapore: MOM", Human Resources Director, accessed November 8, 2019, https://www.hcamag.com/asia/news/general/flexi-work-more-common-in-singapore-mom/172338.
[192] Human Resources Director, "Flexi-Work "More Common" in Singapore".
[193] Human Resources Director, "Flexi-Work "More Common" in Singapore".

A significant policy flaw lies in the fact that flexible working schemes have been overwhelmingly directed at working mothers rather than at Singaporean fathers. [194] A 2016 parliamentary meeting demonstrates that Singaporean policymakers continue to highlight and emphasise how flexible working arrangements enable women to undertake two roles. Policymakers may have perceived that flexible working arrangements provide women with the opportunity to contribute to the workforce without compromising on their familial responsibilities. [195] This again reinforces the idea that women are expected to prioritise their family and nation over their own aspirations. Moreover, and as explored in previous sections of this chapter, women undertaking flexible working arrangements may find it harder to advance into STEM leadership positions. This may mean that women in STEM are unlikely to have their issues addressed by STEM leaders. Flexible working arrangements may also mean that women earn less than their male counterparts.

Consequently, the promotion of flexible working arrangements by the PAP government suggests that it perceives women to be responsible for more of the domestic duties. There is no mention of the fact that men can also compromise their family life when working. A 2019 report uncovered that only 34% of working fathers with young children participated in flexi-time arrangements in 2018.[196] In 2019, the Manpower Minister, Josephine Teo acknowledged that flexible working arrangements had been directed significantly at working women. She remarked that "when you promote FWAs as something that only women need, then it creates a certain division in the workplace, which is that 'oh this is for women, they need special treatment."[197] Women in STEM

[194] "Debate on Annual Budget Statement Volume 94, Sitting No 12", Parliament of Singapore, accessed November 8, 2019, https://sprs.parl.gov.sg/search/sprs3topic?reportid=budget-696.
[195] Parliament of Singapore, "Debate on Annual Budget Statement Volume 94, Sitting No 12".
[196] "Most Working Dads Would Quit over Flexi-Work", Human Resources Director, accessed November 8, 2019, https://www.hcamag.com/asia/news/general/most-working-dads-would-quit-over-flexi-work/170153.
[197] Human Resources Director, "Most Working Dads Would Quit over Flexi-Work".

could face repercussions. For instance, companies may choose not to hire women in STEM out of the fear that they will take more leave than their male counterparts. As such, it is clear that Singaporean women in STEM may be deterred from this policy because it comes with the expectation that they are still primarily responsible for their familial and domestic duties.

5.5.4 Foreign Maid Levy Relief

One of the reasons why this chapter has chosen to explore the Foreign Maid Levy Relief is because it is perceived by academics and researchers as a notable form of policy and one that has contributed to higher rates of women labour participation. Established by the PAP government for Singaporean working women the initiative allows women to claim, "relief for (a) foreign domestic worker levy paid in the previous year."[198] Notably, only women with a married, separated, divorced or widowed status can apply for relief. The Inland Revenue Authority of Singapore cites that the primary aim of the scheme is to encourage Singaporean women to remain in the workforce.[199] The Singaporean government first introduced programs surrounding the use of foreign domestic workers in 1978. The scheme did result in an influx of foreign maids from countries including the Philippines, Indonesia and Sri Lanka.[200] In their work, Jean Lee, Kathleen Campbell and Audrey Chia uncovered that the female labour participation rate increased from 44.3% in 1980 to 51.3% in 1998.[201] This coincides with the fact that in 1988, there was an estimated 40,000 foreign maids in Singapore. In 1992, this had increased to 65,000 and by 1998, there were more than 100,000 foreign domestic maids in Singapore.[202] This suggests that

[198]"Foreign Maid Levy (FML) Relief", Inland Revenue Authority of Singapore, accessed August 24, 2018, https://www.iras.gov.sg/IRASHome/Individuals/Locals/Working-Out-Your-Taxes/Deductions-for-Individuals/Foreign-Maid-Levy--FML--Relief/.
[199] Inland Revenue Authority Singapore, "Foreign Maid Levy (FML) Relief".
[200] Lee, Campbell and Chia, *The 3 Paradoxes*, 60.
[201] Lee, Campbell and Chia, *The 3 Paradoxes*, 60-61.
[202] Lee, Campbell and Chia, *The 3 Paradoxes*, 60.

domestic workers have led to higher levels of female participation. Statistics from the Ministry of Manpower reveal that more households in Singapore are utilising the services of foreign domestic maids. In 2014, 222,500 work permits were provided to foreign domestic workers, however, by 2019, this figure has grown to 255,800.[203] Correspondingly, in recent times, Singapore has the second-largest population of foreign domestic workers in the Asia region.[204]

One of the biggest causes for concern with regards to the Foreign Maid Levy Relief is that there are significant policy implications for women working as domestic maids in Singapore. Recent findings into the conditions and working environment of domestic workers has found that most maids are susceptible to exploitation.[205] Despite some legal rights, domestic workers in Singapore can experience "overwork, verbal abuse, salary problems, inadequate food, and having to give their employers massages."[206] Unlike other Asian countries, Singapore does not guarantee a minimum wage for maids and there is no information on what constitutes as reasonable household work.[207] The Lee Kuan Yew School of Public Policy also uncovered that there is a power imbalance between foreign domestic workers, employment agencies and employers.[208] This increases the economic and social risks associated with being employed as a foreign domestic worker.

[203] Ministry of Manpower, "Foreign Workforce Numbers", accessed November 8, 2019, https://www.mom.gov.sg/documents-and-publications/foreign-workforce-numbers.
[204] Kok Xinghui, "Singapore's Domestic Workers Vulnerable to Forced Labour: Report", *South China Morning Post*, January 15, 2019, https://www.scmp.com/news/asia/southeast-asia/article/2182233/singapores-foreign-domestic-workers-vulnerable-forced.
[205] Xinghui, "Singapore's Domestic Workers".
[206] Xinghui, "Singapore's Domestic Workers".
[207] Ben Westcott and Katie Hunt, "Most Singapore Foreign Domestic Workers Exploited, Survey Says", *CNN*, December 4, 2017, https://www.cnn.com/2017/11/28/asia/singapore-domestic-helpers-maids/index.html.
[208] The Lee Kuan Yew School of Public Policy, "Foreign Domestic Workers in Singapore", 7.

Additionally, this initiative may not be helpful to women in STEM because it does not seek to change socio-cultural attitudes surrounding women and domestic work. As remarked upon by Huang and Yeoh, Singaporean working women employ foreign maids to resolve their own domestic crisis in the home.[209] Going further, they contend that working women "are complicit in perpetuating gendered notions of the reproductive sphere by shifting household responsibilities from local to migrant Third World women.[210] Similarly, this contributes to patriarchal ideology which maintains the belief that housework is women's work.[211]This has implications for women in STEM because it further enforces gendered stereotypes and exists alongside those which maintain that STEM careers are masculine.

A further issue with the scheme is that it is heavily dependent on women choosing to employ the services of a foreign maid. Research into the costs associated with hiring a foreign maid have found that it is expensive with short-term and long-term costs.[212] This suggests that only married women earning a sufficient level of income are able to claim the benefits associated with the Foreign Maid Levy Relief scheme. In addition, many Singaporean women in STEM working on a part-time or casual basis could be unable to afford the cost of hiring a foreign maid to aid them in their household responsibilities. A lack of other alternative measures means that it is unlikely that they will be able to offset domestic chores and return to their STEM careers. As such, it is clear that the Foreign Maid Levy Relief measure does not address the social and economic implications of

[209] Shirlena Huang and Brenda S.A Yeoh, "Maids and Ma'ams in Singapore: Constructing Gender and Nationality in the Transnationalization of Paid Domestic Work", *Geography Research Forum* 18 (1998): 25, https://scholarbank.nus.edu.sg/handle/10635/20093.
[210] Huang and Yeoh, "Maids and Ma'ams in Singapore".
[211] Shirlena Huang and Brenda S. A. Yeoh, "Ties That Bind: State Policy and Migrant Female Domestic Helpers in Singapore", *Geoforum* 27, no. 4 (1 January 1996): 479, https://doi.org/10.1016/S0016-7185(96)00023-1.
[212] "(2021 Edition) How Much Does It Cost To Hire A Maid In Singapore?' Dollars and Sense, accessed November 8, 2019, https://dollarsandsense.sg/2019-edition-much-cost-hire-maid-singapore/.

domestic work. Foreign maids are at risk of exploitation and moreover, working women may find it expensive to hire one. Consequently, women in STEM and especially, those in part-time, casual positions as well as those on career breaks may not benefit from the scheme.

5.6 Conclusion

By employing feminist analytical approaches, including a gendered discursive policy framing analysis and drawing from a range of scholarly and government sources, this chapter has revealed that the Singaporean government has implemented valuable policies and programs for girls and women interested in pursuing STEM education and occupations. However, programs have a number of flaws that can undermine women's participation in STEM. The Singaporean government's commitment to increasing the participation rates of girls and women in STEM has been contradictory as government discourse argues for both the need for women to fulfil familial roles whilst also contributing to the economy. These dual expectations have sometimes resulted in flawed policy framing. The government has, and continues to, change policies and programs that impact women when they perceive it to be necessary for safeguarding Singapore's economic wellbeing. The Singaporean government's discourse also involves a gender-neutral and meritocratic approach. This has meant that STEM is not heavily regarded as a masculine area of study or work. Nonetheless, subsequent sections of this chapter also demonstrated that the meritocratic and gender-blind approach has also meant that barriers faced by women in STEM have not been adequately acknowledged or addressed by the examined policies and initiatives. Consequently, despite the fact that Singapore's version of neoliberalism potentially allows for more government intervention than is the case in many other countries, some useful interventions have not occurred. Moreover, a lack of

up-to-date statistical information regarding the participation rates of females in STEM means that it is challenging to ascertain whether there are large scale areas of concern. The lack of publicly available reports about programs makes it hard to determine whether women in STEM are taking part in schemes and whether they are benefiting from them. Despite this, initiatives such as SkillsFuture do demonstrate that the Singaporean government is committed to increasing its STEM labour force. The positive as well as negative lessons that can be learned from Singapore's approach will be further discussed in the Conclusion. Chapter Six of this thesis will now examine how Australian, Indian, and Singaporean governments have capitalised on the benefits technology provides by encouraging women to pursue entrepreneurial careers, noting that the emphasis on entrepreneurism also reveals the influence of neoliberalism in all three countries.

Chapter 6: Expanding on the T in STEM

6.1 Introduction

As acknowledged in Chapter One, a feminist comparative examination of Australian, Indian and Singaporean government policy via a case study approach has enabled this thesis to explore differences and also identify similarities. A key similarity that has been identified is the influence of neoliberal ideology which has seen the adoption of entrepreneurial policies and initiatives for women. Australian, Indian and Singaporean governments have also closely aligned STEM with entrepreneurship.[1] Drawing on the work of Adrienne Roberts it will be argued that the common focus on neoliberal entrepreneurship reflects what she terms "transnational business feminism".[2] Whilst some of these can benefit women in STEM, the chapter will outline how such a neoliberal discursive framing has led to policy and program flaws.

Using the feminist analytical approaches outlined previously, including a gendered discursive policy framing approach, the chapter will analyse some Australian, Indian and Singaporean policies and initiatives that aim to increase the participation rates of women in entrepreneurial roles. The examined policies and initiatives were active as of February 2022. Additionally, by drawing on policy discourse such as policies, initiatives,

[1] Debra Panizzon and Deborah Corrigan, "Innovation and Entrepreneurship as Economic Change Ages: The Role of STEM Education in Australia", *XVII IOSTE Symposium* 12 (July 2016): 1–9, https://www.researchgate.net/publication/322244731_Innovation_and_entrepreneurship_as_economic_change_ages_The_role_of_STEM_education_in_Australia.
Shuriah Niazi, "India Has Reached 'Watershed' for Science and Innovation", *University World News*, June 18, 2021, https://www.universityworldnews.com/post.php?story=20210618133004502.
"Singapore Women in Tech: Championing Future Generations of Females in STEM", SGInnovate, February 10, 2021, https://www.sginnovate.com/blog/singapore-women-tech-championing-future-generations-females-stem.
[2] Adrienne Roberts, "The Political Economy of 'Transnational Business Feminism'", *International Feminist Journal of Politics* 17, no. 2 (2014): 209-210, https://www.tandfonline.com/doi/full/10.1080/14616742.2013.849968.

government material and reports, the chapter will argue that Australian, Indian and Singaporean governments have capitalised on the opportunities technology provides by developing programs that encourage women to pursue entrepreneurial roles. However, sections of this chapter will illustrate some of the ways that Australian, Indian and Singaporean governments have overemphasised the positive attributes of entrepreneurial roles without consideration of the potential economic consequences should a venture fail. Moreover, the chapter will argue that governments have neglected to understand how women entrepreneurs are interacting with STEM. Women entrepreneurs are engaging with STEM in ways that have not been thoroughly assessed by policymakers or researchers. Consequently, the insights obtained from this chapter will provide essential background for the discussion of possible suggestions for improving policy which will be explored in the Conclusion.

In recent years, Australian, Indian and Singaporean governments have recognised that technological advances have made it possible for women to participate in the economy whilst allowing them to undertake flexible working conditions.[3] Australian, Indian and Singaporean governments have taken advantage of the benefits technology provides by creating programs that aim to increase the rates of women undertaking entrepreneurial roles. Entrepreneurial pathways offer STEM researchers a way to market and sell new technologies, innovations, products and services. STEM entrepreneurships can

[3] "Future of Work: Where Technology and Work Intersect", Workplace Gender Equality Agency, last modified May 12, 2020, https://www.wgea.gov.au/publications/future-of-work-technology-and-work.
"Action Area: Jobs of the Future: Towards 2025 - An Australian Government Strategy to Boost Women's Workforce Participation", Australian Government, accessed November 26, 2021, https://womensworkforceparticipation.pmc.gov.au/action-area-jobs-future.html.
"Women Entrepreneurs", Ministry of Micro, Small & Medium Enterprises, accessed November 26, 2021, https://msme.gov.in/women-entrepreneurs.
"SBF Launches the Singapore Women Entrepreneurs Network to Connect Women Entrepreneurs", Singapore Business Federation, accessed November 2, 2021, https://www.sbf.org.sg/sbf-launches-the-singapore-women-entrepreneurs-network-to-connect-women-entrepreneurs.

strengthen a country's ability to compete in international markets and create new careers and industry opportunities.[4] Consequently, Australian, Indian and Singaporean governments have been keen to encourage girls and women to pursue STEM entrepreneur pathways. Notably, a focus on increasing the participation rates of women entrepreneurs reveals "a neoliberal model of competition, privatization, and market-based development."[5] Further sections of this chapter will illustrate how entrepreneurial roles which are shaped by neoliberal ideology do have the potential to negatively impact some groups of women. This insight will be used as background for the discussion of how policies can be strengthened as well as how governments can implement additional schemes to address some of the issues explored in this chapter.

6.2 Overview

This section will briefly illustrate how technology has potentially benefited women and, moreover, created new opportunities for women with familial responsibilities to work, while also acknowledging some potential downsides in terms of gendered care responsibilities. This section is useful in explaining why Australian, Indian and Singaporean policymakers have created programs that encourage women to undertake entrepreneurial based work. This thesis recognises that the term 'entrepreneurship' is deeply multifaceted with a lack of a commonly recognised definition.[6] Despite this, the

[4] "Australian Government Science, Technology, Engineering and Mathematics (STEM) Initiatives for Girls and Women", Australian Government, accessed February 14, 2020, https://www.industry.gov.au/sites/default/files/2019-04/australian-government-stem-initiatives-for-women-and-girls.pdf.

[5] Natascia Boeri, "Challenging the Gendered Entrepreneurial Subject: Gender, Development, and the Informal Economy in India", *Gender & Society* 32, no. 2 (1 April 2018): 158, https://doi.org/10.1177/0891243217750119.

[6] Margaret Kobia and Damary Sikalieh, "Towards a Search for the Meaning of Entrepreneurship", *Journal of European Industrial Training* 34, no. 2 (1 January 2010): 110–27, https://doi.org/10.1108/03090591011023970.

thesis will define 'entrepreneurship' as "anyone who starts and builds a business".[7] Entrepreneurial ventures can be based in many industry areas and sectors.

Technological advances as well as the creation of IT platforms, applications and tools have altered the way that women can potentially participate in the economy. Technological devices and online platforms are not geographically constrained thereby supporting working from home arrangements.[8] As Marian Baird explains, working from home eases some pressure on women "who were usually rushed for time getting to work and preparing children for school, meals and after school pickups."[9] However, recent research surrounding the impact of working from home arrangements during the COVID-19 pandemic found that without support systems such as school and childcare, women face a disproportional amount of household labour.[10] The above findings are based on the idea that many women undertaking working from home arrangements are likely to have a child in school or childcare. An additional consideration is that technology has potentially helped to mitigate some of the experiences and challenges faced by working women. As explained in Chapter Two, women in STEM industries can often be marginalised due to existing workplace practices that reinforce so-called 'boys clubs'. Rani Molla notes that utilising technology and working from home has meant that women may be less likely to experience gendered practices that can occur in workplaces.[11]

---

[7] "Self-Employment and Entrepreneurship", National Skills Commission, accessed December 18, 2021, https://www.nationalskillscommission.gov.au/self-employment-and-entrepreneurship.
[8] Ukpere, Slabbert, and Ukpere, "Rising Trend in Social Media Usage", 553.
The Telegraph, "The Ultimate Business Cost Efficiency Guide", *The Telegraph*, June 16, 2021, https://www.telegraph.co.uk/business/ready-and-enabled/cost-efficiency/guide-for-businesses/.
[9] Anna Patty Wade Matt, "'They Know the Drill": Women Happier Working from Home than Men", *The Sydney Morning Herald*, October 27, 2020, https://www.smh.com.au/business/workplace/they-know-the-drill-women-happier-working-from-home-than-men-20201026-p568pw.html.
[10] Monique Frize et al., "The Impact of COVID-19", 391.
[11] Rani Molla, "For Women, Remote Work Is a Blessing and a Curse", *Vox*, July 13, 2021, https://www.vox.com/recode/22568635/women-remote-work-home.

Entrepreneurial roles have been cited as a viable area of employment given that technology has made it possible for women to virtually develop, market and sell items and services. While there is a lack of detailed information regarding women entrepreneurs, available data indicates that 40% of new entrepreneurs are women.[12] This growth suggests that technology has made it easier for women to pursue entrepreneurial roles.[13] Technological platforms and social media platforms have been used by some women entrepreneurs in STEM and non-STEM sectors to market to global audiences while also finding niche clienteles.[14] Women entrepreneurs have also invested more in social media than their male counterparts.[15] Technology can also provide women entrepreneurs with the ability to access information and knowledge as well as join social and business networks.[16] Women from disadvantaged backgrounds can create and join online communities that help them in their entrepreneurial venture.[17] This may reduce feelings of isolation as explored in Chapter Two. Technology can also facilitate a means of entering spaces and areas that have been identified as masculine. In traditionally male-orientated markets, products that are manufactured by women tend to be valued less than their male counterparts and vice versa.[18] However, technology and digital services have provided women with some means of anonymously engaging in economic markets that

[12] Caroline Castrillon, "Why More Women Are Turning To Entrepreneurship", *Forbes*, February 4, 2019, https://www.forbes.com/sites/carolinecastrillon/2019/02/04/why-more-women-are-turning-to-entrepreneurship/.
[13] Joe McKendrick, "Technology Is Driving Entrepreneurial Growth, And We're Not Just Talking About Silicon Valley", *Forbes*, November 28, 2017, https://www.forbes.com/sites/joemckendrick/2017/11/28/technology-is-driving-entrepreneurial-growth-and-were-not-just-talking-about-silicon-valley/.
[14] See "Women Entrepreneurs We Love", Shopify, accessed November 26, 2021, https://www.shopify.com.au/blog/women-owned-businesses.
[15] Ukpere, Slabbert, and Ukpere, "Rising Trend in Social Media Usage", 553.
[16] United Nations Conference on Trade and Development, *Empowering Women Entrepreneurs through Information and Communications Technologies: A Practical Guide* (New York and Geneva, 2014), 13-14, https://unctad.org/system/files/official-document/dtlstict2013d2_en.pdf.
[17] Crittenden, Crittenden, and Ajjan, "Empowering Women Micro-Entrepreneurs in Emerging Economies", 199.
[18] "Better If It's Man-Made?" Stanford Graduate School of Business, accessed March 2, 2020, https://www.gsb.stanford.edu/insights/better-if-its-man-made.

were previously regarded as male dominated. Consequently, entrepreneurship can be regarded as an alternative career path that allows women to engage in the economy whilst also attending to (gendered) familial obligations.[19]

Whilst the above illustrates how entrepreneurial careers can counter challenges as outlined in Chapter Two, it can be argued that governments have also framed entrepreneurial careers as a solution to resolving gender equality and moreover, improving the conditions of economic markets. In her work on transnational business feminism, Adrienne Roberts suggests that governments and private actors have sought to take a market-orientated approach to gender inequality. In doing so, 'investing' in women is perceived as financially beneficial to both the state and global economy.[20] Analysing Australian, Indian and Singaporean discourse reveals that governments have adopted an economic lens with regards to policies and programs that support women entrepreneurs. A 2022 Australian government press release states that "supporting Australia's women entrepreneurs to build successful businesses is good for their economic security, and good for the Australian economy". [21] Similarly, India's Union Home Minister Amit Shah noted a record of loans dispersed to "women entrepreneurs who today empower the Indian economy with their womanly force". [22] The Singaporean government has also sought to promote how women entrepreneurs have made contributions that have supported the economy.[23] These instances demonstrate that Australian, Indian and Singaporean

[19] Meraiah Foley, Marian Baird, Rae Cooper and Sue Williamson, "Is Independence Really an Opportunity? The Experience of Entrepreneur-Mothers", *Journal of Small Business and Enterprise Development* 25, no. 2 (1 January 2018): 313–29, https://doi.org/10.1108/JSBED-10-2017-0306.
[20] Adrienne Roberts, "The Political Economy of 'Transnational Business Feminism'", 209-210.
[21] "Supporting Businesswomen to Launch to New Heights", Department of Industry, Science and Resources, accessed 23 July 2023, https://www.minister.industry.gov.au/ministers/duniam/media-releases/supporting-businesswomen-launch-new-heights.
[22] Press Trust of India, "Modi Govt Disbursed 27 Crore Mudra Loans To Women: Home Minister Amit Shah", *Outlook India*, 6 June 2023, https://www.outlookindia.com/national/modi-govt-disbursed-27-crore-mudra-loans-to-women-home-minister-amit-shah-news-292532.
[23] "Opening Speech by Mrs Josephine Teo, Minister of Communications and Information, at the Motion on Singapore Women's Development on 5 April 2022", Singapore Ministry of Communications and

governments are contributing to and legitimising discourse that aligns gender equality to 'smart economics', a term coined by the World Bank which has been popularised by private corporations and governments. [24] The term 'smart economics' is based on the idea that there is a business case for gender equality. By investing in girls and women, governments and private actors can increase competitiveness, productivity and profitability. Women are engaged or empowered to participate in the economic market as opposed to a non-economic activity such as housework. Participation in the economic markets is perceived to be a solution to all sorts of problems.[25] However, as noted by Roberts, transnational business feminism reproduces many neoliberal macroeconomic conditions, including the devaluing of social reproduction.[26] Like the neoliberal discursive framing which influences it, transnational business feminism also neglects to consider the causes of gender-based inequality. This has meant that governments and private actors have not sufficiently sought to address challenges faced by working women as identified in this thesis. As the next section will highlight, Australian, Indian and Singaporean governments have recognised the benefits of technology examined in this section and thus, have created programs that encourage women to pursue entrepreneurial work.

6.3 Government Programs for Women Entrepreneurs

As noted above, technology has made it easier for women entrepreneurs to work from home while also undertaking domestic responsibilities. Additionally, analysing

Information, accessed 23 July 2023, https://www.mci.gov.sg/pressroom/news-and-stories/pressroom/2022/4/opening-speech-by-minister-josephine-teo-at-the-motion-on-singapore-womens-development-on-5-april-2022.

[24] Roberts, "The Political Economy of 'Transnational Business Feminism'", 209-10, 212

[25] Elizabeth Prügl and Jacqui True, "Equality Means Business? Governing Gender through Transnational Public-Private Partnerships", *Review of International Political Economy* 21, no.6 (2014): 1143, https://www.tandfonline.com/doi/full/10.1080/09692290.2013.849277.
Roberts, "The Political Economy of 'Transnational Business Feminism'", 219.

[26] Roberts, "The Political Economy of 'Transnational Business Feminism'", 220.

government discourse has revealed that Australian, Indian and Singaporean governments have adopted an economic lens to gender equality. The development of policies that encourage women to adopt entrepreneurial careers suggests that Australian, Indian and Singaporean governments are also influenced by neoliberal ideology that contends that women should be primarily responsible for their own economic standing.[27] As noted in previous chapters, this neglects the fact that there are social, cultural, political and economic factors that undermine women's participation in the labour force. Subsequent sections of this chapter will explain how entrepreneurial roles can pose severe economic and social harms. While issues of length prevent the examination of all programs for women entrepreneurs, this section will examine a few key ones to emphasise that Australian, Indian and Singaporean governments have capitalised on the opportunities technology provides by creating programs that seek to encourage women to pursue entrepreneurial roles. Government discourse including press statements, reports and websites will be utilised. The section will seek to address the key research questions as outlined in Chapter One. Notably, the examined programs are not exclusively for women with STEM expertise.

6.3.1 Australia

6.3.1.1 Women in STEM and Entrepreneurship (WISE) Program

Announced in December of 2016, the Women in STEM and Entrepreneurship (WISE) Program aims to support investment in gender equity initiatives that seek to eliminate barriers for women's participation in STEM education and careers, and entrepreneurship.[28] The program is a component of the Inspiring all Australians in Digital

[27] Boeri, "Challenging the Gendered Entrepreneurial Subject", 158.
[28] "Supporting Women in STEM and Entrepreneurship", Department of Industry, Science, Energy and Resources, November 6, 2017, https://www.minister.industry.gov.au/ministers/sinodinos/media-releases/supporting-women-stem-and-entrepreneurship.

Literacy and STEM element of the National Innovation and Science Agenda.[29] The then-Acting Minister for Industry, Innovation and Science, Michaelia Cash stated that the program aids girls and women by "helping them develop entrepreneurial skills and professional networks, paving the way for more Australian women to start their own businesses and become entrepreneurs."[30] Notably, this discursive framing positions women entrepreneurs as resources that have the potential to increase national productivity. The framing also neglects to address the fact that women entrepreneurs may require more support than the developing of entrepreneurial skills and networks to counter gendered norms, practices and beliefs. Notably, the WISE program closely associates STEM and entrepreneurial careers. The Australian government may perceive that women with STEM skills are more likely to succeed in an entrepreneurial career. It also suggests that the government is keen to increase its innovation status and believes that women can further this agenda.

Determining the effectiveness of the WISE program has been challenging because there are no publicly available documents which illustrate the extent that programs funded by the WISE grant have been successful. In 2019, Treasurer Josh Frydenberg revealed that the current future female entrepreneurs program had supported 55,000 young women.[31] However, this cannot be verified. Final report templates from August 2017 and October 2017 reveal that awardees had to provide a vast amount of information about the

"Women in STEM and Entrepreneurship – Round 3", Australian Government: Business, accessed January 20, 2021, https://business.gov.au/grants-and-programs/women-in-stem-and-entrepreneurship.

[29] "Archived Grant Opportunity View – GO102", Australian Government - Grant Connect, accessed December 19, 2021, https://www.grants.gov.au/Go/Show?GoUuid=8A2902CA-EE6D-3DA6-478A-215246D52A52.

[30] Department of Industry, Science, Energy and Resources, "Supporting Women in STEM and Entrepreneurship".

[31] *The Guardian*, "Treasurer Josh Frydenberg's 2019 Budget Speech".
See also "Budget Archive 2020-21", Australian Government, accessed December 19, 2021, https://archive.budget.gov.au/2020-21/index.htm. Budget document titled 'JobMaker – Creating Jobs and Rebuilding Our Economy', 41.

expenditure of the initiative. Questions regarding the initiative's outcomes were framed in a manner that prioritised short answer responses.[32] Feedback obtained from participants also has the potential to be influenced by external factors or be possibly biased. Allowing awardees to submit reports rather than undertaking independent evaluations could be a policy flaw because it could potentially lead to misleading project outcomes. Furthermore, it is not known whether there are sufficient regulatory measures in place in order to ensure that programs are effective. A lack of clear and accessible documentation about the effectiveness of the initiative means that it is challenging to determine if there is a clear causal relationship between the implementation of these programs and the participation rates of girls and women in STEM. Instead, researchers and government agencies may need to rely on reports produced by research institutes that indicate that Australian women's participation in entrepreneurial pursuits is significantly lower than that of Australian men.[33] A lack of a clear evidence base has the potential to impact women's participation in STEM and suggests that there are significant policy flaws with regards to the regulatory measures in place to ensure the efficiency of programs. Notably, the 2021 round of the grant application process recommends that successful applicants evaluate their project using the Australian government's Women in STEM Ambassador's National Evaluation Guide.[34] It is unclear as to whether it is compulsory for successful applicants to provide an evaluation of their project due to the use of terminology which states 'recommends' rather than 'must'. Despite this, the Department of Industry, Science, Energy and Resources 2020 Action Plan reveals that

[32] "Commonwealth Grant Agreement", August 2017, Department of Industry, Innovation and Science, 17-19. PDF only available via Google search. Automatically downloaded.
"Women in STEM and Entrepreneurship – Sample Grant", October 2017, Department of Industry, Innovation and Science, 7-9. PDF only available via Google search. Automatically downloaded.
[33] Peter Alford, "Age is No Barrier to Starting a Business", *The Australian*, March 19, 2019, https://www.theaustralian.com.au/higher-education/age-is-no-barrier-to-starting-a-business/news-story/178e012908b2e944f4428c7f878987b6.
[34] Australian Government: Business, "Women in STEM and Entrepreneurship – Round 3".

future WISE grants "could be used to upscale projects that have been evaluated and clearly demonstrate their impact in accelerating gender equity in STEM."[35]

Other concerns about the program lie in the fact that it encourages women in STEM to turn to entrepreneurial pursuits without addressing relevant gendered issues as explained in Chapters Two and Three. In 2016, then-Minister Greg Hunt subscribed that the WISE program would "contribute to gender equality and economic growth by driving systemic change and improving career opportunities and pathways for women."[36] This discursive framing reflects the idea that entrepreneurial avenues provide women with economic empowerment and are more resistant to gender inequalities. It also presumes the neoliberal ideal that women are largely responsible for systemic change with limited government intervention. However, entrepreneurial start-ups require adequate levels of funding, are less legally protected and have little job security. Other key barriers to women entrepreneurs include issues surrounding implicit and explicit bias, prejudice against women's pitches and a lack of women making investment decisions.[37] Given this, the program's framing has the potential to produce damaging policy outcomes for women in STEM. Additionally, the WISE program does not guarantee initiatives with the necessary funding to continue long-term agendas. Many of the awarded grants are limited in scope and are short-term solutions to a highly multifaceted problem. For instance, a project that is only held for three days may not be enough to convince female students or

[35] "Advancing Women in STEM Strategy: 2020 Action Plan", Department of Industry, Science, Energy and Resources, accessed January 5, 2021, https://www.industry.gov.au/data-and-publications/advancing-women-in-stem-strategy/2020-action-plan.
[36] "$8 Million to Support Women in STEM and Entrepreneurship", Greg Hunt, accessed December 19, 2021, https://www.greghunt.com.au/8-million-to-support-women-in-stem-and-entrepreneurship/.
[37] Joan Winn, "Women Entrepreneurs: Can We Remove the Barriers?" *International Entrepreneurship and Management Journal* 1, no.3 (2005): 386, https://link-springer-com.proxy.library.adelaide.edu.au/article/10.1007/s11365-005-2602-8.

women to undertake STEM education and entrepreneurial careers especially, given the prevalence of powerful social, cultural and familial influences.[38]

Consequently, while some women may indeed benefit from the programme, the WISE program does not adequately tackle issues faced by women entrepreneurs given its lack of a regulatory framework and inability to address challenges associated with funding. The WISE initiative also prioritises short-term programs that may not be successful in countering pervasive familial, social, cultural and economic influences that deter girls and women from STEM and entrepreneurial careers.

In contrast to Australia's WISE program, the Indian government under Modi has developed an initiative that seeks to address some of the challenges identified in Chapter Four. However, there are a number of concerns as the section below will explore.

6.3.2 India

6.3.2.1 The Women Entrepreneurship Platform

The Women Entrepreneurship Platform (WEP) was developed by the National Institution for Transforming India (NITI Aayog) in 2018 under the Modi government.[39] The platform provides Indian women with an online unified entry portal that provides access to information from government and private sector actors as well as services such as free credit ratings, a community forum, mentorship opportunities, and funding support.[40] The

[38] Australian Government: Business, "Women in STEM and Entrepreneurship Grant Recipients", last modified June 4, 2021, https://business.gov.au/grants-and-programs/women-in-stem-and-entrepreneurship/women-in-stem-and-entrepreneurship-grant-recipients.

[39] "NITI Aayog to Launch Women Entrepreneurship Platform on International Women's Day", Government of India: Press Information Bureau, accessed June 28, 2019, http://pib.nic.in/newsite/PrintRelease.aspx?relid=177074.

[40] "About WEP", Government of India: NITI Aayog, accessed April 29, 2019, https://wep.gov.in/about-wep.

Government of India: Press Information Bureau, "NITI Aayog to Launch Women Entrepreneurship Platform on International Women's Day".

WEP specifies that "as a driver of change, (it) will also promote offline initiatives and outreach programmes to promote entrepreneurial spirit among potential women entrepreneurs."[41] The program was developed because of the Indian government recognising growth in female driven entrepreneurial start-ups. In his speech to the Women Entrepreneurship Platform Conclave, the Vice President of India, Shri M. Venkaiah Naidu cited that more than 8 million women have started or are running businesses in India. Naidu also explained that 58% of women entrepreneurs were starting ventures between the ages of 20 and 30. The "newly developed WEP portal will enable increased engagement between the entrepreneurs and ecosystem enablers."[42] The WEP platform aims to foster greater female labour participation which has the potential to increase India's GDP. Women's contribution to India's GDP is at 17% with labour force participation at approximately 27%. This is below the global average of 37%.[43] Correspondently, the Press Information Bureau released a statement commenting that "the platform aspires to substantially increase the number of women entrepreneurs who will create and empower a dynamic New India."[44] This discursive framing illustrates and reaffirms that the Indian government under Modi is influenced by neoliberal ideology which puts the onus on women to independently empower themselves. The framing also suggests that an economic lens has been applied to gender equality. The Indian government perceives the increasing of women entrepreneurs as contributing to national development. As illustrated in Chapter Four, this ignores the social and cultural barriers that deter women from STEM employment. Analysing the WEP has revealed that it

[41] Government of India: NITI Aayog, "About WEP".
[42] "All Political Parties Should Ensure the Passage of Women's Reservation Bill: Vice President", Government of India: Press Information Bureau, accessed June 28, 2019, http://pib.nic.in/newsite/PrintRelease.aspx?relid=186453.
[43] Government of India: Press Information Bureau, "All Political Parties Should Ensure the Passage of Women's Reservation Bill: Vice President".
[44] Government of India: Press Information Bureau, "NITI Aayog to Launch Women Entrepreneurship Platform on International Women's Day".

promotes and supports many female entrepreneurial start-ups and businesses that can be considered as heavily STEM-based.[45] The WEP program provides resources and information that encourages women to learn STEM concepts or adopt STEM practices.[46]

One advantage for women entrepreneurs is that the WEP has developed partnerships with industry groups such as NASSCOM, the Federation of Indian Chambers of Commerce & Industry, the Confederation of Indian Industry and Small Industries Development Bank of India. Moreover, partnerships with business entities including ShopClues can also be considered valuable as they have promised to deliver mentorships to 12 female entrepreneurs a year.[47] These discussed benefits do address some of the issues identified in previous sections of Chapter Four. Women entrepreneurs are provided with practical learning experiences, networking opportunities and chances to obtain venture capital. However, a lack of data means that it is challenging to uncover how many women have benefited from the program. It is also unclear as to the extent that the WEP benefits women from disadvantaged communities and backgrounds.

The WEP can be harmful to women in STEM because it does not provide adequate information on the dangers that can befall them when they choose to pursue certain schemes. This is particularly concerning as a majority of the initiatives listed on the WEP are microcredit schemes.[48] While these schemes provide loans to women who wish to

[45] Government of India: NITI Aayog, "About WEP".
"Small Business Innovation Research Initiative (SBIRI)", Government of India: NITI Aayog (The Women Entrepreneurship Platform), accessed February 22, 2020, https://wep.gov.in/knowledge-bank/blogs/small-business-innovation-research-initiative-%28sbiri%29.
[46] "Knowledge Bank - Technology", Government of India: NITI Aayog (The Women Entrepreneurship Platform), accessed February 22, 2020, https://wep.gov.in/knowledge-bank/listing/growth-management/technology.
[47] Sanghamitra Kar, "On Women's Day, Niti Aayog Launched Women Entrepreneurship Platform", *Economic Times*, March 8, 2018, https://economictimes.indiatimes.com/startups/on-womens-day-niti-aayog-launches-women-entrepreneurship-platform/articleshow/63217679.cms.
[48] "Saranya (Self Employment Scheme For The Destitute Women)", Government of India: NITI Aayog (The Women Entrepreneurship Platform), accessed July 15, 2019, https://wep.gov.in/knowledge-bank/blogs/saranya-%2528self-employment-scheme-for-the-destitute-women%2529.

pursue STEM based work, especially in IT, they also have the potential to severely impact their economic well-being. Katharine Rankin also contends that microcredit schemes should be recognised as a state strategy that constitutes women's needs in a manner consistent with the neoliberal agenda.[49] Rankin notes how neoliberal ideology has influenced the development of microcredit schemes which frame and reinforce the idea that women are largely responsible for their own economic progress. Microfinance supports the idea of women being 'rational' economic actors who can self-regulate markets.[50] In her work on transnational business feminism theory, Roberts also remarks on the tendency for women to be viewed as 'rational' because they are perceived to be more risk adverse than men.[51] This aversion to risk which has been gendered as feminine has been deemed as an important asset that can support profitability and performance. Additionally, the framing of women as 'rational' also supports a neoliberal framing that women can lift themselves out of poverty due to their responsible behaviour and individual choices.[52] This framing, however, does not consider historical, social, economic and political factors that have contributed to gendered norms, practices and beliefs nor does it recognise the role women play with regards to social reproduction. This lack of recognition means that microcredit schemes do not significantly challenge gendered norms, practices and beliefs because they are based on the premise that access

"Credit Guarantee Fund Trust For Micro And Small Enterprises (Cgtmse)", Government of India: NITI Aayog (The Women Entrepreneurship Platform), accessed July 15, 2019, https://wep.gov.in/knowledge-bank/blogs/credit-guarantee-fund-trust-for-micro-and-small-enterprises-%28cgtmse%29.
"Sidbi Make In India Loan For Enterprises (Smile)", Government of India: NITI Aayog (The Women Entrepreneurship Platform), accessed July 15, 2019, https://wep.gov.in/knowledge-bank/blogs/sidbi-make-in-india-loan-for-enterprises-%2528smile%2529.

[49] Katharine Rankin, "Governing Development: Neoliberalism, Microcredit, and Rational Economic Woman", *Economy and Society* 30, no. 1 (2001): 20, https://www.tandfonline.com/doi/abs/10.1080/03085140020019070.

[50] Rankin, "Governing Development", 32.
See also K. Kalpana, "Economic Entitlements via Entrepreneurial Conduct? Women and Financial Inclusion in Neoliberal India", *Journal of World-Systems Research* 21, no. 1 (2015): 50-68, http://jwsr.pitt.edu/ojs/jwsr/article/view/527.

[51] Roberts, "The Political Economy of 'Transnational Business Feminism", 214-215.

[52] Roberts, "The Political Economy of 'Transnational Business Feminism", 210.

to credit is sufficient enough to support women with economic and social empowerment.[53] Thus, as Bakker summarises, "women are called upon to become 'genderless workers' and rational economic actors yet at the same time, the social supports for reproductive and caring work are being weakened and privatised" with governments and non-state actors preferencing strategies, including microcredit schemes.[54]

Research into the Saranya scheme found that if a borrower is unable to repay three consecutive instalments and does not reply to reminders, then the government of Kerala has the right to initiate "revenue recovery action to realise the loan amount with interest."[55] Indian women who undertake microcredit programs could also fall back on repayments and be charged with higher rates of interest.[56] Compounding this issue further is that women who gain loans from microcredit programs are in competition with not only other women but also with other IT start-ups with higher financial means.[57] This undermines a female borrower's ability to repay their loans. Women below the poverty line are also less likely to increase income flows because they tend to be more conservative and rarely invest in new technology.[58] Women can be forced to work a heavier workload in order to meet the demands specified by the Indian government or financial institution. In other instances, loans targeted at women can be controlled by other individuals who can use the funds for their own means. The inability to repay loans

[53] Rankin, "Governing Development", 32-33.
[54] Bakker, "Social Reproduction and the Constitution of a Gendered Political Economy", 550.
[55] "SARANYA: Self Employment Scheme for the Destitute Women Scheme, National Employment Service (Kerala), accessed July 1, 2019, https://employment.kerala.gov.in/saranya/.
[56] Nagar, *Women and Employment,* 178.
[57] "Microfinance Misses Its Mark", Stanford Social Innovation Review, accessed July 1, 2019, https://ssir.org/articles/entry/microfinance_misses_its_mark.
See further for general issues, Kenji Wada, "Microfinance: Empowering Women and/or Depoliticizing Poverty?" in *Handbook on the International Political Economy of Gender,* ed. Juanita Elias and Adrienne Roberts (Cheltenham: Edward Elgar Publishing, 2018), 252-264.
[58] Stanford Social Innovation Review, "Microfinance Misses Its Mark".

can also lead to extreme debt stress. [59] As an Indian borrower noted, "defaulting a loan is not an option, it doesn't just mean being barred from future loans but also barred from society through humiliation, hostility, shame and harassment."[60] Notably, none of the schemes mentioned on the WEP platform provide any information about the flexibility of loan repayments nor do they encourage women to visit financial advisors before applying. The Indian government has also neglected to promote alternative supplementary measures to financially support women from disadvantaged communities. An alternative funding scheme may mean that Indian women from low income areas may be less at risk of severe financial penalties. This is a significant policy flaw because it can mean that Indian women in STEM and those from vulnerable communities can suffer financial and social repercussions if their entrepreneurial careers do not succeed.

This section has illustrated that the WEP scheme does have the ability to assist some Indian women interested in pursuing entrepreneurial carers. Future plans to develop an evidence base for WEP also suggests that the Modi government is committed to addressing some of the program's flaws.[61] However, there are a number of significant flaws that prevent it from assisting a larger majority of Indian women. The lack of information regarding the possible harm of microcredit loans suggests that Indian women in STEM could be potentially pursing entrepreneurial careers that leave them economically and legally vulnerable. Additionally, as previously raised microcredit schemes can be regarded being part of fulfilling a neoliberal ideology which has meant that WEP does not adequately address the issues faced by women entrepreneurs explored

[59] Soutik Biswas, "India's Micro-Finance Suicide Epidemic", *BBC News,* December 16, 2010, https://www.bbc.com/news/world-south-asia-11997571.
[60] Navjot Sangwan, "Loan Sharks Are Circling for Poor Indian Debtors Failed by Microfinance", *The Guardian*, October 29, 2018, https://www.theguardian.com/global-development/2018/oct/29/loan-sharks-circling-poor-indian-debtors-failed-by-microfinance.
[61] Sanghamitra Kar, "On Women's Day, Niti Aayog Launched Women Entrepreneurship Platform".

in previous sections of this thesis. The next section will examine how the Singaporean Lee government has encouraged women to pursue entrepreneurial roles and, moreover, will identify whether the approach assists women entrepreneurs.

6.3.3 Singapore

In contrast to the governments of Australia and India, the Singaporean PAP government under Lee Hsien Loong does not have many programs solely targeted at women entrepreneurs. As explained in Chapter Five of this thesis, the Singaporean government under Lee Hsien Loong has adopted a gender-blind and meritocratic approach to policy and program development. Notably, this has meant that information on Singaporean female entrepreneurs is limited. Work from Ling Han, Chengpang Lee and Gracia Jieyi Lee, however, does illustrate that Singaporean women entrepreneurs struggle with many of the challenges explored in previous chapters of this thesis.[62] A meritocratic approach may have also contributed to a relatively low female participation rate with regards to entrepreneurial work. Available statistics suggest that only 26.3% of business owners are Singaporean women despite the fact that, in 2021, Singapore was rated as the number one city for female founders.[63] The creation of the Singapore Women Entrepreneurs Network (SG-WEN) in September of 2021, however, suggests that the government may possibly develop more schemes to further women's participation in entrepreneurial occupations.[64] Launched by Singapore's Business Federation (SBF), SG-WEN aims to provide a platform for Singaporean women entrepreneurs to "collaborate for business

[62] Ling Han, Chengpang Lee, and Gracia Jieyi Lee, "Caught between State and Motherhood: The Public Image of Female Entrepreneurs in Singapore", *Asian Women - The Research Institute of Asian Women* 37, no. 2 (30 June 2021): 46-55, http://e-asianwomen.org/_common/do.php?a=current&bidx=2610&aidx=29654.
[63] Stefanie Yeo, "Ups, Downs, and Advice from 3 Women Entrepreneurs in Singapore", *Tech in Asia*, March 11, 2021, https://www.techinasia.com/ups-downs-advice-3-women-entrepreneurs-singapore.
Casey Hynes, "Singapore Tops New List of Best Startup Cities", *Forbes*, August 9, 2017, https://www.forbes.com/sites/chynes/2017/08/09/singapore-tops-new-list-of-best-startup-cities/.
[64] Singapore Business Federation, "SBF Launches the Singapore Women Entrepreneurs Network".

growth, influence culture and policy and drive industry changes in Singapore and the Asia-Pacific".[65] Notably, SBF was established following the 2001 SBF Act which was passed in the Singaporean parliament.[66] It continues to work closely with the government. Available information does not currently specify how proactive the SG-WEN initiative will be. While SG-WEN does not heavily cite the importance of women having STEM skills and knowledge, it does note that women entrepreneurs utilising SG-WEN will have the ability to access initiatives on digitisation.[67] This suggests that future initiatives for women entrepreneurs could potentially encourage them to pursue STEM particularly, in technology education.

While there is a low participation rate with regards to women entrepreneurs, 64% of all social enterprises have women holding a majority in senior management roles.[68] Home-based businesses in Singapore are more likely to have women entrepreneurs at the helm.[69] Historically, the Singaporean government has sought to encourage more women to undertake entrepreneurial careers.[70] This continues under the government of Lee Hsien Loong. However, most initiatives are not proactive. The PAP government has instead been very receptive to external organisations wishing to increase the level of female participation.[71] The PAP government has also vocally expressed its support for women

[65] Singapore Business Federation, "SBF Launches the Singapore Women Entrepreneurs Network".
[66] "About Us", Singapore Business Federation, accessed January 28, 2022, https://www.sbf.org.sg/about-us/overview-about-us.
[67] Singapore Business Federation, "SBF Launches the Singapore Women Entrepreneurs Network".
[68] Julie Pybus, "Singapore's Social Entrepreneurs Are Young - and Mostly Female", *Pioneers Post*, March 1, 2021, https://www.pioneerspost.com/news-views/20210301/singapore-s-social-entrepreneurs-are-young-and-mostly-female.
[69] "Workplace Flexibility and Entrepreneurship", NUS Institute of Real Estate and Urban Studies, accessed September 6, 2021, https://ireus.nus.edu.sg/2019/03/07/workplace-flexibility-and-entrepreneurship/. PDF available on webpage, 8.
[70] Ling Han, Chengpang Lee, and Gracia Jieyi Lee, "Caught between State and Motherhood", 36.
[71] "Singapore Launch of the 'Women Entrepreneurs Development Program'", WEConnect International, accessed September 3, 2021, https://weconnectinternational.org/procter-gamble-and-weconnect-international-launch-the-women-entrepreneurs-development-program-to-support-womens-majority-owned-businesses-in-singapore/.

entrepreneurs. During the 2019 Women's Forum Asia, Singapore's President Halimah Yacob emphasised that there was potential for more women to pursue science, engineering and entrepreneurial work.[72] Yacob's statement indicates that the Singaporean government closely associates entrepreneurial careers with STEM-based work. Moreover, Yacob had also indicated that there was a strong business case for increasing women's participation in workplaces and on boards. Noting the work of Roberts, this discursive framing suggests that the Singaporean government has taken a market-orientated approach to gender equality and perceives women's participation in the economy as financially beneficial to the nation.[73] President Yacob also stressed that private industries and businesses must continue to embrace diversity in leadership positions. This position assumes somewhat of a neoliberal idea in that private industries and businesses are held responsible for developing initiatives for women in STEM and women entrepreneurs rather than the Lee Hsien Loong government. This discursive framing also suggests that the Singaporean government is not overly committed to proactively addressing issues that do not arise from the workplace. As noted in Chapters Two and Five, Singaporean women in STEM face cultural, political, economic and familial barriers that impact on their ability to maintain employment. With this in mind, it can be argued that the Singaporean government has maintained a mostly meritocratic approach towards policies and programs for women entrepreneurs. The section below will demonstrate that the Singaporean PAP government is vocally encouraging of schemes and policies that encourage women to pursue entrepreneurial roles. Yet, it

[72] Yun Ting Choo, "Gender Equality and Women Leaders Benefit Companies and Society: President Halimah", *The Straits Times*, September 18, 2019, https://www.straitstimes.com/business/gender-equality-and-women-leaders-benefit-companies-and-society-president-halimah.
[73] Yun Ting Choo, "Gender Equality and Women Leaders Benefit Companies and Society: President Halimah", *The Straits Times*, September 18, 2019, https://www.straitstimes.com/business/gender-equality-and-women-leaders-benefit-companies-and-society-president-halimah.

maintains that it is the responsibility of private businesses to implement proactive policies.

6.3.3.1 Women Entrepreneur Awards

Established in 2016, the Women Entrepreneur Awards aim to "cultivate the entrepreneurial spirit in women and inspire the next generation of women in power."[74] The award also seeks to celebrate and promote successful and promising female entrepreneurs. Successful awardees are provided with the opportunity to receive advice from a panel of judges, join the WE club to further their networking opportunities and have their professional profiles raised.[75] Enterprise Singapore supports the Women Entrepreneur Awards, SkillsFuture Singapore and the Infocomm Media Development Authority. [76] Notably, these can be defined as STEM-based areas of government. A number of private businesses also sponsor the award. Singaporean politicians and ministers including Dr Koh Poh Koon, Josephine Teo and Sim Ann have been guests of honour.[77] Their presence at the Women Entrepreneur Awards ceremony events indicates that the Singaporean government does wish to increase the visibility and participation rates of Singaporean female entrepreneurs. In 2018, the then-Minister for Manpower, Josephine Teo thanked women entrepreneurs noting that "our business scene is more

[74] "Women Entrepreneur Awards", Women Entrepreneur Awards, accessed August 19, 2021, https://wea-sg.com/the-awards/.
[75] Women Entrepreneur Awards, "Women Entrepreneur Awards".
[76] Women Entrepreneur Awards, "Women Entrepreneur Awards". See "With Thanks to Our Partners" section.
[77] "Speech by SMS Koh Poh Koon at the Women Entrepreneur Awards 2019", Ministry of Trade and Industry Singapore, accessed September 6 2021, https://www.mti.gov.sg/Newsroom/Speeches/2019/07/Speech-by-SMS-Koh-Poh-Koon-at-the-Women-Entrepreneur-Awards-2019.
"Address by Mrs Josephine Teo, Minister for Manpower, at the Women Entrepreneur Awards 2018 Award Ceremony and Gala Dinner", Ministry of Manpower, accessed September 6, 2021, https://www.mom.gov.sg/newsroom/speeches/2018/0711-address-by-mrs-josephine-teo-minister-for-manpower-at-the-women-entrepreneur-awards-2018-award-ceremony-and-gala-dinner.
The Straits Times, "New Award to Recognise Aspiring Women Entrepreneurs", *The Straits Times*, November 23, 2017, https://www.straitstimes.com/business/companies-markets/new-award-to-recognise-aspiring-women-entrepreneurs.

vibrant and many more jobs have been created".[78] This framing reinforces that the Singaporean government has taken a market approach to gender equality and perceives higher female employment rates as economically beneficial to the wider economy. During the 2019 awards, Dr Koh Poh Koon stated that the Women Entrepreneur Awardees could "lead the way and show how Flexible Work Arrangements can become pervasive in the workplace to unleash the full potential of many of our women in the workplace while allowing them to meet their family care obligations."[79] In this sense, Koon perceived the awards as a way to promote women who could succeed in their entrepreneurial career whilst undertaking domestic responsibilities. This seems to reflect the belief that entrepreneurial careers with flexible working arrangements are a viable way for women to accommodate familial and work roles.

Information on the Women Entrepreneur Awards is limited making it difficult to fully assess the initiative and determine how successful applicants have benefited from the program. Analysis into publicly available information does indicate that it can disadvantage women who are unable to afford the payments required to participate. Women entrepreneurs participating in the awards must pay an application fee of $642 and may pay up to $19,260 on their congratulatory package.[80] Additionally, the Women Entrepreneur Awards do not aid a large amount of women because the program is limited in scope and does not adequately address the ongoing and persisting issues that affect women entrepreneurs. The awards also maintain some of the inequalities that exist for women that come from disadvantaged backgrounds. For instance, successful awardees

[78] Ministry for Manpower, "Address by Mrs Josephine Teo, Minister for Manpower, at the Women Entrepreneur Awards 2018 Award Ceremony".
[79] Ministry of Trade and Industry Singapore, "Speech by SMS Koh Poh Koon at the Women Entrepreneur Awards".
[80] "Submission Requirements", Women Entrepreneur Awards, accessed September 6, 2021, https://wea-sg.com/application-guidelines/.

who pay the high congratulatory costs are provided invitations to exclusive entrepreneurial networking events and opportunities. Thus, based on the information obtained, the Women Entrepreneur Awards does not heavily address the issues as explored in previous chapters.

Consequently, the governments of Australia, India and Singapore have implemented beneficial initiatives that support women entrepreneurs. However, as discussed above, there are a number of flaws with governments influenced by neoliberalism and also somewhat prone to taking a market-orientated approach to gender equality. The Australian government's WISE scheme does not adequately address barriers that affect women in STEM as noted in Chapters Two and Three. Programs provided with funding are short-term and lack sufficient regulatory procedures. The Indian's government's WEP initiative does not provide women entrepreneurs with balanced information about microcredit schemes that can pose severe financial risks to women with low incomes. There is also little promotion on schemes that provide safer forms of financial assistance to Indian women entrepreneurs. Correspondingly, the Singaporean government's Women Entrepreneur Awards does not support many women with less financial means. Awardees are required to pay significant costs to benefit from the initiative. Moreover, as noted in the above policy sections, Australia, India and Singapore have aligned STEM skills and knowledge to programs for women entrepreneurs. Australia's WISE program encourages women to pursue STEM and entrepreneurial opportunities, India's WEP program heavily promotes STEM-based ventures whilst Singapore's Women Entrepreneur Awards are supported by STEM-based areas of government. Subsequent sections of this chapter will argue that women entrepreneurs could be engaging in STEM in ways that are less specialised and not recognised by Australian, Indian and Singaporean governments. The section below will now elaborate on how Australian, Indian and Singaporean

governments who have been influenced by neoliberalism and have adopted a market-orientated approach to gender equality have overemphasised the economic positives of entrepreneurial pathways for women without adequately addressing the potential risks.

6.4 Entrepreneurial Disadvantages

As noted in the above sections of this chapter, Australian, Indian and Singaporean governments have capitalised on the benefits technology provides by creating programs that aim to encourage women to pursue entrepreneurial pathways. Governments have also sought to promote entrepreneurial start-ups to women in STEM because STEM innovations can be created, marketed and sold thereby increasing a country's STEM capability and contributing to new industries and jobs. As demonstrated above, governments have been largely influenced by neoliberal ideals that maintain that women are largely responsible for their own economic standing. Moreover, entrepreneurial roles have been perceived as careers that fulfil neoliberal ideas and also adhere to the idea that a market-orientated approach should be applied to gender equality. However, by drawing on the wider literature which discusses the broader challenges that women entrepreneurs may encounter, this section will explore some of the potential risks entrepreneurial ventures pose to women that have not been adequately addressed by Australian, Indian and Singaporean governments. This section will address the key flaws of government initiatives that aim to support women entrepreneurs as it is a key research question that this thesis seeks to address as outlined in Chapter One.

Entrepreneurial careers have been identified as a risky economic venture for women as many struggle to obtain capital even in industries that are predominantly female.[81]

[81] Yang and Triana, "Set Up to Fail" 932.

Researchers suggest that many women's inability to attract capital and funding can be partly attributed to the fact that the entrepreneurial environment is influenced by gendered ideology, practices and norms.[82] Venture capitalists, investors and other resource providers are more likely to be male. Sharing the same gender, male entrepreneurs may find it easier to connect and join professional networks that are predominately male dominated.[83] Consequently, due to a lack of female representation, gendered ideology continues to be maintained. For many resource providers, entrepreneurs are perceived to possess masculine traits.[84] Men are perceived as more competent and trustworthy because they possess entrepreneurial attributes such as being pragmatic and having risk-taking behaviour.[85] These characteristics omit women who are regarded as being feminine and having a maternalistic identity. Consequently, women are less likely to obtain funding. Conversely, in their work, Dilani Jayawarna, et al. contend that women entrepreneurs are more likely to be regarded as convenience entrepreneurs.[86] Convenience entrepreneurs are individuals, commonly women, who decide to pursue start-ups and businesses in order to accommodate childcare responsibilities. Convenience entrepreneurs have slow sales growth and business "potential is constrained by limited time, education and expectations."[87] In contrast, economically driven entrepreneurs are a group that closely resemble the "stereotyped, gendered view of the masculine entrepreneurial hero."[88] Yet,

[82] Vishal K. Gupta, Daniel B. Turban, S. Arzu Wasti and Arijit Sikdar, "The Role of Gender Stereotypes in Perceptions of Entrepreneurs and Intentions to Become an Entrepreneur", *Entrepreneurship: Theory and Practice* 33, no. 2 (1 March 2009): 400, https://web-s-ebscohost-com.proxy.library.adelaide.edu.au/ehost/detail/detail?vid=0&sid=91f72701-0ed0-4b2e-bdcb-983901085682%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZSZzY29wZT1zaXRl#db=bsu&AN=36839781.
[83] "Why Aren't Venture Capitalists Backing Female Entrepreneurs?" World Economic Forum, accessed August 31, 2021, https://www.weforum.org/agenda/2016/05/why-arent-venture-capitalists-backing-female-entrepreneurs/.
[84] Gupta et al., "The Role of Gender Stereotypes in Perceptions of Entrepreneurs and Intentions" 410.
[85] Yang and Triana, "Set Up to Fail", 929.
[86] Jayawarna, Rouse, and Kitching, "Entrepreneur Motivations and Life Course", 47.
[87] Jayawarna, Rouse, and Kitching, "Entrepreneur Motivations and Life Course", 47.
[88] Jayawarna, Rouse, and Kitching, "Entrepreneur Motivations and Life Course", 47.

many men in this group have childcare responsibilities. Notably, there are other groups that fit within entrepreneurial classes, however, the two described establish that there are differences in the way in which male and female entrepreneurs are regarded.

These forms of gendered perceptions do have economic repercussions for women entrepreneurs. Women entrepreneurs were only able to get a 2.2% share of the $130 billion given out globally in venture capital in 2018.[89] In 2019, companies with one female founder managed to receive 17% of venture capital.[90] However, for sole female founders, this figure decreased to 2%.[91] In their global report, HSBC Banking found that one third of all female entrepreneurs experienced gender bias when trying to get capital for their start-ups and businesses.[92] Female entrepreneurs are more likely to be asked questions about their family circumstances and personal life than their work. Women founders are also more likely to receive fewer positive ratings on their ventures. This affects their ability to attract funding. Moreover, it potentially creates a "secondary effect where investor-side biases may be anticipated and internalised by female entrepreneurs, resulting in lower aspiration and expectations for their ventures."[93] This leads to more women choosing to leave their entrepreneurial careers which then results in lower representation.

While entrepreneurial careers have been suggested as a viable way for women to balance competing roles, entrepreneurial careers may also potentially place additional pressures on women. In order to ensure a business is successful and generates income, women may

[89] Brock Blake, "Women Business Owners Still Face Difficulties in Obtaining Capital", *Forbes*, October 14, 2019, https://www.forbes.com/sites/brockblake/2019/10/14/women-business-capital/.
[90] Blake, "Women Business Owners".
[91] Blake, "Women Business Owners".
[92] Chloe Taylor, "A Third of the World's Female Entrepreneurs Face Gender Bias from Investors, HSBC Claims", *CNBC*, October 3, 2019, https://www.cnbc.com/2019/10/03/hsbc-a-third-of-the-worlds-female-entrepreneurs-face-gender-bias.html.
[93] World Economic Forum, "Why Aren't Venture Capitalists Backing Female Entrepreneurs?"

often need to offer a large amount of time and effort into their entrepreneurial career.[94] This may reduce their chances of having an effective work and family balance. The COVID-19 pandemic has notably increased the challenges associated with balancing dual responsibilities.[95] Women with domestic and child caring responsibilities may find it harder to devote time to their entrepreneurial career.[96] This can result in poor business performance and moreover, mean that more women leave their entrepreneurial careers. Some scholars have also emphasised that home-based self-employment is not entirely cost effective. Women working within home-based business models are reliant on a small number of customers and have little power to determine payment and deadlines.[97] Entrepreneurial women can also have limited resources.[98] This is an important factor as to whether women entrepreneurs can legally contest and challenge unfair practices. Compounding these issues further is that women can potentially suffer from long-term economic consequences. Entrepreneurial occupations offer little income security and no employee benefits.[99] As such, few women can financially contribute to their superannuation at the early stages of their start-up. [100] Women operating in sectors with lower barriers to entry also face more competition from other entrepreneurs.[101] These combined pressures have the potential to significantly undermine the ability of women, particularly those from disadvantaged backgrounds to successfully pursue and maintain entrepreneurial occupations. Women who leave their occupations to pursue

[94] Neneh, "Why Foreignness Matters", 85.
[95] Tatiana S Manolova, Candida G Brush, Linda F Edelman, and Amanda Elam, "Pivoting to Stay the Course: How Women Entrepreneurs Take Advantage of Opportunities Created by the COVID-19 Pandemic", *International Small Business Journal* 38, no. 6 (1 September 2020): 481–91, https://doi.org/10.1177/0266242620949136.
[96] Neneh, "Why Foreignness Matters", 85.
[97] Thompson, Jones-Evans, and Kwong, "Women and Home-Based Entrepreneurship", 228.
[98] Thompson, Jones-Evans, and Kwong, "Women and Home-Based Entrepreneurship", 228-229.
[99] Thompson, Jones-Evans, and Kwong, "Women and Home-Based Entrepreneurship", 228.
[100] Foley, "Becoming a 'Mumpreneur'".
[101] Thompson, Jones-Evans, and Kwong, "Women and Home-Based Entrepreneurship", 228-229.

entrepreneurial careers in order to have an effective work and life balance instead find themselves again having to overcome barriers that undermine their ability to work.

Academic scholars have also found that entrepreneurial occupations have the potential to maintain or reinforce gendered ideology. Camilla Nelson cites the rise of 'mumpreneurs.'[102] The term 'mumpreneurs' describes mothers with entrepreneurial occupations. Notably, there is no term associated with fathers who are entrepreneurs. Mumpreneur has been a polarising term with many women arguing that it is devalues their work. [103] In contrast, other women have labelled the term as a positive one that gives context to their working conditions.[104] Studies on mumpreneurs have examined how women perceive entrepreneurial roles. Meraiah Foley et al.'s work notes that mumpreneurs have a wide range of motivations for becoming entrepreneurs. However, one of the underlying reasons is that entrepreneurial roles enable them to create, maintain and reinforce certain ideologies. Entrepreneurial roles enable women to maintain the 'good mother' ideal.[105] In order to conform to this ideal, women perceived that independence was vital in ensuring that they could be a 'good mother.' This independence came in the form of being able to control the timing and location of their work.[106] For women in Foley et al.'s study, "entrepreneurship emerged as a way to keep their work identities without sacrificing their identities as mothers."[107] However, a large group of mumpreneurs explain that the needs of their children are prioritised over work

[102] Nelson, "The Rise of the Digital 'Mumpreneur'".
[103] Nicola Appleton, "Let's Take Women's Businesses Seriously, and Ditch "Mumpreneur"", *The Sydney Morning Herald*, April 21, 2019, https://www.smh.com.au/lifestyle/gender/let-s-take-women-s-businesses-seriously-and-ditch-mumpreneur-20190418-p51f8u.html.
[104] Tamara Arbib, "Defining Yourself as a Mumpreneur Is a Powerful Statement", *The Guardian*, September 17, 2014, http://www.theguardian.com/women-in-leadership/2014/sep/17/mumpreneur-working-mother-proud-job-divides-opinion.
[105] Foley, Baird, Cooper and Williamson, "Is Independence Really an Opportunity? 320.
[106] Foley, Baird, Cooper and Williamson, "Is Independence Really an Opportunity? 320.
[107] Foley, Baird, Cooper and Williamson, "Is Independence Really an Opportunity? 321.

commitments. Nelson contends that the rise in women entrepreneurs and the mumpreneur movement can also be attributed to the fact that caring responsibilities have been deemed as being of lesser cultural value.[108] Subsequently, by analysing the government discourse in the above section, this thesis has found that entrepreneurial careers have been appropriated by governments as viable ways that women can contribute to the nation. This framing suggests that women entrepreneurs are more likely to be valued than women undertaking domestic and childcare responsibilities which is perceived to be a non-economic activity. Women are perceived as fulfilling the neoliberal ideal of self-empowerment in that they are overcoming challenges through their own individual resilience.[109] Moreover, entrepreneurial work is regarded as the remedy to working for businesses that do not provide enough flexibility or discriminate against women. Concerningly, Foley et al. note that some working women consider entrepreneurial careers to be a last resort.[110] Thus, in a sense, mumpreneurs believe that they fulfil the ideal of being able 'to have it all' through undertaking entrepreneurial work.[111] This framing, however, omits that there are institutional, political, cultural and societal forces that severely undermine a woman's ability to work. [112] These factors have been explored in previous chapters of this thesis. Hence, the framing posits that women can be individually blamed when they fail in their entrepreneurial pursuits. Consequently, there is less criticism of unfair workplace practices and unjust social and political structures. Consequently, the entrepreneurial escape route has been made easier to travel upon given the prominence of technology and the political promotion of entrepreneurial roles.

[108] Nelson, "The Rise of the Digital 'Mumpreneur'".
[109] Kara Van Cleaf, "'Of Woman Born" to Mommy Blogged: The Journey from the Personal as Political to the Personal as Commodity", *Women's Studies Quarterly* 43, no. 3/4 (2015): 253.
[110] Foley, "Becoming a 'Mumpreneur'".
[111] Nelson, "The Rise of the Digital 'Mumpreneur'".
[112] Foley, "Becoming a 'Mumpreneur'".

Accordingly, this section has illustrated some of the potential disadvantages of entrepreneurial pathways. Entrepreneurial careers present numerous challenges given that they offer women less secure work and require them to challenge gendered ideology which maintains that they lack the masculine traits required to succeed in an entrepreneurial career. In other cases, women can be labelled as 'mumpreneurs' which emphasise their domestic and caretaking roles over their career identities. This can be damaging as resource providers may consider them as unprofitable. Entrepreneurial occupations also help reinforce the neoliberal ideal that contends that women are largely responsible for their own economic standing. This omits the social, historical, political and economic influences that impact upon women entrepreneurs. Governments have not included supplementary schemes within programs to address economic issues that women from disadvantaged communities may encounter as evident in the section above. These flaws have the potential to undermine attempts to increase women's participation in entrepreneurial careers. The next section will illustrate that governments have often neglected to understand how women entrepreneurs are often interacting with STEM.

6.5 Women Engaging with STEM Using Technology

This chapter has chosen to explore how women engage with STEM using technology because this can provide policymakers with insight into how to better develop policies that encourage women to learn STEM skills and knowledge. Chapter Three of this thesis has noted that Australia could be impacted by STEM skill shortages whilst Chapter One has argued that a lack of women's representation in STEM may potentially impact how future technologies take into account the needs and experiences of women.[113] However, women may not require highly specialised STEM skills and knowledge, and may instead

[113] ACS, "ACS Australia's Digital Pulse".

only require knowledge on how to perform certain STEM activities. This would reduce the time required to develop a skilled STEM workforce. Moreover, as noted in Chapter Four, Indian women are affected by patrifocal ideology that can limit their participation in STEM education.[114] This chapter posits that the Indian government could be raising more awareness about technological tools and platforms that teach women certain STEM practices. This can assist women entrepreneurs from marginalised and economically poor areas. Within the Singaporean context, the promotion of technologies could help women entrepreneurs that struggle to balance competing roles.[115] Women entrepreneurs with multiple familial demands may find it hard to learn the STEM skills However, the promotion of existing technology mediums and services can provide opportunities for them to enter the online economic market. Notably, technologies such as WordPress, Domain and DreamHost enable women to build and maintain websites without needing to code or learn extensive STEM skills.[116] Similarly, women digital influencers engaging in forms of entrepreneurial work are engaging with digital practices and knowledge despite the fact that may not have highly specialised technological skills.[117] However, as this section has noted, there are technological mediums that can be used by women entrepreneurs who may not have a high degree of STEM skills and knowledge.

In light of the above, this section will argue that governments have often neglected to consider the ways that women have utilised existing technology to advance their understanding of relevant STEM practices, skills and knowledge. Governments have

[114] Mukhopadhyay and Seymour, *Women, Education, and Family Structure in India*, 103–34.
[115] Dutta, "Women's Discourses of Leadership", 233-249.
[116] "How to Choose the Best Website Builder in 2021 (Compared)", WP Beginner, last modified December 15, 2021, https://www.wpbeginner.com/beginners-guide/how-to-choose-the-best-website-builder/.
[117] Marianny Jessica de Brito Silva, Salomão Alencar de Farias, Michelle Kovacs Grigg, and Maria de Lourdes de Azevedo Barbosa, "Online Engagement and the Role of Digital Influencers in Product Endorsement on Instagram", *Journal of Relationship Marketing* 19, no. 2 (2 April 2020): 133–63, https://doi.org/10.1080/15332667.2019.1664872.

conceived that women must have STEM accredited qualifications, knowledge and skills in order to be identified as a STEM professional. They have also maintained that women will require a STEM education in order to adapt to potential technological disruptions. However, it will be argued here that women entrepreneurs are using technological platforms and tools to engage with STEM, without necessarily having formal technological qualifications. While technological platforms do not provide women entrepreneurs with a high specialisation in a STEM subject, they have the potential to increase their understanding about how to apply STEM concepts or engage in a STEM activity. Correspondingly, Australian, Indian and Singaporean governments have also not adequately assessed how technology has altered rather than disrupted occupations within non-STEM positions. Subsequent sections will note that technology has changed the way that STEM positions are identified. Researchers contend that jobs in the future will require a combination of STEM and non-STEM skills and knowledge. In certain cases, women may only require knowledge or skills that enable them to perform a particular STEM practice or activity either by learning new knowledge themselves or by using platforms and tools that have been designed by technical experts to be used by the broader public. The findings obtained from this section will provide background for the discussion of suggestions that will be explored in the Conclusion.

Research reveals that women entrepreneurs have adopted alternative educational strategies to learn about specific STEM practices or acts. Technological platforms such as YouTube have enabled more women to learn about how to apply STEM practices and knowledge to their entrepreneurial endeavours. In one study, a women entrepreneur stated, ““I built the website myself. But I do not write code…” “YouTube has been my

teacher."[118] The woman's use of YouTube as an educational resource has furthered her understanding of website building but not high-level coding. Despite this, she has engaged in an aspect of technological learning. The statement demonstrates that women entrepreneurs from non-STEM backgrounds may have potentially engaged with STEM skills and knowledge in ways that do not fit within current government conceptions of what constitutes as a STEM education. A further consideration is that YouTube is a free resource that enables women entrepreneurs to learn flexibly. As noted in previous chapters of this thesis, formal qualifications in STEM can be costly and time consuming. Utilising a technological platform like YouTube means that women entrepreneurs, particularly those from disadvantaged backgrounds, can learn about certain STEM concepts or engage in STEM activities in ways that are time and cost effective. Technological platforms such as W3Schools provide opportunities for women to learn about specialised IT concepts as well as practice how to write code. Women can participate in free online modules and activities based on specific IT disciplines.[119] Notably, Australian, Indian and Singaporean governments have not adequately promoted such platforms to women. This policy neglect may mean that women continue to rely on traditional education providers to learn about STEM. As discussed in previous sections of this thesis, some institutional areas maintain practices, norms and beliefs that maintain that women do not belong in certain STEM disciplines such as IT. In contrast, online technological platforms such as YouTube and W3Schools provide an alternative opportunity for women to learn and apply certain STEM concepts and practices while mitigating some gendered barriers.

---

[118] Yuliani Suseno and Ling Abbott, "Women Entrepreneurs' Digital Social Innovation: Linking Gender, Entrepreneurship, Social Innovation and Information Systems", *Information Systems Journal* 31, no. 5 (2021): 717–44, https://doi.org/10.1111/isj.12327.

[119] "W3Schools Online Web Tutorials", W3Schools, accessed March 5, 2020, https://www.w3schools.com/.

Technological advancements have also changed the way that women can engage with STEM. No-Code platforms allow women to develop software without writing code. Women using no-code platforms can be described as undertaking a form of visual programming.[120] Women can use visual elements to code rather than write it. No-code tools are predominately online, are easier to learn and require no formal training.[121] These factors make it a beneficial tool for women with caretaking responsibilities given that no-code platforms are flexible and self-paced. Moreover, it could be potentially used as a stepping stone for women with low confidence in their STEM and digital competency. There are also a range of economic benefits which may assist women from disadvantaged backgrounds or who are geographically constrained. India is currently experiencing a no-code 'boom' as individuals look for cheap and efficient ways to build online services.[122] Yet, the Indian government has not heavily encouraged women to learn coding or utilise coding through no-code platforms. Similarly, Australian and Singaporean governments have not adequately maximised these opportunities or adopted policies that encourage women to pursue these alternative pathways. Rather, Australian, Indian and Singaporean governments have perceived that women require formal STEM training to be considered as a STEM professional or as engaging with STEM.

Researchers have also argued that STEM occupations have not been clearly defined by governments who have a vague conception of what they consist of. In their work, Debra Panizzon et al., suggest that governments have been unclear as to what occupations can

[120] Rina Diane Caballar, "Programming Without Code: The Rise of No-Code Software Development", *IEEE Spectrum*, March 11, 2020, https://spectrum.ieee.org/programming-without-code-no-code-software-development.
[121] Caballar, "Programming Without Code".
[122] Mimansa Verma, "India's No-Code Boom Is Ushering in a New Wave of Entrepreneurs", *Quartz*, October 11, 2021, https://qz.com/india/2066451/indias-no-code-boom-is-ushering-in-a-new-wave-of-entrepreneurs/.

be considered as STEM-based.[123] One of the underlying issues is that governments have often neglected to consider that subjects can be multidisciplinary. Consequently, governments have not adequately considered that occupations can consist of both STEM and non-STEM skills and knowledge. This hybridity has increased following technological advances. New occupations such as Data Analyst require individuals to have statistical knowledge, a STEM skill.[124] However, individuals may also need to be competent in non-STEM areas such as business analysis. In other cases, existing occupations have required individuals to have STEM skills and knowledge. Graphic designer roles now require some individuals to be proficient in HTML and JavaScript alongside their artistic design abilities.[125] Inna Grinis suggests that STEM occupations within non-STEM industries may not require individuals to undertake a STEM qualification or degree. Instead, she remarks that micro-credentials which require less training would allow women to develop relevant STEM skills and knowledge.[126] Similarly, this thesis argues that encouraging women to pursue alternative and short-paced learning strategies may be more effective in increasing STEM engagement rates for women. As noted throughout this thesis, women with familial responsibilities as well as women from disadvantaged backgrounds face additional barriers given that most programs do not provide measures to assist with flexible arrangements or financial support. Yet, the above findings demonstrate that technology has provided opportunities for women to undertake STEM learning and microcredit courses that are flexible, less time consuming and relatively cost efficient. Additionally, women undertaking

[123] Panizzon, Corrigan, Forgasz and Hopkins, "Impending STEM Shortages in Australia", 74.
[124] Matt Sigelman, "Why the STEM Gap Is Bigger Than You Think", *LinkedIn*, April 28, 2016, https://www.linkedin.com/pulse/why-stem-gap-bigger-than-you-think-matt-sigelman/.
[125] Sigelman, "Why the STEM Gap Is Bigger Than You Think".
[126] Inna Grinis, "The STEM Requirements of "Non-STEM" Jobs: Evidence from UK Online Vacancy Postings", *Economics of Education Review* 70 (1 June 2019): 156, https://doi.org/10.1016/j.econedurev.2019.02.005.

alternative learning strategies may benefit in instances of technological disruption. STEM skills can rapidly advance due to technological advances and, subsequently, individuals with formal qualifications can often be left with knowledge that is obsolete.[127] However, offering shorter and technology based educational alternatives has the potential to mitigate this and equip women with STEM skills that are updated, can be combined with their current industry role, and address some of their barriers.

6.6 Conclusion

This chapter has argued that whilst there are some benefits, Australian, Indian and Singaporean governments have overemphasised the positive attributes of entrepreneurial roles without due consideration. Using a discursive policy framing approach has revealed that there are policy flaws with the examined initiatives which do not adequately address issues faced by women entrepreneurs. A discursive policy framing approach has also demonstrated how governments have adopted a market-orientated approach to gender equality. By analysing policy discourse such as government material, policies, initiatives and press releases, the chapter has also argued that all three governments are influenced by neoliberal framing which still neglects the value of social reproduction as well as historical, cultural, societal and economic influences that have shaped how women are able to participate in STEM employment. A neoliberal policy framing has meant that policies and programs for women entrepreneurs do not address gender inequities. Women entrepreneurs face gendered practices, norms and beliefs as many resource providers maintain that masculine attributes are required to succeed. Women entrepreneurs may also not achieve an effective work and family balance given that they must work harder to compete in hostile environments and gendered areas. Policymakers have not

[127] "Is the Pace of Technology Driving the STEM Skills Gap?" Burning Glass Technologies, accessed November 30, 2021, https://www.burning-glass.com/pace-technology-driving-the-stem-skills-gap/.

implemented supplementary schemes to support vulnerable women or to mitigate some of the prescribed barriers. This chapter has also argued that governments have neglected to consider how women are using technology to advance their knowledge of STEM practices and skills. Technological tools provide opportunities for women to learn aspects of a STEM discipline that can further their career prospects or lead to a STEM role. The insights obtained from this chapter will now help in the discussion of possible recommendations.

Chapter 7: Conclusion

7.1 Introduction

As noted in Chapter One, Australian, Indian and Singaporean policies and programs for women in STEM highlight that the underrepresentation of women in STEM is a major issue for governments and policymakers, particularly given their views on the importance of STEM for future strategic and economic developments. As such, this thesis has sought to examine Australian, Indian and Singaporean policies and initiatives that aim to increase women's participation in STEM. The thesis has sought to address the key (interrelated) research questions, including:

- how have Australian, Indian and Singaporean governments attempted to increase the representation of women in STEM in the periods being studied?
- have policies and initiatives been effective and if not, what are the key policy flaws and causes for them?
- how can Australian, Indian and Singaporean governments strengthen policies and initiatives, and further improve on attempts to increase women's representation in STEM?
- are there lessons that the respective countries can learn from one another?

Chapter One has set out the theoretical and methodological approaches used to examine these research questions. It was explained that the thesis drew heavily on feminist theory and analyses, particularly in regards to issues such as the underrepresentation of women in STEM education and occupations, and explored the caring role of women in the home. Both these issues were discussed further in subsequent chapters, including Chapter Two,

which provided evidence on the barriers women face in STEM. Chapter One also explained that the thesis utilised feminist comparative policy and case study approaches in its analysis of relevant government policy in Australia, India and Singapore. It explained the reasons for studying the policies in those particular countries, pointing out that doing so would fill a major gap in the existing academic literature on government policies regarding women and STEM, which tend to be western-centric in focus.

Chapter One explained that the other methodological approaches used would be combined with gendered discursive policy framing analyses. The discourse analysed included a range of government statements, speeches, and policy and program documents. Such an analysis would identify the underlying frames that shape the relevant policies, drawing attention not only to what was included in the policies and why, but also the issues and measures that were not addressed because of the frames used. In the process, this thesis has identified a number of social, economic, historical and cultural factors that have influenced policy frames, ranging from gendered expectations of women's caring roles to the influence of gendered economic ideology, patrifocal, pro-natalist, meritocratic and nationalist views amongst others.

The influence of economic ideology on policy framing has proved to be particularly influential in terms of shaping what is seen as the appropriate role for the state to play with regards to facilitating women's more equal participation in STEM and ruling out other measures, especially in regard to the relationship between the state and the private sector. Chapters Three, Four, Five and Six have demonstrated that policymakers and politicians have been influenced by neoliberalism which contends that governments should not heavily interfere in economic markets and that women are largely responsible for their own economic and social standing. However, Chapter Five has also explained

that the Singaporean government has been influenced by neoliberalism but has been more prepared to take on interventionist policy positions and approaches. Consequently, the policies and programs for women in STEM that have been studied have been discursively framed to reflect neoliberal ideals. The thesis has argued that those neoliberal ideals are also gendered in themselves. For example, by drawing on the broader feminist literature such as work from Bakker and Gill, the thesis has analysed how a neoliberal policy framing has neglected women's contribution to care work and social reproduction.[1] A neoliberal policy framing has also meant that Australian, Indian and Singaporean governments have focused too much on issues of individual opportunity and have not adequately addressed barriers such as social and cultural disadvantage, and historical, economic and political influences. Barriers impacting on women's participation in education and employment have been explored in Chapter Two and in the subsequent case study chapters. A neoliberal-influenced framing involving a reluctance to intervene too much in the market has also influenced the lack of adequate regulatory and reporting measures that have been identified at various points in this thesis, for example, in regards to issues such as government procurement policies, oversight/inspections, data collection and evaluation. The thesis has also cited literature that suggests that neoliberalism has had a detrimental impact on broad areas of women's policy, however, a detailed examination of those areas is beyond the scope of the thesis.

This Conclusion will summarise the analysis and arguments made throughout the chapters of this thesis. In line with feminist comparative policy analysis, the chapter will also draw attention to different initiatives to demonstrate how the countries could usefully learn from each other, with a particular focus, given the Australian based nature of this

[1] Bakker and Gill, "Rethinking Power, Production, and Social Reproduction", 507.

thesis, on what Australia may be able to learn from India and Singapore. Subsections of this Conclusion illustrate that Australian, Indian and Singaporean governments have implemented some beneficial policies and programs for girls and women interested in STEM education and careers. For instance, programs such as the Young Indigenous Women's Academy demonstrate that the Australian government is aware of the additional challenges faced by women from disadvantaged backgrounds and is committed to addressing some of them. Similarly, the Indian government's KIRAN scheme addresses issues arising from when women in STEM take mid-career breaks or face barriers associated with the patrifocal family model as explored in Chapter Four of this thesis. Singapore's SkillsFuture program enables women to access accredited STEM courses at a significantly reduced cost. However, as chapters of this thesis have argued, there are also a number of flaws such as those arising from neoliberal ideology. These flaws include policies and programs not adequately addressing social and cultural disadvantage as well as neglecting the role that women play with regards to social reproduction and care work. This Conclusion will summarise some of the flaws that exist within the examined Australian, Indian and Singaporean policies and programs for women in STEM. The Conclusion will then provide suggestions on how government schemes can be strengthened to support more girls and women interested in STEM pathways and entrepreneurial careers. Alternative policies and programs that could potentially be implemented by Australian, Indian and Singaporean governments will also be explored.

As highlighted in the Introduction, a comparative case study approach and FCP approach has offered a number of advantages. Utilising a comparative case study approach, combined with a gendered discursive framing analysis has meant that the thesis has advanced understandings of how policymakers from Asian countries approach the issue

of women's underrepresentation in STEM. This may assist in the development and implementation of better policies, particularly in multicultural countries such as Australia. It may also contribute to filling a gap in the international literature on government policies and programs regarding women and STEM. A FCP approach combined with a case study approach has enabled the thesis to examine whether Australia, India and Singapore have made progress in mitigating gender-based inequities. It has also demonstrated that women from Australia, India and Singapore have some distinct barriers that have arisen from differing cultural, political, historical and economic contexts that have also influenced policy framing. The thesis has drawn from broader feminist literature to explain that Australian women in STEM are also often forced to turn to economically vulnerable part-time and casual positions due to social and political influences that maintain that they are primarily responsible for familial responsibilities. In contrast, Indian women in STEM are likely to face barriers that arise from the patrifocal family model. As noted in Chapter Four, the patrifocal family model has the tendency to prioritise a son's education over a daughter's. Moreover, the model suggests that an education in STEM can be socially and culturally dangerous for women who may be deemed as unmarriageable. Conversely, Chapter Five examined how Singaporean women struggle with combining their roles as mothers and employees. The PAP government historically appropriated roles for women who were encouraged to work in STEM occupations in order to advance Singapore's economy and skilled workforce. Alongside this framing, the PAP also maintained that Singaporean women were still expected to adhere to cultural expectations that reinforced their status as wives and mothers. Moreover, Singapore's decreasing fertility rate continues to be a primary concern for policymakers who continue to prioritise pre-natal policies over employment ones. As such, these examples demonstrate that there are also other gendered social,

cultural, historical and political factors which have influenced policy framing. Further sections of this Conclusion will summarise flaws, illustrate how governments can mitigate some policy shortfalls and suggest ways that Australia, India and Singapore can learn from one another.

Despite differences between Australia, India and Singapore, a comparative case study analysis has also revealed that there are some common issues. Academic literature explored in Chapter Two notes that women in STEM often struggle to contest gendered and unfair practices and norms due to hostile working environments, legal barriers and poor evaluative practices and/or regulatory oversight. Chapter Three acknowledged that the WGEA does not have adequate reporting mechanisms in place to assist Australian women who have signed non-disclosure agreements as a requirement of their STEM occupation. Chapter Four demonstrates that enforcing India's Equal Remuneration Act is challenging given that there is a limited amount of labour inspectors and they are expected to enforce multiple laws. Additionally, Chapter Five contends that Singapore's Women's Charter provides little legislative power to challenge unequal or unfair practices. Consequently, the three countries have policy issues with how they enable women and particularly, those employed in STEM industries to legally challenge gendered and discriminatory practices. As already indicated, a neoliberal frame that is reluctant to regulate or penalise the private sector has been an influence. Chapter Six also suggests that there are deficiencies within Australia, Indian and Singaporean policies and programs that arise from not understanding the barriers that impact women's participation in STEM and entrepreneurial pathways. Utilising a gendered discursive policy framing approach, Chapter Six argues that Australian, Indian and Singaporean governments, influenced by a neoliberal framing, have adopted a market-orientated approach to gender equality. This means that governments have collectively overemphasised the positive

attributes of entrepreneurial occupations, often with an excessive focus on individuals, without considering broader gendered barriers which arise from historical, cultural, social and economic influences that have been discussed previously in this thesis. The above instances demonstrate that Australia, India and Singapore share a number of common issues and the suggestions which will be provided further below can thus be applied to all three countries.

7.2 The Australian Government Approach

As discussed in Chapter Three, the Morrison government has implemented some useful programs that address some of the challenges faced by women in STEM. Initiatives such as the Young Indigenous Women's Academy ensure that First Nations women can be supported when they encounter challenges in obtaining a STEM education or career. Other schemes like the Women in STEM Cadetship and Advanced Apprenticeship Program provide opportunities for women to work whilst undertaking a STEM degree or course. Women benefiting from this program may find it easier to transition into higher paid roles following the completion of their STEM education. This outcome can result in a higher Australian female representation rate with regards to STEM leadership careers. Despite this, there are a number of policy flaws that have the potential to undermine attempts to increase the participation rate of Australian women in STEM.

7.2.1 Neoliberal Ideology and Gendered Discursive Policy Framing

The federal government has been influenced by neoliberal ideology that often neglects to consider how pervasive forces can impact on a woman's ability to procure and maintain a STEM occupation. Chapters Two and Three have illustrated how social, cultural, historical, economic and political forces have played a role in establishing STEM as a masculine field of study and employment. However, neoliberal-influenced policy

framing suggests that governments should have a restricted role and that women are primarily responsible for their own economic and social standing. Notably, the emphasis is on individual choice and aspiration. This has implications for women in STEM. Governments influenced by neoliberal ideology are less likely to intervene or undermine the structural, economic, institutional and cultural factors that maintain that women are the primary caregivers of children. Neoliberal ideology also neglects to value the importance of social reproduction and the role that women play in undertaking unpaid care work. Subsequently, neoliberal ideology has resulted in some programs assuming a narrow objective. Applying a gendered discursive policy framing analysis to the Women in STEM Cadetship and Advanced Apprenticeship reveals that it does not attempt to address issues that can deter women from pursuing a STEM education whilst working. The scheme does not sufficiently provide women, and particularly those from low economic backgrounds with financial assistance. Women may find it difficult to offset the costs associated with undertaking STEM courses, including material and administrative fees. Moreover, women with children may also struggle to afford childcare services. These issues are compounded when considering that women participants of the program are working on a reduced income. Women from high income backgrounds are more likely to benefit from the program than others from lower economic positions. The lack of financial assistance for women does seem to fulfil the neoliberal ideal that women should be supporting themselves rather than depending on the state.[2] However, this framing neglects to adequately consider how issues surrounding income and childcare can impact upon a working woman's ability to successfully pursue a STEM education. As such, the Women in STEM Cadetship and Advanced Apprenticeship does little to

[2] Julie Douglas and Katherine Ravenswood, "'We Can't Afford Pay Equity': Examining Pay Equity and Equal Pay Policy in a Neoliberal Environment", *New Zealand Sociology* 34, no. 2 (2019): 184-185, https://doi.org/10.3316/informit.901226625196284.

ensure that women can financially sustain undertaking a STEM education. It also does not sufficiently address the fact that women may have other competing familial demands.

A gendered discursive policy framing approach has also revealed that neoliberal ideology impacts how policies support women in STEM. For instance, the WGEA and its act have little legislative power to penalise STEM companies that breach or violate requirements. The decision by the Morrison government to not enforce additional reporting requirements reflects the neoliberal idea that the government should not intervene in the market nor should it seek to overly regulate it.[3] Businesses are still seen as the key drivers of change. Under this framework, the Australian government does not heavily intervene and has instead tasked themselves with providing assistance and information, rather than what is seen as over-regulation. This policy approach which is influenced by neoliberal ideology has significant implications for women in STEM. STEM businesses face few consequences when they do not fulfil a gender equality obligation. Women may leave their profession because unfair pay practices are not being addressed. Chapter Two also revealed that women working in STEM, particularly in IT industries, are often silenced and forced to concede to powerful confidentiality agreements. The WGEA's established reporting mechanisms have not facilitated an effective way for women to personally report pay inequalities or hostile working environments. This may affect how policymakers are able to identify issues that affect women's participation in STEM occupations. Therefore, neoliberal ideology has impacted the extent to which the WGEA and its act can benefit working women in STEM.

[3] Terry Hathaway, "Neoliberalism as Corporate Power", *Competition & Change* 24, no. 3–4 (July 2020): 322-325, https://doi.org/10.1177/1024529420910382.

7.2.2 Lack of an Evidence Base and Insufficient Data

The analysis of programs for Australian girls and women in STEM in this thesis has also revealed that policymakers have neglected to develop a clear evidence base for evaluating programs (which as argued previously, has also been partly influenced by neoliberal policy framings). Programs may be providing funding to grant recipients when they may not be entirely suitable or do not address the needs of girls and women. Chapter Six notes that there should be greater transparency with regards to the outcomes of initiatives such as those funded under the WISE program. Discursive policy framing analysis of the WISE program revealed that prior to the latter half of 2020, the report template emphasised expenditure costs over initiative outcomes. The WISE program's evaluation process also does little to address cases where awardees have potentially omitted or misconstrued information. This policy flaw may have severely impacted on whether policymakers could determine whether initiatives demonstrated short-term and long-term outcomes. A lack of information around program outcomes may have made it harder for policymakers to regulate and assess whether a WISE participant had used the funds to create a worthwhile initiative. This may have affected the types of government policies and programs available to girls and women. Policymakers may mistakenly perceive ineffective initiatives as a viable way to encourage women to pursue STEM and entrepreneurial opportunities. Similarly, STARportal has not facilitated a process that enables training providers to reveal their program's outcomes. STARportal has not facilitated a way for girls to publicly share or communicate their experiences. Such information is crucial as there may be underlying and unidentified issues with programs meant to encourage further female participation in STEM. There may be differing factors arising from age and background that are not being thoroughly explored. Families may be also be reluctant to encourage their daughters to take part in expensive events

promoted by STARportal given that there is little way to ascertain a course's success. Moreover, a lack of an evidence base can contribute to programs such as GiST that are not entirely advantageous to girls. GiST does not effectively engage with girls from differing age groups and backgrounds. This can be attributed to limited information on the types of resources and activities that are available to girls of any age group.

Consequently, policymakers have neglected to establish an effective and detailed evidence-based framework. The lack of sufficient regulatory measures appears to reflect the government's neoliberal belief that businesses should not be overregulated and that it should not heavily intervene. However, this has implications for women in STEM. Policymakers appear to have little insight into the extent that programs and initiatives are able to generate long-term outcomes for girls and women interested in STEM and entrepreneurial pathways. Flaws are potentially being replicated in future initiatives for girls and women in STEM.

Nonetheless, the Australian federal government has recently made stronger commitments to establishing an evidence base for initiatives aimed at women in STEM and female entrepreneurs. The STEM Equity Monitor highlights the federal government's progress in obtaining up-to-date statistical information on the amount of women undertaking STEM education and employed in STEM occupations. During 2020-1, the federal government also commissioned research group, YouthInsight to examine the experiences of Aboriginal and Torres Strait Islander school children undertaking STEM education.[4] This recent development indicates that the government is seeking to understand how girls

[4] "STEM Equity Monitor – In Focus: Engaging Aboriginal and Torres Strait Islander Girls in STEM", Department of Industry, Science, Energy and Resources, accessed November 20, 2021, https://www.industry.gov.au/data-and-publications/stem-equity-monitor/in-focus-engaging-aboriginal-and-torres-strait-islander-girls-in-stem.

from disadvantaged backgrounds face additional barriers in pursuing STEM education and training. The Women in STEM Ambassador's efforts in establishing evaluation processes for government schemes such as the WISE program also demonstrates a commitment to creating regulatory processes for federal initiatives. This thesis only covers developments up to February 2022. Nonetheless, it is worth noting that the Albanese government may possibly seek to further address some of the barriers explored in this thesis. In September 2022, the Minister for Industry and Science, Ed Husic along with an independent panel engaged ACIL Allen to evaluate programs for women in STEM. Similarly to the thesis, the report suggests that there is little evidence to determine the long-term impact of the GiST program and also notes that the limiting funding of the WiSE program does not position "grantees to drive long-term systemic change in the STEM sector".[5] However, given the nature of the consultant's report, the underlying neoliberal policy framing that contributed to such flaws in existing policy was not identified. The Albanese government has also commissioned the *Diversity in STEM Review* which seeks to support the access of STEM to underrepresented groups. The draft recommendations of the Diversity in STEM Review note the importance of long-term funding and ensuring that women from all backgrounds can access and participate in initiatives. Similarly, to the thesis, the draft review also recommends that stronger accountability mechanisms should be in place to support implementation of policies and programs for women in STEM.[6] At present, such measures remain just recommendations with the Albanese government still to develop its policy response to the final Review. While such recent evaluation initiatives are welcome, the analysis in this thesis suggests

[5] Department of Industry, Science and Resources, "Women in STEM Evaluation Final Report", page 99 and 135.
[6] Department of Industry, Science and Resources, "Pathway to Diversity in STEM Review: Draft Recommendations".

that more needs to be done, including challenging the underlying ways in which policy has been framed.

The subsequent section will explore how the Indian government has also implemented programs that prove its commitment to addressing the underrepresentation of women in STEM careers.

7.3 The Indian Government Approach

As argued in Chapter Four, the Modi government has implemented beneficial programs for women wishing to pursue a STEM education or advance in a STEM career. As noted in Chapter Four, Indian women commonly take career breaks because of familial responsibilities. The Indian government took steps to address this by establishing the KIRAN initiative. Under the KIRAN scheme, WOS A, B and C provide an avenue for Indian women to return to their STEM occupation following a career break. The schemes also address additional challenges that may arise for women. Women are provided with financial support to offset expenses or contribute to their household incomes. There are also policy measures to further support Indian women from disadvantaged backgrounds and circumstances. These policy measures are an area that the Australian government may draw from when examining how women from disadvantaged backgrounds are able to pursue STEM. Thus, the Indian government under Modi has made efforts to address some of the issues impacting women in STEM. The government has implemented additional measures to programs to further assist women from marginalised and disadvantaged backgrounds. However, the section that follows will summarise some policy flaws examined in Chapter Four.

7.3.1 Social Reproduction and Women as Primary Caregivers

Despite the progressive policies and initiatives discussed above, the Modi government has not adequately addressed the fact that Indian women overwhelmingly remain the sole primary caregiver of children and elderly family members. Programs by the Modi government have been discursively framed to reinforce this belief whilst neglecting to encourage men to play a large role in the home. For instance, many of the schemes explored in Chapter Four and which aim to support women's dual responsibilities to the home and work place do not provide men with similar opportunities. This issue is also prevalent in Australia's case. The Mobility Scheme does not account for men wishing to move in order to support their wife's relocation. The WOS A, B and C also do not support men who choose to have a career break in order to support their families. These policy flaws help maintain the belief that women should be taking career breaks to support their families. As such, the policies and programs do not fully seek to address the fact that women undertake a disproportionate amount of unpaid labour which is often critical for social reproduction. Married couples may also determine that it is financially and socially more advantageous for a wife to have a career break rather than a husband. Conversely, the Maternity Benefit Act and its amendment continue to regard women as the sole primary caregivers of children. There is no legal provision for paternity leave in India. Only Indian government officials have the right of 15 days of paternity leave.[7] Changes to policy in 2020 have allowed single fathers working in government to claim up to two years of paid childcare leave.[8] However, most Indian fathers are not provided with paternity leave schemes. A lack of paternity leave has meant that it is more economically

[7] *Mint*, "From One Year to 10 Days: A Look at Paternity Leaves around the World", *Mint*, July 2, 2021, https://www.livemint.com/news/world/from-one-year-to-10-days-a-look-at-paternity-leaves-around-the-world-11625195516054.html.

[8] Ayushi Agarwal, "A Fatherhood More Fulfilling", *The Indian Express*, November 8, 2020, https://indianexpress.com/article/opinion/a-fatherhood-more-fulfilling-7013342/.

viable for women to take career breaks in order to look after children. As a gendered discursive policy framing approach has revealed, a lack of paternity leave for Indian men also reinforces gendered ideology which maintains that women are largely responsible for undertaking a larger proportion of domestic tasks and care work which is necessary for social reproduction. This belief fuels views that women in STEM are not able to devote time to STEM fields that are highly competitive.[9] The Modi government's neglect in considering fathers to be equal caregivers of children and supporters of wives can potentially contribute to an unequal dynamic that justifies gendered inequality and unfair practices within the home and in the workplace.

7.3.2 Neoliberalism

Similarly to Australia, the Modi government has implemented initiatives such as the WEP that are influenced by neoliberal ideals. As explored in Chapter Four, Indian governments under Vishwanath Pratap Singh, Chandra Shekhar and PV Narasimha Rao began to promote a language of empowerment in the 1990s. This neoliberal ideology promoted the idea that empowering women would turn them into "producers of their own welfare and bounty".[10] By providing neoliberal empowerment strategies, women could economically and socially advance whilst also contributing to the nation's growth. This neoliberal ideology continues to attribute failure to the individual. However, as articulated in Chapter Six, women entrepreneurs are impacted by social, institutional, political and economic factors that undermine their ability to succeed. Analysing the WEP revealed that the Modi government continues to be influenced by neoliberal ideology that maintains that women are primarily responsible for their own social and

[9] Bridget M Kuehn, "Planning During Pregnancy", *ELife* 8 (May 2019): 3, https://doi.org/10.7554/eLife.47985.
[10] Sharma, *Logics of Empowerment*, 19.

economic development. The Modi government has also taken a market approach to gender equality.

Whilst the WEP does empower women to pursue entrepreneurial careers, it does not adequately address external issues affecting them. This reflects a neoliberal ideal that contends that women are predominately responsible for their failure. Drawing from the work of feminist scholars and researchers, Chapter Four articulates that historical, cultural and societal forces continue to instil the belief that Indian women are primarily responsible for the home. Yet, a neoliberal policy framing neglects these factors and the issues they cause and moreover, does not place value on women's care work and role in social reproduction. Issues not sufficiently addressed by the WEP include little information on schemes that can assist women with children or those caring for elderly family members. There are also few resources available that can assist Indian women facing gender discrimination. Additionally, analysing policy discourse, including the government platform found that the WEP promotes empowering strategies such as microcredit schemes without recognising that Indian women entrepreneurs are operating within a competitive male dominated area. Analysis also highlighted that microcredit schemes are a neoliberal strategy that do not significantly challenge gendered norms, practices and beliefs because they are based on the premise that access to credit is sufficient enough to support women.[11] Additionally, social and cultural norms, practices and beliefs continue to maintain that women are not suited to entrepreneurial careers because they require masculine traits. Consequently, few women obtain capital funding for their start-ups due to gender discrimination. Women with more capital, resources and wealth are more likely to benefit from microcredit schemes advertised on the WEP than

[11] Rankin, "Governing Development", 32-33.

women from disadvantaged backgrounds. As noted in Chapter Six, the lack of informed information on microcredit schemes promoted on WEP can compound these issues further and lead to additional inequalities for disadvantaged women. Accordingly, the Indian government's adoption of neoliberal ideology has impacted how women in STEM and women interested in entrepreneurial careers are able to counter gendered practices, norms and beliefs. Compounding this issue further is that the Indian government has not adequately evaluated programs for women interested in STEM and entrepreneurial pathways. Moreover, information regarding women participants from disadvantaged backgrounds is limited. This makes it difficult to ascertain whether Indian women from disadvantaged backgrounds are able to access the program. There is also a significant lack of data relating to the career trajectories of women participants. These gaps in information mean that policymakers influenced by neoliberal ideology are potentially neglecting to address barriers that significantly impact upon Indian women from disadvantaged backgrounds. As such, these policy flaws as well as the fact that government policies and programs continue to position women as the sole caretakers of children and elderly family members can undermine Indian women's participation in STEM. However, as mentioned above, the Indian government's KIRAN scheme reflects the Indian government's commitment to addressing some of the barriers encountered by women in STEM.

7.4 The Singaporean Government Approach

In contrast to Australia and India, the Singaporean government has adopted a meritocratic gender-neutral approach with regards to policies and programs for women in STEM. This framing will be explored further below. Despite this, the Singaporean government under Lee Hsien Loong has implemented a range of policies and programs that have benefited

women wishing to pursue STEM education and occupations. Initiatives such as the SkillsFuture program have enabled women to access subsidised STEM courses. Women can undertake STEM courses in data analytics, finance, technology and entrepreneurship. Other women can use SkillsFuture to re-train or upgrade their existing STEM skills and knowledge. Moreover, the Singaporean PAP government has recently made attempts to highlight the experiences of working women as well as those employed in STEM industries. Throughout 2017 and 2018, Singaporean politicians raised concerns over the lack of female representation in STEM fields. In 2020, the Lee government announced that it would launch engagement sessions that examined the barriers that impacted women at home, in school, workplaces and the community. This may have been a response to studies finding that Singaporean women expressed dissatisfaction with their marriages as they shouldered a larger proportion of household responsibilities during the COVID-19 pandemic.[12] Chapter Five contends that the Singaporean government may have perceived this finding as concerning given that it can potentially undermine attempts to increase the fertility rate. This will be discussed further below. Nonetheless, the engagement sessions titled 'Conversations on Singapore Women's Development' attracted 5700 participants.[13] Subsequently, the PAP government announced that it would create a White Paper based on the discussions. The government promised that the release of the White Paper in 2022 will have 'concrete proposals' that tackle women's issues.[14]

However, despite the Lee government's recognition of barriers affecting women's participation in STEM, it has remained clear that programs will continue to function

[12] Theresa Tan, "Women in Singapore Less Satisfied with Their Marriages during and after Circuit Breaker: Study", *The Straits Times*, May 26, 2021, https://www.straitstimes.com/singapore/women-in-singapore-less-satisfied-with-their-marriages-during-covid-19-pandemic-study.
[13] Reach: Government Feedback Unit, "Conversations on Singapore Women's Development".
[14] Michelle Ng, "Concrete Proposals to Tackle Women's Issues to Be Presented in Early 2022: PM Lee", *The Straits Times*, September 18, 2021, https://www.straitstimes.com/singapore/community/concrete-proposals-to-tackle-womens-issues-to-be-presented-in-early-2022-pm-lee.

under a meritocratic approach. In a closing speech for the Conversations on Singapore Women's Development September 2021 session, Prime Minister Lee stated that "more (women) will advance into senior leadership roles and they can be proud that they did so on their own merit, and not through some special scheme or treatment".[15] As this statement reveals, the Singaporean government is committed to its meritocratic approach and it is unlikely that policies and programs will be developed exclusively for working women in STEM. The next section will summarise the impact of a meritocratic approach on Singaporean women in STEM.

7.4.1 Meritocratic Approach

In comparison to Australia and India, the Singaporean government has utilised a meritocratic approach in its efforts to encourage girls and women to pursue STEM. However, as Chapter Five has noted, Singaporean politicians and policymakers are influenced by neoliberalism and have adopted a survivalist discursive policy framing approach which prioritises economic growth. Although, the Singaporean government has been more interventionist in its version of neoliberalism than is the case in some other countries. Chapter Five has highlighted how the Singaporean government's use of the terms of gender-neutral and meritocratic can be considered as neoliberal as they continue to maintain that belief that women are largely responsible for their own economic and social standing.

According to the Singaporean government, a meritocratic approach means that individuals are appointed or promoted to positions on the basis of their hard work and

[15] "PM Lee Hsien Loong's Speech at the Closing Session of the Conversations on Singapore Women's Development", Prime Minister's Office Singapore, last modified September 18, 2021, https://www.pmo.gov.sg/Newsroom/pm-lee-conversations-on-singapore-womens-development.

talent.[16] A meritocratic approach also contends that everyone is allowed the opportunity to succeed.[17] Yet, this discursive framing neglects the social, cultural and economic barriers that impact women's participation in STEM employment. Chapter Five illustrates that a meritocratic approach towards early education policies encouraged more girls to undertake STEM education. However, analysis made in Chapter Five reveals that a meritocratic approach has not sufficiently increased the participation rates of Singaporean women in STEM employment. The PAP government has designed programs that are gender-neutral reflecting their belief that meritocracy is a significant component to policy development. This approach, however, neglects factors that can disadvantage some individuals and benefit others. Social class and gender can impact to what extent and how quickly hardworking individuals are able to obtain life goals or socially and economically advance. This is evident when assessing Singapore's education system. A belief that purely meritocratic principles are being applied can also conceal harmful and pervasive gendered ideology. Gendered beliefs may permeate recruitment and promotion processes. Women believing that the process is genuinely meritocratic are likely to perceive their lack of promotion as fair rather than question whether unfair and gendered practices, norms and ideas have affected their career.[18] Therefore, meritocracy could be legitimising a social hierarchy that exacerbates gendered inequalities as well as maintaining neoliberal ideals.[19] Singaporean women in STEM are likely to perceive that

[16] "Meritocracy: Time For An Update?" Civil Service College Singapore, accessed September 28, 2021, https://www.csc.gov.sg/articles/meritocracy-time-for-an-update.
[17] "Meritocracy in Singapore: Solution or Problem?" Global Is Asian, accessed September 28, 2021, https://lkyspp.nus.edu.sg/gia/article/meritocracy-in-singapore-solution-or-problem.
[18] Virginie Wiederkehr, Virginie Bonnot, Silvia Krauth-Gruber and Céline Darnon, "Belief in School Meritocracy as a System-Justifying Tool for Low Status Students", *Frontiers in Psychology* 6 (July 2015): 2, https://doi.org/10.3389/fpsyg.2015.01053.
[19] Wiederkehr, Bonnot, Krauth-Gruber and Darnon, "Belief in School Meritocracy", 2.

their current social and economic status is fair and legitimate rather than impacted by political, cultural, economic and institutional forces.

The analysis of SkillsFuture revealed that it is based on the meritocratic principle that all individuals regardless of gender can benefit. Statistics suggest that 55% of SkillsFuture participants were women.[20] While this is encouraging, the Singaporean government could facilitate additional measures in the SkillsFuture program in order to mitigate the specific barriers faced by women interested in STEM education and employment, such as those discussed in Chapters Two and Five. Existing issues have the potential of reducing women's future participation in the program. Chapter Five's gendered discursive policy framing analysis found that STEM courses on the SkillsFuture program may not accommodate mothers with young children or working women requiring flexible arrangements. This is important given that Singaporean women in STEM are likely to balance a higher proportion of familial responsibilities with work or study requirements. Some women leave their STEM profession or studies if they are unable to acquire flexible working arrangements. SkillsFuture also does not have support mechanisms to aid women from low economic backgrounds. As Singaporean women make up 60% of informal caregivers, they are less likely to have the financial means to offset costs associated with SkillsFuture courses.[21] Moreover, similarly to Australia and India, the Singaporean government has not released a substantial amount of information on the participation rates of women from diverse racial and ethnic backgrounds. Women belonging to minority racial and cultural communities may have additional and undisclosed barriers impacting on their ability to participate in the SkillsFuture program.

[20] Parliament of Singapore, "Parliamentary Debates Singapore - Official Report Thirteenth Parliament: First Session Volume 94, No 44".
[21] Marina Lopes, "As Singapore Ages, Single Women Pay the Price of Caring for Elderly Parents", *The Washington Post*, April 12, 2021, https://www.washingtonpost.com/world/asia_pacific/women-asia-singapore-parents-ageing/2021/04/12/1479ef98-95da-11eb-8f0a-3384cf4fb399_story.html.

Chapter Five contends that the Singaporean government under Lee has not published many publicly available reports on women that participate in government initiatives. Information obtained about women's participation in SkillsFuture was dependent on discourse such as government press release statements and parliament reports. As such, it is difficult to ascertain how Singaporean policies and programs for girls and women in STEM can be further improved upon without publicly available information. This instance highlights that Singaporean policymakers may not be collecting relevant gender statistics given that they are influenced by meritocratic principles that do not consider how gender can impact upon an individual's career trajectory. As such, the Singaporean government could implement additional measures for women participating in SkillsFuture in order to ensure that they are provided with the same opportunity to advance in their STEM educational and career pursuits as their male counterparts.

7.4.2 Shifting Expectations

Chapter Five of this thesis revealed that Singaporean girls and women in STEM have also been historically affected by contradictory policies and programs from the PAP governments under Lee Kwan Yew and Goh Chok Tong. In times of economic strife, Singaporean women were urged to work largely due to the government's focus on the economy. However, Singapore's declining fertility rate was, and continues to be, a concern for political leaders. A declining fertility rate affects Singapore's future labour workforce and economic standing. Political leaders and policymakers have maintained a narrative that promotes Asian family values in order to illustrate that women are expected to assume their traditional roles as wives and mothers. Moreover, the Singaporean government has also framed the issue of declining birthrates as a survivalist narrative

which as Dugo explains, supports a combination of authoritarian and neoliberalism.[22] As a result, PAP government policies and programs for Singaporean women have been centred on children and family more so than participation in the workforce. PAP governments have taken steps to address issues faced by Singaporean women only when they have a pragmatic motive. Lazar identifies this as strategic equalitarianism.[23] An inability to address concerns may negatively affect female workforce participation or the fertility rate. The Singaporean government will attempt to ease concerns when they believe that a national objective is at risk. Nonetheless, the Lee government has continued to implement and maintain policies that encourage Singaporean women to have children. However, it has also contended that women can balance work and family expectations. Notably, Chapter Two reveals that balancing work and family can present a number of challenges to women in STEM. Similarly, Singaporean women in STEM face challenges associated with fulfilling these dual demands. They may not pursue leadership roles or advance higher in their STEM career given that they must also find time to fulfil cultural and societal expectations. Singaporean women in STEM who choose flexible working arrangements may also contend with a lower income and insecure employment. Other women in STEM may choose to take career breaks. This results in fewer Singaporean women in STEM obtaining leadership positions and, moreover, contributes to a lower STEM female participation rate.

Utilising a gendered discursive policy framing analysis approach in Chapter Five revealed that there are few additional measures within the examined programs and initiatives that aim to address the challenges associated with working women in STEM.

[22] Dugo, “Neoliberal Singapore: Nation-State and Global City”, 28.
[23] Lazar, "For the Good of The Nation", 59.

The Lee government's advocacy for flexible working arrangements reflects Lazar's theory that it will act on issues impacting on women when there is a pragmatic need. In this case, flexible working arrangements seek to ensure that Singaporean women can continue working whilst looking after children or elderly family members. The promotion of flexible working arrangements also reflects somewhat of a neoliberal ideal in that it places the onus on companies and industries to support women in STEM. Moreover, it adheres to the neoliberal idea that governments should not heavily interfere in the economic markets. The Lee government's promotion of flexible working arrangements does provide some Singaporean women in STEM with benefits. There are financial incentives for Singaporean companies with the Enhanced Work-Life Grant for Flexible Working Arrangements scheme. An additional potential benefit is that employers could make more effort to facilitate job sharing arrangements. This could potentially increase the amount of Singaporean women in STEM leadership roles. Yet, flexible working arrangements are not particularly helpful to Singaporean women in STEM that belong to disadvantaged backgrounds. Women from disadvantaged backgrounds might find it challenging to work on a reduced income. They may also contend with insecure working conditions and less career advancement prospects. Additionally, flexible working arrangements can also reinforce gendered expectations that insist that women are primarily responsible for familial duties. It is clear then, that the Singaporean government could develop supplementary measures to further assist working women in STEM. The section below will highlight some of the ways that Australian, Indian and Singaporean governments can implement measures to complement their schemes for girls and women in STEM.

7.5 Suggestions for Schemes

As illustrated in previous sections, the governments of Australia, India and Singapore have implemented beneficial schemes for girls and women interested in pursuing STEM and deserve credit for doing so. Nonetheless, as indicated above, Australian, Indian and Singaporean government schemes can be further improved upon to mitigate policy flaws and thus better support girls and women in STEM. The section below will suggest complementary measures that can be added to the examined schemes.

7.5.1 Evidence Base and Evaluation Process

One potential suggestion that can be implemented by Australian, Indian and Singaporean governments is to develop an effective evidence base and evaluation process for schemes. Chapter Three found that the Australian government's WGEA requires companies to adopt gender equality strategies. However, it is not compulsory for a STEM company to demonstrate that a strategy has produced an effective outcome for Australian working women in STEM. Existing issues such as the gender pay gap and gender discrimination are being addressed slowly or not at all. This may be contributing to a declining female STEM workforce rate. Other initiatives such as the WISE program did not heavily encourage successful grant recipients to deeply evaluate their schemes outcomes. As this thesis has illustrated, policymakers are unable to assess whether women from disadvantaged backgrounds are accessing government schemes due to a lack of information. A lack of data can also limit how policymakers are able to understand what elements of the program are successful in increasing female STEM participation rates at both the university and workforce level. Compounding this issue further is that there has been a lack of external or internal oversight. Evaluations are dependent on participants solely submitting information. Information could be potentially shaped to give an overly

favourable outcome. The absence of an evaluation framework can also result in girls and women being deterred from participating in STEM programs. This thesis argues that the Australian government could gather feedback anonymously from girl participants. This would reduce the risk that grant recipients suffer reputational damage whilst also providing deeper insight into what aspects of a program engaged with girl participants interested in STEM. As acknowledged in Chapter Three, workshops and camps for girls can be expensive for those with low incomes. A lack of a feedback system can result in families choosing not to invest in good STEM programs for girls particularly, if policymakers are unable to demonstrate the strengths of a specific initiative. This can contribute to fewer girls nurturing an interest in STEM. Similarly, the Modi government has not introduced an evaluation scheme for programs and initiatives aimed at girls and women in STEM. Whilst the KIRAN initiative does provide information on the amount of Indian women who have benefited from the schemes, it does not provide information as to whether women from disadvantaged backgrounds participate. There is also little publicly available information on the specific types of challenges disadvantaged Indian women may have when they participate in a KIRAN scheme. Correspondingly, the Conclusion's summary focusing on Singapore noted that the Lee government publishes little information related to women's participation in initiatives. Consequently, this thesis argues that Australian, Indian and Singaporean governments could do more to establish and maintain an evaluation and regulatory framework that ensures that any issues faced by girls and women in STEM can be identified and resolved more efficiently. More detailed and informative data may also provide insight into specific challenges faced by women participants from diverse cultural and socio-economic backgrounds. A stronger regulatory framework means that STEM companies and grant holders will be held more

accountable for inadequate programs. These may result in further female participation in STEM.

7.5.2 Financial Assistance

Australian and Singaporean governments could also provide supplementary financial assistance to women participants from disadvantaged backgrounds. This would further support women who undertake unpaid care work as well as symbolise that governments value social reproduction. Initiatives under India's KIRAN program provide women with a monthly salary over the duration of the schemes. This is in addition to the program's research grant provided to successful applicants. Families of Indian women in STEM then have an economic incentive to encourage their wives and daughters to participate in the program. This discursive policy framing helps counter patrifocal and gendered ideology that maintain that a wife's or daughter's education is not as important as a husband's or son's. Additional financial assistance can also support Indian women in STEM with children or elderly family members as well as those from disadvantaged backgrounds. The Modi government could incorporate additional funding to expand the program so that more Indian women interested in beginning or maintaining a STEM career can participate. In contrast to India, the Australian and Singaporean governments have neglected to address the financial barriers around a woman's ability to participate in government programs aimed at increasing STEM participation. Women participants of the Morrison government's Women in STEM Cadetships and Advanced Apprenticeships Program are not provided with financial assistance to support them as they transition into part-time employment. Women from low income households may struggle to offset costs associated with their participation in the program. This may affect their ability to successfully complete the program. Moreover, many women participants may find it challenging to pay for childcare with a reduced income. Singaporean women

participating in the SkillsFuture program also face similar struggles. Whilst the program provides Singaporean women with credit and subsidised course costs, it does not offset childcare expenses nor does it account for the cost of educational materials. Some of the ways that Australian and Singaporean governments could financially assist women participants of programs include the creation of a stipend to assist with costs associated with child or elderly care. Additionally, a bursary or grant can help to offset study costs. Policymakers could assess whether female participants with children and from lower socio-economic backgrounds can be given reduced or fully subsidised childcare while they are participating in a government program that aims to increase their STEM skills and knowledge.

7.5.3 Online Unified Portal

A further measure that could be implemented into the examined Australian, Indian and Singapore policies and initiatives includes the creation and maintenance of an online unified portal for girls and women in STEM and entrepreneurial careers. Chapter Six argues that the Modi government's WEP initiative makes it easier for women to obtain information about schemes that assist them in their entrepreneurial career. Noting the research question which asks if there are there any lessons that the examined countries can learn from each other, it can be argued that Australian and Singaporean policymakers could seek further insight into the Indian government's WEP initiative. As Chapter Six notes, the platform enables women to access resources online whilst also providing them with opportunities to connect with STEM-based companies and industries. The Modi government, however, has neglected to develop a similar online portal for Indian girls and women interested in STEM education and employment. This is also the case when examining Australia and Singapore. Information about Australian policies and programs for girls and women in STEM are spread across multiple government departments and

websites. Conversely, the Singaporean government has adopted a meritocratic approach towards policies and programs for girls and women in STEM. Singapore's Ministry of Social and Family Development provides little information on STEM resources other than the SkillsFuture program. In all three case studies, girls and women interested in STEM must devote considerable time and effort to search for government policies and initiatives that aim to support them. Some women may choose to forgo their STEM education or employment pathways out of the belief that there is little government assistance available to support them. Women in Australia and India have additional challenges as states and territories may have information on their policies and programs on differing platforms. An online portal can greatly reduce these barriers given that all government policies and programs for women in STEM can be integrated. Therefore, a unified portal can potentially increase the visibility and awareness of government schemes for women in STEM. Public entities such as libraries, local government offices, schools and training providers may also be further likely to encourage girls and women to pursue STEM pathways offered by the government given that knowledge would be more accessible and streamlined. Given this, Australian, Indian and Singaporean governments should each create and maintain a unified portal that provides information about government policies and programs for girls and women in STEM. This would enable women to access information about critical resources earlier, thereby reducing the likelihood that they abandon a STEM pathway.

7.6 Suggestions for Additional Policies and Programs

This section will provide some suggestions about possible programs and schemes Australian, Indian and Singaporean governments can implement to increase the

participation rates of girls and women in STEM. The thesis will also illustrate that the Australian, Indian and Singaporean governments can learn from each other's approaches.

7.6.1 Australia

This thesis argues that the Australian government could learn from the Singaporean government's SkillsFuture initiative and incorporate a similar strategy to increase women's participation in STEM microcredentials. In 2020, the Morrison government announced that it would develop a nationally consistent platform which would compare course outcomes, duration, mode of delivery and credit point value.[24] The platform would build on the microcredential initiative that aims to increase the availability of short online courses in order to address skills shortages.[25] The then-Minister for Education, Dan Tehan stated that microcredentials would give Australians the skills required "to be job-ready".[26] Within this context, the Australian government could create policy strategies to encourage more women to undertake STEM microcredentials. Reflecting on the Singaporean government's SkillsFuture initiative, the Australian government could offer credit and financial subsidies to support women from all backgrounds to access and participate in STEM microcredentials. They could develop advertising strategies to specifically target Australian women taking career breaks or maternity leave. Women in STEM considering leaving their profession could also be encouraged. Microcredential courses do not require long time commitments and can be flexible in their structure. Australian women with young children or those on maternity leave could potentially benefit from this flexibility. Moreover, microcredentials can be cost efficient and some are not geographically restricted. This can benefit Australian women from disadvantaged

[24] "Marketplace for Online Microcredentials", Minister's Media Centre, last modified June 22, 2020, https://ministers.dese.gov.au/tehan/marketplace-online-microcredentials.
[25] Minister's Media Centre, "Marketplace for Online Microcredentials".
[26] Minister's Media Centre, "Marketplace for Online Microcredentials".

backgrounds as well as those living in rural and remote areas. The federal government could offer free or subsidised childcare to women participants as an additional incentive. The government could also allocate funding to the creation of bursaries, scholarships or grants that assist with costs associated with caretaking and course materials. However, noting the limitations of the STARportal initiative and the Women in STEM and Entrepreneurship program, the thesis suggests that the Australian government should ensure that there are adequate regulatory mechanisms in place to document the effectiveness of projects and programs that aim to support the participation rates of girls and women in STEM. The government should intervene in cases where microcredentials or training providers do not adhere to requirements or report low outcomes. This would ensure that issues and barriers impacting women in STEM can be addressed efficiently.

Following the completion of a microcredential course, Women who have obtained STEM microcredentials could be encouraged to play a role in strengthening Australia's manufacturing industry. This is an area of focus for the Australian government. In 2021, it cited six key areas including resources technology and critical minerals processing, food and beverage, medical products, recycling and clean energy and defence.[27] Drawing from the Indian government's Women Entrepreneurship Platform, the Australian government could facilitate partnerships with STEM industries in the manufacturing sector to offer women with flexible paid internships or placements that allow them to obtain practical working experience in STEM areas. STEM companies could be provided with financial incentives or tax subsidies. These positions could make it easier for women to transition into STEM employment. This may reduce the amount of women who leave

[27] "$1.3 Billion Modern Manufacturing Initiative Blasts off" (Hon Karen Andrews), Ministers for the Department of Industry, Science, Energy and Resources, accessed October 15, 2021, https://www.minister.industry.gov.au/ministers/karenandrews/media-releases/13-billion-modern-manufacturing-initiative-blasts.

the workforce and improve economic inequalities. By encouraging women to pursue STEM microcredentials, the Australian government could increase female STEM representation whilst also strengthening their commitment to building and maintaining national manufacturing capabilities. Therefore, the proposed suggestion would not only potentially increase Australian's women's participation in STEM education, it would lay the foundations of STEM roles that accommodate the needs of women.

As mentioned previously, it is possible that the Albanese government will address some of the problematic policy issues raised in this thesis as it evaluates and revises existing policies and programs as well as develops new ones to encourage women's participation in STEM. Hopefully, such polices might also include measures, as discussed in Chapter Three, that were suggested to a previous Labor government in the 1990s, such as tighter procurement policy requirements. These could require companies to have serious equal opportunity programmes in place to tackle barriers to employment and promotion in STEM as well as broader gender (not just sexual) harassment in the workplace. Similarly, the issue of major public awareness campaigns could be pursued. However, those policies have not been developed yet and are, in any case, beyond the scope of this current thesis.

7.6.2 India

The Indian government under Modi has implemented a number of beneficial schemes for girls and women in STEM. However, the examined government policies and initiatives are flawed in their ability to mitigate the obstacles faced by Indian women, and particularly those from disadvantaged backgrounds. Legal mechanisms such as the Equal Remuneration Act do not facilitate a way for Indian women to contest gendered and discriminatory practices, norms and beliefs in STEM areas and workplaces. The eligibility requirements of most KIRAN schemes also require women applicants to be

unemployed. For many marginalised Indian women, it is economically unfeasible to go through a period of unemployment. Subsequently, this thesis suggests that the Indian government could develop a program similar to the Australian Government's Young Indigenous Women's STEM Academy which could be aimed at Indian schoolgirls from marginalised groups and lower socio-economic areas.

Similarly to the Australian government's Young Indigenous Women's STEM Academy, a potential Indian government program could provide marginalised Indian women with personalised long-term support that enables them to transition into a STEM career. A range of services may potentially counter patrifocal ideology as well as address any concerns expressed by participants. Indian schoolgirls from marginalised backgrounds could also access fully funded internships, workshops and activities. As they progress into higher education, participants enrolled in STEM courses could be offered with financial assistance in the form of grants, scholarships and bursaries. This would reduce some of the economic and cultural concerns faced by disadvantaged families. At the end of their STEM degree, continuing participants could access resources that help transition them into a STEM career. However, as acknowledged above, legal mechanisms such as the Equal Remuneration Act are limited in their ability to support women in India largely because of a lack of resourcing. As such, this thesis recommends that the Indian government could invest more in resources that can support effective implementation of policies that support Indian women. It is also important that the Indian government evaluate programs and policies that attempt to increase the representation of women in STEM to ascertain how they can be improved.

7.6.3 Singapore

The Singaporean government's meritocratic and gender-blind framing approach towards education policies continues to influence the high level of female participation in STEM in so far as it implicitly challenges conceptions that STEM is an inappropriate field for women.[28] However, Chapter Five illustrates that the Singaporean government has neglected to implement measures that support working women in STEM who have work and family responsibilities. For instance, SkillsFuture does not have additional measures to aid women with young children or requiring flexible arrangements. There are also few strategies that assist women in STEM returning from career breaks. In response to this, the thesis suggests that the Singaporean government could adopt more measures that specifically target women interested in pursuing STEM. In particular, the Singaporean government could adopt initiatives similar to the Indian government's KIRAN scheme which supports women to work on small to mid-scale STEM projects while they are on career breaks or working whilst undertaking care work. The Singaporean government could also implement grants that support STEM businesses and stakeholders who wish to engage with women in STEM. This would potentially increase Singapore's research capacity whilst also contributing to higher women participation in STEM workplaces. It is also suggested that the Singaporean government could include supplementary measures into existing programs such as SkillsFuture. For instance, women participants could be provided with a stipend or have subsidised childcare costs. This would further support women undertaking care work and who contribute to social reproduction. A further point of consideration is that the Singaporean government could implement similar schemes for men wishing to undertake caring duties. Utilising a gendered discursive policy framing approach revealed that the Singaporean government could also

[28] Mastercard, "Eight in Ten Female First-Jobbers in Singapore".

do more to encourage more men in STEM to utilise government or workplace initiatives that can assist them with familial and domestic responsibilities. Here as elsewhere, a gendered discursive policy framing analysis is useful for identifying what is not included in policy as well as what is.

This thesis also proposes that Australian, Indian and Singaporean policymakers and statutory agencies could potentially encourage the exchange of information relating to programs for women in STEM. As mentioned in Chapter One, Australia and India share a Comprehensive Strategic Partnership whilst Australia and Singapore have signed a Digital Economy Agreement. Given these partnerships, this thesis notes that policymakers could facilitate opportunities to share information which would widen the evidence base of the respective countries. Australian, Indian and Singaporean policymakers could collectively learn from each other on how to mitigate flaws, strengthen approaches and implement innovative programs. The next section will now offer a concluding section that summarises the findings and arguments made throughout the thesis.

7.7 Concluding Section

This thesis has analysed Australian, Indian and Singaporean policies and initiatives that aim to increase the participation rates of girls and women in STEM education and occupations. Moreover, the thesis has used feminist analytical approaches, including a gendered discursive policy framing approach and a feminist comparative policy approach to argue that Australian, Indian and Singaporean government's policy framing of women's participation in STEM has been influenced by social, cultural, historical, political and economic factors that have sometimes resulted in flawed policy approaches. The thesis has explored how there are cultural, social, historical, economic and political

differences between the three countries, however, it has been identified that all three countries are influenced by neoliberal ideology which neglects the importance of social reproduction and women's unpaid labour and contributes to a reluctance for governments to use more interventionist measures. This chapter has sought to address the key research questions and in particular, how the examined policies and programs can be strengthened and further improved. It has also considered how the respective countries can learn from one another.

As acknowledged in Chapter One, examining policy with a gender perspective is important because it provides insight into how women can be potentially marginalised or excluded from policy decisions. Examining policies with a gender focus can also explore how social, cultural, political and economic factors impact on policy development. It can also reveal whether governments reinforce gendered norms, beliefs and practices. Similarly, the thesis' utilisation of a FCP approach (combined with a gendered discursive framing one) allows it to examine whether Australia, India and Singapore have adequately addressed barriers that impact on women's participation rates in STEM. This thesis has been inspired by FCP given that it is problem-driven and seeks to ensure that policy development and implementation is fair and equitable.

Importantly, a comparative case study of Australia, India and Singapore using these methods has enabled this thesis to fill in a gap within the wider academic literature. Few comparative studies explore countries in the Asian region. This is a cause for concern because it can lead to the generalisation of 'western' concepts that do not sufficiently apply to more diverse countries. As such, this thesis advances understandings of how Asian policymakers approach the issue of women's representation in STEM. Findings from this thesis may provide opportunities for countries to mutually learn from one

another as well as develop new initiatives that benefit women in STEM. Examining Australian and particularly, Indian and Singaporean policies and programs has also enabled the thesis to provide insights on how countries differ in their approach of tackling the low representation rates of women in STEM. For instance, initiatives under India's KIRAN scheme feature additional measures to specifically support women from disadvantaged backgrounds. These measures reveal the Indian government's recognition that women from particular groups can face higher barriers when they attempt to maintain a STEM education or career. In contrast, advocacy groups continue to encourage the US federal government to take an intersectional approach with regards to policies and programs for women in STEM.[29] The Singaporean government's SkillsFuture program provides opportunities for women to undertake STEM microcredentials without facing significant financial penalties. The program can assist women in obtaining a STEM education or career within a faster timeframe than a traditional pathway. Furthermore, such insights can have broader international implications. For example, a 2021 report from the National Academies of Sciences, Engineering and Medicine noted that few attempts have been made at creating alternative STEM pathways for women in the US.[30] The thesis' examination of Australia, India and Singapore as case studies can then further understandings of how women in STEM can be supported internationally and moreover, how policymakers can develop policies that assist women from various cultural and socio-economic backgrounds.

[29] The National Academies of Sciences, Engineering, and Medicine, *Transforming Trajectories for Women of Color in Tech,* (Washington: The National Academies Press, 2021), 23.
See also Teirra Holloman, Walter Lee, Jeremi London, Atota Halkiyo and Gilbert Jew, *A Historical and Policy Perspective on Broadening Participation in STEM: Insights from National Reports (1974-2016),* (American Society for Engineering Education, 2018), 3.
[30] The National Academies of Sciences, Engineering, and Medicine, *Transforming Trajectories for Women of Color in Tech*, 11.

As noted in Chapter One, utilising a gendered discourse policy framing analysis has highlighted the ways in which policies and programs have not adequately addressed barriers that impact how women, and particularly, those from disadvantaged communities can pursue STEM education and occupations. It has also revealed how governments have not thoroughly recognised the value of social reproduction or how women are impacted by social and cultural forces that maintain that their primary responsibility lies in the home. Chapters Three, Four and Five have also examined how Australian, Indian and Singaporean policymakers have implemented beneficial policies and programs that may not fully address some of the issues that are faced by women in STEM. Chapter Six, in particular, has argued that Australian, Indian and Singaporean policymakers have been influenced by neoliberal policy framing and adopted a market-orientated approach to gender equality. Consequently, policymakers have encouraged women to undertake entrepreneurial roles without considering how gendered ideology, practices and norms can potentially prevent them from succeeding in their venture.

Chapter Two of this thesis examined barriers faced by women as identified by the wider academic literature. It explored how policy tools such as the Leaky Pipeline model neglect to take into account the diverse career paths of women STEM professionals. Chapter Two also assessed how women in STEM struggle to balance competing demands arising from work and home. Moreover, institutional barriers as well as cultural and social factors also play a role in prescribing which STEM disciplines are appropriate for women to undertake an education and career in. Notably, Australian, Indian and Singaporean women are impacted by barriers as explored by the wider academic literature in Chapter Two. However, Chapters Three, Four and Five examine the work of Australian, Indian and Singapore feminist scholars in order to better assess whether there are additional or different barriers for women in these countries. The inclusion of scholarly work from

Australian, Indian and Singaporean researchers and feminists is important as it mitigates the risk that the thesis may inappropriately generalise findings from just one country case-study. A gendered analysis has revealed that Australian, Indian and Singaporean governments have implemented some beneficial policies and programs for women in STEM. However, the barriers faced by women as highlighted in Chapter Two as well as those in Chapters Three, Four, Five and Six are immense. Many of the policy flaws identified in this thesis have been due to governments failing to address those barriers sufficiently. Moreover, Chapters Three, Four and Five have also explored how Australian, Indian and Singaporean politicians have been influenced by neoliberal principles that emphasise individual self-reliance and aspiration. However, neoliberal ideological framing has downplayed institutional, cultural, historical and structural forces that undermine a woman's ability to succeed in a STEM pathway. Chapter Six demonstrates that Australian, Indian and Singaporean governments have encouraged women to pursue entrepreneurial roles which, are shaped by neoliberal ideology without mitigating the potential consequences that arise from them. Sections of this Conclusion have made some suggestions for policy directions that might assist Australia, Indian and Singaporean policymakers.

An examination of Australian, Indian and Singaporean policies and programs for women in STEM has drawn attention to problems arising from the failure to address restrictive gender expectations and neoliberal perspectives. Furthermore, the governments' understanding of how women are impacted by barriers affecting their ability to pursue STEM pathways has been somewhat insufficient. Chapter Six illustrated that governments have adopted a market orientated approach to gender equality and have also not sufficiently grasped how women can or are using STEM tools, skills and knowledge.

The chapter also demonstrated that Australian, Indian and Singaporean governments have neglected to effectively capitalise on the benefits technology provides.

In short, the methodological and analytical scholarly approaches used in this thesis have enabled a much deeper and more thorough understanding of both the nature and limitations of the policies being studied, both in terms of the factors influencing their content and the limitations that have resulted. In the process, the thesis has filled a major gap in the existing academic literature on policies regarding women and STEM by utilising a combination of methods to provide a comparative analysis of countries largely ignored in the existing international literature. It has identified the multiple factors that can influence policies for women in STEM in a comparative perspective. The primary aim of this thesis has been to produce an academic policy analysis. However, it is hoped that the findings in this thesis will also demonstrate the practical relevance of academic work, by assisting policymakers in the development or, rather, the nurturing of policies and programs that strive to make STEM areas and workplaces a fairer and more equitable place.

Bibliography

Primary Sources

(Including Government and Government-Sponsored Programmes)

Australia

Australian Government – Former Ministers. "The International Conference for Women Engineers and Scientists" (Hon Kate Ellis MP). July 20, 2011. https://formerministers.dss.gov.au/582/the-international-conference-for-women-engineers-and-scientists/.

Australian Government – Former Ministers. "Women and Leadership Australia's National 2011 Adelaide Symposium" (Hon Kate Ellis MP). July 15, 2011. https://formerministers.dss.gov.au/583/women-and-leadership-australias-national-2011-adelaide-symposium/.

Australian Government – Grant Connect. "Archived Grant Opportunity View – GO102". Accessed December 19, 2021. https://www.grants.gov.au/Go/Show?GoUuid=8A2902CA-EE6D-3DA6-478A-215246D52A52

Australian Government – Grant Connect. "Archived Grant Opportunity View - GO1323". Accessed March 19, 2019. https://www.grants.gov.au/?event=public.GO.show&GOUUID=6CD0AD8E-003C-7940-C57A97C2C0B9D9F3.

Australian Government. "Action Area: Jobs of the Future: Towards 2025 – An Australian Government Strategy to Boost Women's Workforce Participation". Accessed November 26, 2021. https://womensworkforceparticipation.pmc.gov.au/action-area-jobs-future.html.

Australian Government. "Australian Government Science, Technology, Engineering and Mathematics (STEM) Initiatives for Girls and Women". Accessed February 14, 2020. https://www.industry.gov.au/sites/default/files/2019-04/australian-government-stem-initiatives-for-women-and-girls.pdf.

Australian Government. "Budget Archive 2020-21". Accessed December 19, 2021. https://archive.budget.gov.au/2020-21/index.htm.

Australian Government. "Fair Work Act 2009". Accessed February 24, 2021. https://www.legislation.gov.au/Details/C2017C00323/Html/Volume_1, http://www.legislation.gov.au/Details/C2017C00323.

Australian Government. "National STEM School Education Strategy". Accessed August 28, 2023, https://www.education.gov.au/education-ministers-meeting/resources/national-stem-school-education-strategy.

Australian Government: Business. “Women in STEM and Entrepreneurship – Round 3”. Accessed January 20, 2021. https://business.gov.au/grants-and-programs/women-in-stem-and-entrepreneurship.

Australian Government: Business. “Women in STEM and Entrepreneurship Grant Recipients”. Last Modified June 4, 2021. https://business.gov.au/grants-and-programs/women-in-stem-and-entrepreneurship/women-in-stem-and-entrepreneurship-grant-recipients.

Australian Maths Trust. “Curious Minds”. Accessed June 2, 2021. https://www.amt.edu.au/curious-minds.

Australian Maths Trust. “DigIT FAQs”. Accessed April 4, 2019. https://www.amt.edu.au/digit-faqs.

Australian Research Council. “Kathleen Fitzpatrick and Georgina Sweet Australian Laureate Fellows”. Last Modified August 24, 2021. https://www.arc.gov.au/policies-strategies/strategy/gender-equality-research/kathleen-fitzpatrick-and-georgina-sweet-australian-laureate-fellows.

CSIRO. “About the Young Indigenous Women’s STEM Academy”. Accessed June 4, 2021. https://www.csiro.au/en/education/programs/young-indigenous-womens-stem-academy/about-the-academy.

CSIRO. “Academy Program”. Accessed June 4, 2021. https://www.csiro.au/en/education/programs/young-indigenous-womens-stem-academy/academy-program.

CSIRO. “Frequently Asked Questions”. Accessed June 4, 2021. https://www.csiro.au/en/education/programs/young-indigenous-womens-stem-academy/faqs.

CSIRO. “Join the Academy”. Accessed June 4, 2021. https://www.csiro.au/en/education/programs/young-indigenous-womens-stem-academy/join-the-academy.

CSIRO. “STEM Professionals in Schools”. Accessed May 28, 2021. https://www.csiro.au/en/education/programs/stem-professionals-in-schools.

Department of Defence. “Women in STEM Support Hits Record High”. August 18, 2021. https://www.minister.defence.gov.au/minister/melissa-price/media-releases/women-stem-support-hits-record-high.

Department of Education, Skills and Employment. ‘The Outcomes of the Women in STEM Cadetships and Advanced Apprenticeships Program 2021 Application Round Have Now Been Announced”. Accessed March 8, 2021. https://www.dese.gov.au/women-stem-cadetships-and-advanced-apprenticeships/announcements/advanced-apprenticeships-program-2021-application-round-announced.

Department of Education, Skills and Employment. “Other Grants Guidelines (Education) Amendment (Women in STEM) 2020”. Accessed March 22, 2021. https://www.legislation.gov.au/Details/F2020L01515/Html/Text.

Department of Education, Skills and Employment. “Residential Programs”. November 13, 2021. https://www.dese.gov.au/australian-curriculum/national-stem-education-resources-toolkit/introductory-material/residential-programs.

Department of Education, Skills and Employment. “STEM Jobs Growing Almost Twice as Fast as Other Jobs”. Accessed November 2, 2020. https://www.employment.gov.au/newsroom/stem-jobs-growing-almost-twice-fast-other-jobs.

Department of Education, Skills and Employment. “Summer Camp Brings Curious Young Minds to Canberra”. December 12, 2019. https://ministers.dese.gov.au/tehan/summer-camp-brings-curious-young-minds-canberra.

Department of Education, Skills and Employment. “Support for Science, Technology, Engineering and Mathematics (STEM)”. Last Modified October 6, 2021, https://www.dese.gov.au/australian-curriculum/support-science-technology-engineering-and-mathematics-stem.

Department of Education, Skills and Employment. “Women in STEM Cadetships and Advanced Apprenticeships”. Accessed March 8, 2021. https://www.dese.gov.au/women-stem-cadetships-and-advanced-apprenticeships.

Department of Education, Skills and Employment. “Women in STEM Cadetship and Advanced Apprenticeship Program Frequently Asked Questions”. Accessed March 5, 2021. https://www.dese.gov.au/women-stem-cadetships-and-advanced-apprenticeships/frequently-asked-questions.

Department of Employment and Workplace Relations. “Fee-Free TAFE”. Accessed August 31, 2023, https://www.dewr.gov.au/skills-reform/fee-free-tafe.

Department of Employment and Workplace Relations. “TAFE Technology Fund”. Accessed August 31, 2023, https://www.dewr.gov.au/skills-reform/tafe-technology-fund.

Department of Foreign Affairs and Trade. “Australia-Singapore Digital Economy Agreement”. Accessed November 26, 2021. https://www.dfat.gov.au/trade/services-and-digital-trade/australia-and-singapore-digital-economy-agreement.

Department of Foreign Affairs and Trade. “Joint Statement on a Comprehensive Strategic Partnership between Republic of India and Australia”. Accessed November 26, 2021. https://www.dfat.gov.au/geo/india/joint-statement-comprehensive-strategic-partnership-between-republic-india-and-australia.

Department of Industry, Science and Resources. “Fifteen Years of the Australia-India Strategic Research Fund”. Accessed February 12, 2023. https://www.industry.gov.au/news/fifteen-years-australia-india-strategic-research-fund.

Department of Industry, Science and Resources. “Supporting Businesswomen to Launch to New Heights”. Accessed July 23, 2023. https://www.minister.industry.gov.au/ministers/duniam/media-releases/supporting-businesswomen-launch-new-heights.

Department of Industry, Science and Resources. “Women in STEM Evaluation Final Report”. Accessed August 30, 2023. https://www.industry.gov.au/publications/women-stem-initiatives-evaluation-report.

Department of Industry, Innovation and Science. “Advancing Women in STEM Strategy”. Accessed November 13, 2020. https://www.industry.gov.au/data-and-publications/advancing-women-in-stem.

Department of Industry, Innovation and Science. “Grant Opportunity Guidelines - Girls in STEM Toolkit”. (Canberra, May 2018). https://www.bulletpoint.com.au/wp-content/uploads/2018/06/Girls-in-STEM-Toolkit-Grant-Opportunity-Guidelines.pdf.

Department of Industry, Science, Energy and Resources. “Academy for Enterprising Girls”. Accessed May 27, 2021. https://www.thegist.edu.au/students/get-involved/activities-and-events/academy-for-enterprising-girls/.

Department of Industry, Science, Energy and Resources. “Action area: Enabling STEM Potential Through Education”. March 2, 2021. https://www.industry.gov.au/data-and-publications/advancing-women-in-stem-strategy/vision-for-equal-opportunity-in-stem/action-area-enabling-stem-potential-through-education.

Department of Industry, Science, Energy and Resources. “Activities and Events”. Accessed May 27, 2021. https://www.thegist.edu.au/students/get-involved/activities-and-events/?ItemsPerPage=3&Page=2&DocType=eventDetail&SortBy=startDate_solis_s&SortDirection=ASC.

Department of Industry, Science, Energy and Resources. “Advancing Women in STEM Strategy: 2020 Action Plan”. Accessed January 5, 2021. https://www.industry.gov.au/data-and-publications/advancing-women-in-stem-strategy/2020-action-plan.

Department of Industry, Science, Energy and Resources. “Australian Government Science, Technology, Engineering and Mathematics (STEM) Initiatives for Girls and Women”. April 2019. https://www.industry.gov.au/sites/default/files/2019-04/australian-government-stem-initiatives-for-women-and-girls.pdf.

Department of Industry, Science, Energy and Resources. “Commonwealth Grant Agreement”. August, 2017.

Department of Industry, Science, Energy and Resources. “Future Employment”. Accessed May 28, 2021. https://www.thegist.edu.au/students/explore-stem-careers/future-employment/.

Department of Industry, Science, Energy and Resources. “Helping Girls on the Path to High-Tech Jobs”. September 26, 2018.

https://www.minister.industry.gov.au/ministers/karenandrews/media-releases/helping-girls-path-high-tech-jobs.

Department of Industry, Science, Energy and Resources. “Indigenous Girls’ STEM Academy”. September 2, 2020, https://www.niaa.gov.au/indigenous-affairs/education/indigenous-girls-stem-academy.

Department of Industry, Science, Energy and Resources. “Network and Connect”. Accessed June 2, 2021. https://www.thegist.edu.au/students/get-involved/network-and-connect/.

Department of Industry, Science, Energy and Resources. “STEM Equity Monitor”. Accessed March 24, 2021. https://www.industry.gov.au/data-and-publications/stem-equity-monitor.

Department of Industry, Science, Energy and Resources. “STEM Equity Monitor - In Focus: Engaging Aboriginal and Torres Strait Islander Girls in STEM”. Accessed November 20, 2021. https://www.industry.gov.au/data-and-publications/stem-equity-monitor/in-focus-engaging-aboriginal-and-torres-strait-islander-girls-in-stem.

Department of Industry, Science, Energy and Resources. “STEM: Equity Monitor: Methodology”. Accessed March 24, 2021. https://www.industry.gov.au/data-and-publications/stem-equity-monitor/methodology.

Department of Industry, Science, Energy and Resources. “STEM Equity Monitor: University Enrolment and Completion in STEM and Other Fields”. Accessed January 24, 2021.
https://www.industry.gov.au/data-and-publications/stem-equity-monitor/university-enrolment-and-completion-in-stem-and-other-fields

Department of Industry, Science, Energy and Resources. “STEM: Equity Monitor: University Graduate Outcomes Data’. Accessed March 24, 2021. https://www.industry.gov.au/data-and-publications/stem-equity-monitor/graduate-outcomes/university-graduate-outcomes-data.

Department of Industry, Science, Energy and Resources. “STEM: Equity Monitor: Vocational Education and Training Graduate Outcomes Data’. Accessed March 24, 2020. https://www.industry.gov.au/data-and-publications/stem-equity-monitor/graduate-outcomes/vocational-education-and-training-graduate-outcomes-data.

Department of Industry, Science, Energy and Resources. “Supporting Women in STEM and Entrepreneurship”. November 6, 2017. https://www.minister.industry.gov.au/ministers/sinodinos/media-releases/supporting-women-stem-and-entrepreneurship.

Department of Industry, Science, Energy and Resources. “Supporting Girls to See a Future in STEM” (Hon Karen Andrews MP). October 30, 2020. https://www.minister.industry.gov.au/ministers/karenandrews/media-releases/supporting-girls-see-future-stem.

Department of Industry, Science, Energy and Resources. “Tips and Resources”. Accessed May 27, 2021. https://www.thegist.edu.au/families/getting-her-interested-in-stem/tips-and-resources/.

Department of Industry, Science, Energy and Resources. “Women in STEM and Entrepreneurship – Sample Grant”. October, 2017.

Department of Industry, Science, Energy and Resources. “Young Australians Value STEM For the Future’. March 7, 2019. https://www.industry.gov.au/news-media/science-news/young-australians-value-stem-for-the-future.

Department of Prime Minister and Cabinet – PM Transcripts. “2010 Prime Minister’s Prizes for Science”. Transcript 17502. Accessed March 1, 2021. https://pmtranscripts.pmc.gov.au/release/transcript-17502.

Department of Prime Minister and Cabinet. “Long-Term Action to Support Girls and Women in STEM” (Hon Kelly O’Dwyer). Accessed June 19, 2018. https://ministers.pmc.gov.au/odwyer/2018/long-term-action-support-girls-and-women-stem.

Department of Social Services. “2009 Women’s Budget Statement”. May 1, 2009. https://www.dss.gov.au/our-responsibilities/women/publications-articles/government-international/budget-publications/2009-womens-budget-statement.

Department of Social Services. “Review of the Equal Opportunity for Women in the Workplace Act and Agency”. Accessed March 5, 2019. https://www.dss.gov.au/our-responsibilities/women/programs-services/economic-security/review-of-the-equal-opportunity-for-women-in-the-workplace-act-and-agency.

Department of Social Services. “Women’s Budget Statement 2008-09”. Last Modified November 7, 2014. https://www.dss.gov.au/our-responsibilities/women/publications-articles/government-international/budget-publications/womens-budget-statement-2008-09.

Department of Social Services. “Women’s Statement 2012 – Achievements and Budget Measures”. May 1, 2012. https://www.dss.gov.au/our-responsibilities/women/publications-articles/government-international/budget-publications/womens-statement-2012-achievements-and-budget-measures.

Department of the Prime Minister and Cabinet. “Women’s Economic Security Statement 2020”. Accessed May 28, 2021. https://pmc.gov.au/office-women/economic-security/wess.

Department of the Treasury. *Budget 2012-13: Budget Strategy and Outlook - Budget Paper NO.1* (Canberra, May 2012), 1-33. https://archive.budget.gov.au/2012-13/index.htm.

Department of the Treasury. *Budget 2013-14: Budget Measures - Budget Paper No.2* (Canberra May 2013), 1-321, https://archive.budget.gov.au/2013-14/bp2/BP2_consolidated.pdf.

Department of the Treasury. *Budget 2014-15: Budget Measures – Budget Paper No.2* (Canberra May 2014), 1-256, https://archive.budget.gov.au/2014-15/bp2/BP2_consolidated.pdf.

Department of the Treasury. *Budget 2015-16: Budget Measures – Budget Paper No. 2* (Canberra May 2015), 1-216, https://www.budget.gov.au/2015-16/content/bp2/html/index.htm.

Department of the Treasury. *Budget 2016-17: Budget Measures – Budget Paper No.2* (Canberra May 2016), 1-188, https://archive.budget.gov.au/2016-17/bp2/BP2_consolidated.pdf.

Department of the Treasury. *Budget 2017-18: Budget Measures – Budget Paper No.2* (Canberra May 2017), 1-206, https://archive.budget.gov.au/2017-18/bp2/bp2.pdf.

Department of the Treasury. *Budget 2020-21 Economy Recovery Plan for Australia: JobMaker – Creating Jobs and Rebuilding Our Economy* (Canberra 2020), 1-48. Accessed March 11, 2021. https://archive.budget.gov.au/2020-21/download/glossy_jobmaker.pdf.

Facebook. "STEM Equity Monitor". Accessed March 24, 2021. https://en-gb.facebook.com/IndustryGovAu/videos/stem-equity-monitor/2210597485709620/.

Fair Work Ombudsman. "Welcome to the Fair Work Ombudsman Website". Accessed March 18, 2021. https://www.fairwork.gov.au/.

Liberal NSW. "More STEM Opportunities for Australian Women". Accessed March 18, 2021. https://nsw.liberal.org.au/Shared-Content/News/2021/More-STEM-opportunities-for-Australian-women.

Minister's Media Centre. "Marketplace for Online Microcredentials". Last Modified June 22, 2020. https://ministers.dese.gov.au/tehan/marketplace-online-microcredentials.

Ministers for the Department of Industry, Science, Energy and Resources. "$1.3 Billion Modern Manufacturing Initiative Blasts off (Hon Karen Andrews)". Accessed October 15, 2021. https://www.minister.industry.gov.au/ministers/karenandrews/media-releases/13-billion-modern-manufacturing-initiative-blasts.

Ministers' Media Centre. "Rudd Government to Introduce Paid Parental Leave". May 10, 2009. https://ministers.dese.gov.au/gillard/rudd-government-introduce-paid-parental-leave.

National Skills Commission. "Self-Employment and Entrepreneurship". Accessed December 18, 2021. https://www.nationalskillscommission.gov.au/self-employment-and-entrepreneurship.

Office of Parliamentary Counsel. "Workplace Gender Equality Act 2012". Accessed May 25, 2018. https://www.legislation.gov.au/Details/C2016C00895.

Office of the Chief Scientist – Australian Government. *Australia's STEM Workforce,* Canberra, March 2016. https://www.chiefscientist.gov.au/2016/03/report-australias-stem-workforce/.

Office of the Chief Scientist. “Find an Activity (STARportal)”. Accessed March 21, 2019. https://starportal.edu.au.

Office of the Chief Scientist. “Girls Invent (STARportal)”. Accessed March 21, 2021, https://starportal.edu.au/program/girls-invent.

Office of the Chief Scientist. “STARportal ‘About Us’”. Accessed March 21, 2019. https://starportal.edu.au

Office of the Chief Scientist. “STARportal”. Accessed March 21, 2019. https://starportal.edu.au.

Office of the Chief Scientist. “STEM Camp for Girls (STARportal)”. Accessed March 21, 2019. https://starportal.edu.au.

Office of the Chief Scientist. “STEM Sells Season 2 Workshop (STARportal)”. Accessed March 19, 2021. https://starportal.edu.au.

Office of the Chief Scientist. *Australia’s STEM Workforce: Science, Technology, Engineering and Mathematics.* Government of Australia, 21 July 2020. 1-290. https://apo.org.au/node/307014.

Office of Women in STEM Ambassador. “Year in Review”. (UNSW Sydney, 2020). https://secureservercdn.net/198.71.233.254/f8f.f75.myftpupload.com/wp-content/uploads/2021/03/Year-in-Review-2020-Women-in-STEM-Ambassador.pdf.

Parliament of Australia. “Adjournment - Women in Science, Technology, Engineering and Mathematics, Eating Disorders”. November 13, 2018. https://www.aph.gov.au/Parliamentary_Business/Hansard/Hansard_Display?bid=chamber/hansards/8a611160-5451-4f48-bcda-57b8b94c6bee/&sid=0234.

Parliament of Australia. “Forward With Fairness: Labor’s Plan for Fairer and More Productive Australian Workplaces”. April 2007. https://parlinfo.aph.gov.au/parlInfo/search/display/display.w3p;query=Id:%22library/partypol/WTWM6%22.

Parliament of Australia. “Questions on Notice – Women in Science, Engineering and Technology (Question No. 447). March 24, 1997. https://parlinfo.aph.gov.au/parlInfo/search/display/display.w3p;query=Id%3A%22chamber%2Fhansards%2F1997-03-24%2F0273%22.

Parliament of Australia. “Questions Without Notice – Women in Science”. February 14, 2018. https://www.aph.gov.au/Parliamentary_Business/Hansard/Hansard_Display?bid=chamber/hansards/5bb8ba07-678d-41a7-a360-7109e871eeed/&sid=0139.

Parliament of Australia. ”More Support for Women in Male Dominated Industries” (Julie Collins MP), May 21, 2013. https://parlinfo.aph.gov.au/parlInfo/search/display/display.w3p;query=Id%3A%22media%2Fpressrel%2F2478071%22.

Prime Minister of Australia. “Press Conference – Parliament House Transcript 18 October 2022 - Prime Minister, Prime Minister of Singapore”. Accessed January 22, 2023. https://www.pm.gov.au/media/press-conference-parliament-house-canberra-7.

Prime Minister of Australia. “Remarks, Bengaluru Tech Summit”. Accessed November 26, 2021. https://www.pm.gov.au/media/remarks-bengaluru-tech-summit.

Prime Minister of Australia. “Virtual Speech - Singapore FinTech Festival”. Accessed November 26, 2021. https://www.pm.gov.au/media/virtual-speech-singapore-fintech-festival.

Sciencegovau (@sciencegovau). “Stuck for Activities for Kids This Weekend? #STARportal Has Almost 400 #STEM Events Listed”, Twitter. September 14, 2017. https://twitter.com/ScienceGovAu/status/908261585394814976.

Services Australia. ”Parental Leave Pay”. Accessed February 24, 2021. https://www.servicesaustralia.gov.au/individuals/services/centrelink/parental-leave-pay.

The Guardian. ‘Treasurer Josh Frydenberg’s 2019 Budget Speech – in Full’. April 2, 2019. https://www.theguardian.com/australia-news/2019/apr/02/treasurer-josh-frydenbergs-2019-budget-speech-in-full.

The Treasury. “Budget Paper No.2: Budget Measures”. Accessed October 24, 2021. https://budget.gov.au/2021-22/content/bp2/index.htm.

The Treasury. “Budget Speech 2021-22”. Accessed June 4, 2021. https://ministers.treasury.gov.au/ministers/josh-frydenberg-2018/speeches/budget-speech-2021-22.

Trove. ‘”Women’s Budget Statement Breakfast, Parliament House, Canberra” (Hon Julie Collins MP). June 21, 2012. https://webarchive.nla.gov.au/awa/20130630235912/http://pandora.nla.gov.au/pan/131352/20130701-0936/juliecollins.fahcsia.gov.au/node/196.html.

Trove. “Serious Women’s Business Conference 2009 (Hon Julia Gillard MP)”. November 9, 2009. https://webarchive.nla.gov.au/awa/20100628092709/http://pandora.nla.gov.au/pan/80087/20100628-1337/www.deewr.gov.au/Ministers/Gillard/Media/Speeches/Pages/Article_091109_181844.html.

Trove. “Speech, Launch of the Women in Male-Dominated Industries Toolkit” (Hon Julie Collins MP). May 21, 2013. https://webarchive.nla.gov.au/awa/20130630235913/http://pandora.nla.gov.au/pan/131352/20130701-0936/juliecollins.fahcsia.gov.au/node/362.html.

Trove. “Turnbull Government Supporting Women to Succeed in STEM” (Hon Michaelia Cash). August 19, 2016. http://pandora.nla.gov.au/pan/156011/20171219-1417/ministers.pmc.gov.au/cash/2016/turnbull-government-supporting-women-succeed-stem.html.

Twitter. "#STARportal". Accessed March 21, 2019. https://twitter.com/hashtag/starportal?f=tweets&vertical=default&src=hash.

Twitter. "sciencegovau". Accessed March 24, 2021. https://twitter.com/ScienceGovAu/status/1359655910214361092.

WGEA. "New WGEA Data Shows Employer Action on Gender Equality Has Stalled". Accessed November 24, 2021. https://www.wgea.gov.au/newsroom/new-wgea-data-shows-employer-action-on-gender-equality-has-stalled.

Women in Science, Engineering and Technology Advisory Group. Office of the Chief Scientist - Department of the Prime Minister and Cabinet. *Women in Science, Engineering and Technology*. Canberra, May 1995.

Women in STEM Ambassador. "Future You – Microsite". Accessed March 26, 2021. https://womeninstem.org.au/futureyou/#games.

Women in STEM Ambassador. "Future You FAQs". Accessed March 26, 2021. https://womeninstem.org.au/work/future-you/.

Women in STEM Ambassador. "It's Time to Find Out What Works for Women in STEM: A Guide to Evaluating STEM Gender Equity Programs Launched Today". December 7, 2020. https://womeninstem.org.au/latest-news/evaluation-guide-launched-today/.

Women in STEM Ambassador. "National STEM Evaluation Guide". Accessed March 22, 2021. https://womeninstem.org.au/national-evaluation-guide/.

Workplace Gender Equality Agency. "Explore the New, Self-Service WGEA Portal". Accessed November 24, 2021. https://www.wgea.gov.au/what-we-do/compliance-reporting/new-wgea-portal/exploring-the-self-service-WGEA-Portal.

Workplace Gender Equality Agency. "Gender Equality in the Workplace". Accessed August, 13 2023. https://www.wgea.gov.au/data-statistics/data-explorer

Workplace Gender Equality Agency. "Non-Compliant List". Accessed February 15, 2019. https://www.wgea.gov.au/non-compliant-list.

Workplace Gender Equality Agency. "Reporting". Accessed November 24, 2021. https://www.wgea.gov.au/what-we-do/reporting.

India

Department of Biotechnology: Ministry of Science & Technology. "Biotechnology Career Advancement & Re-Orientation Programme (BioCARe)". Accessed November 25, 2021. https://dbtindia.gov.in/schemes-programmes/special-programmes/biotechnology-career-advancement-re-orientation-programme.

Department of Biotechnology: Ministry of Science & Technology. "Janaki Ammal-National Women Bioscientist Award". Accessed November 25, 2021.

https://dbtindia.gov.in/schemes-programmes/building-capacities/awards/national-women-bio-scientist-awards.

Department of Science and Technology. “Annual Report 2017-18 (New)”. Accessed December 31, 2021. https://dst.gov.in/document/annual-reports/annual-report-2017-18-new.

Department of Science and Technology. “CURIE Initiative of DST Enhancing Research Facilities in Women Universities”. Accessed October 21, 2021. https://dst.gov.in/pressrelease/curie-initiative-dst-enhancing-research-facilities-women-universities.

Department of Science and Technology. “DST Support Empowering Women Scientists”. Accessed July 14, 2019. https://dst.gov.in/dst-support-empowering-women-scientists.

Department of Science and Technology. “KIRAN Scheme of DST Lights Up S&T Paths of Thousands of Women Scientists”. Accessed December 31, 2021. https://dst.gov.in/pressrelease/kiran-scheme-dst-lights-st-paths-thousands-women-scientists.

Department of Science and Technology. “SERB Announces Women Excellence Award 2021 on the International Day of Women and Girls in Science”. Accessed October 21, 2021. https://dst.gov.in/serb-announces-women-excellence-award-2021-international-day-women-and-girls-science.

Department of Science and Technology. “Vigyan Jyoti Encourages Science Uptake Among Rural Girls”. Accessed July 14, 2019. http://www.dst.gov.in/news/vigyan-jyoti-encourages-science-uptake-among-rural-girls.

Department of Science and Technology. “Vigyan Jyoti Programme Spreads to 100 Districts in 2nd Phase Initiated on International Day of Women & Girls in Science”. Accessed November 25, 2021. https://dst.gov.in/vigyan-jyoti-programme-spreads-100-districts-2nd-phase-initiated-international-day-women-girls.

Department of Science and Technology. “Women Scientists Programs”. Accessed July 11, 2019. http://www.dst.gov.in/scientific-programmes/scientific-engineering-research/women-scientists-programs.

Department of Science and Technology. *Call for Expression of Interest to Participate in Pilot of GATI*. Gender Advancement for Transforming Institutions (GATI), KIRAN Division. 1-9. https://dst.gov.in/sites/default/files/Gati%20detailed%20advertisement_0.pdf.

Department of Science and Technology. “Drugs & Pharmaceutical Research”. Accessed January 29, 2022. https://dst.gov.in/drugs-pharmaceutical-research.

Department of Science and Technology. *List of Projects Under Women Scientists Scheme-A (WOS-A) During 2016-17.* Accessed December 31, 2021. http://dst.gov.in/sites/default/files/WOS-A%20Projects%202016-17.pdf.

Department of Science and Technology. “Meet the Minister”. Accessed January 29, 2022. https://dst.gov.in/meet-minister.

Department of Science and Technology. *Mobility Award.* 1-2. http://www.dst.gov.in/sites/default/files/Application%20Format-Mobility.pdf.

Department of Science and Technology. *Vigyan Jyoti: An Initiation to Promote Interest in Science and Technology Amongst Girl Students*. June 4-24, 2018. 1-2. https://www.iitbbs.ac.in/documents/VJ_PR.pdf.

Government of India: Ministry of Education – Department of Higher Education. *All India Survey on Higher Education 2019.* 1-290. New Delhi, 2020. https://www.education.gov.in/sites/upload_files/mhrd/files/statistics-new/aishe_eng.pdf.

Government of India: Ministry of Education. *All India Survey on Higher Education 2020-21*. New Delhi, 2023. 128-129, https://aishe.gov.in/aishe/gotoAisheReports.

Government of India: Ministry of Labour & Employment. "Equal Remuneration Acts and Rules, 1976". Accessed July 28, 2019. https://labour.gov.in/womenlabour/equal-remuneration-acts-and-rules-1976.

Government of India: Ministry of Tribal Affairs. "The Scheme of National Overseas Scholarships For Scheduled Tribe Candidates From 2017-18 To 2019-20. 1-12. https://tribal.nic.in/DivisionsFiles/Education/RevisedGuidelinesNOSST1718.pdf.

Government of India: NITI Aayog (The Women Entrepreneurship Platform). "Saranya (Self Employment Scheme For The Destitute Women)". Accessed July 15, 2019. https://wep.gov.in/knowledge-bank/blogs/saranya-%2528self-employment-scheme-for-the-destitute-women%2529.

Government of India: NITI Aayog (The Women Entrepreneurship Platform). "Credit Guarantee Fund Trust For Micro And Small Enterprises (Cgtmse)". Accessed July 15, 2019. https://wep.gov.in/knowledge-bank/blogs/credit-guarantee-fund-trust-for-micro-and-small-enterprises-%28cgtmse%29.

Government of India: NITI Aayog (The Women Entrepreneurship Platform). "Sidbi Make In India Loan For Enterprises (Smile)". Accessed July 15, 2019. https://wep.gov.in/knowledge-bank/blogs/sidbi-make-in-india-loan-for-enterprises-%2528smile%2529.

Government of India: NITI Aayog (The Women Entrepreneurship Platform). "Small Business Innovation Research Initiative (SBIRI)". Accessed February 22, 2020. https://wep.gov.in/knowledge-bank/blogs/small-business-innovation-research-initiative-%28sbiri%29.

Government of India: NITI Aayog (The Women Entrepreneurship Platform). "Knowledge Bank – Technology". Accessed February 22, 2020. https://wep.gov.in/knowledge-bank/listing/growth-management/technology.

Government of India: NITI Aayog. "About WEP". Accessed April 29, 2019. https://wep.gov.in/about-wep.

Government of India: Press Information Bureau. “All Political Parties Should Ensure the Passage of Women’s Reservation Bill: Vice President”. Accessed June 28, 2019. http://pib.nic.in/newsite/PrintRelease.aspx?relid=186453.

Government of India: Press Information Bureau. “NITI Aayog to Launch Women Entrepreneurship Platform on International Women’s Day”. Accessed June 28, 2019. http://pib.nic.in/newsite/PrintRelease.aspx?relid=177074.

Government of India: Press Information Bureau. “PMEGP Helps More Than 30,000 Women Entrepreneurs”. Accessed July 11, 2019. https://pib.gov.in/newsite/PrintRelease.aspx?relid=181192.

Government of India: Press Information Bureau. “Women Participation in Scientific Research and Development”. Accessed July 11, 2019. http://pib.nic.in/newsite/PrintRelease.aspx?relid=144893.

India International Science Festival. *DST’s Initiatives for Women Scientists & Technologists*. Department of Science and Technology, 2017. https://scienceindiafest.org/wp-content/uploads/2018/05/Dr.VandanaSingh-DST-WSE.pdf.

Indian Institute of Technology Guwahati. “About Vigyan Jyoti”. Accessed July 14, 2019, https://www.iitg.ac.in/vigyanjyoti/.

Indo-US S and T Forum. *The Indo-U.S. Fellowship for Women in Science, Technology, Engineering, Mathematics and Medicine (WISTEMM) Program 2018 Call Awards.* Department of Science and Technology. https://iusstf.org/assets/sitesfile/image/download_links/pdf/pdf_1795169527.pdf.

International Labour Organization. *The Maternity Benefit Act, 1961: Act No. 53 of 1961*. December 12, 1961. https://www.ilo.org/dyn/travail/docs/678/maternitybenefitsact1961.pdf.

Ministry of Finance. “Previous Union Budgets”. Accessed July 12, 2019. https://www.indiabudget.gov.in/previous_union_budget.php.

Ministry of Finance. *Demand No. 1: Department of Agriculture and Cooperation*. Notes on Demands for Grants, 2002-2003. https://www.indiabudget.gov.in/budget_archive/ub2002-03/eb/sbe1.pdf.

Ministry of Finance. *Demand No.68: Department of Science and Technology.* Notes on Demands for Grants, 2001-2002. https://www.indiabudget.gov.in/budget_archive/ub2001-02/eb/sbe68.pdf.

Ministry of Finance. *Demand No.72: Department of Bio-Technology.* Notes on Demands for Grants, 2002-2003. https://www.indiabudget.gov.in/budget_archive/ub2002-03/eb/sbe72.pdf.

Ministry of Finance. *Expenditure Budget Vol.1, 2011-2012: Gender Budget.* Part A – 100% Women Specific Programmes, 68-79. https://www.indiabudget.gov.in/budget2011-2012/ub2011-12/eb/stat20.pdf.

Ministry of Finance. *Expenditure Budget Vol.1, 2015-2016: Gender Budget.* Part A – 100% Women Specific Programmes, 86-97. https://www.indiabudget.gov.in/budget2015-2016/ub2015-16/eb/stat20.pdf.

Ministry of Finance. *Expenditure Budget Vol.1, 2016-2017: Gender Budget.* Part A – 100% Women Specific Programmes, 97-111. https://www.indiabudget.gov.in/budget2016-2017/ub2016-17/eb/stat20.pdf.

Ministry of Finance. *Expenditure Profile 2019-2020: Gender Budget.* 128-141. https://www.indiabudget.gov.in/budget2019-20(I)/ub2019-20/eb/stat13.pdf.

Ministry of Finance: Government of India. "Union Budget 2019-2020". Accessed December 31, 2021. https://www.indiabudget.gov.in/budget2019-20/outcomebudget.php.

Ministry of Human Resource Development: Government of India. *National Policy on Education - 1986.* New Delhi: May 1986. http://psscive.ac.in/assets/documents/Policy_1986_eng.pdf.

Ministry of Labour & Employment: Government of India. *Annual Report 2017-18.* 1-269. https://labour.gov.in/sites/default/files/ANNUAL_REPORT_2017-18-ENGLISH.pdf.

Ministry of Labour & Employment: Government of India. *Subject: The Maternity Benefit (Amendment) Act, 2017.* August 28, 2017. 1-3. https://labour.gov.in/sites/default/files/Advisory.pdf.

Ministry of Micro, Small & Medium Enterprises. "Women Entrepreneurs". Accessed November 26, 2021. https://msme.gov.in/women-entrepreneurs.

Ministry of Science and Technology: Department of Science and Technology. *Mobility Scheme (Addressing Relocation Issue of Women Scientists).* 1-2. http://www.dst.gov.in/sites/default/files/ADVERTISEMENT-Mobility.pdf.

Ministry of Social Justice and Empowerment. "Educational Loan Scheme". Accessed June 29, 2021. https://nsfdc.nic.in/en/educational-loan-scheme.

Ministry of Women & Child Development. "Working Women Hostel". Accessed July 14, 2019. https://wcd.nic.in/schemes/working-women-hostel.

National Crime Records Bureau. "Crime in India 2019". Accessed July 2, 2021. https://ncrb.gov.in/en/crime-india-2019-0.

National Employment Service (Kerala). "SARANYA: Self Employment Scheme for the Destitute Women Scheme". Accessed July 1, 2019. https://www.employmentkerala.gov.in/index.php?option=com_content&view=article&id=182&Itemid=137.

Planning Commission: Government of India. "6th Five Year Plan". Accessed July 5, 2019. https://www.niti.gov.in/planningcommission.gov.in/docs/plans/planrel/fiveyr/index6.html.

Planning Commission: Government of India. “Tenth Five Year Plan 2002-07”. Accessed July 13, 2019, https://www.niti.gov.in/planningcommission.gov.in/docs/plans/planrel/fiveyr/index6.html.

Press Information Bureau: Government of India. “PM Lauds Passage of Maternity Benefit Amendment Bill in Lok Sabha”. Accessed July 28, 2019. http://pib.nic.in/newsite/PrintRelease.aspx?relid=159057.

Science and Engineering Research Board. “SERB POWER”. Accessed October 21, 2021. http://serb.gov.in/serb_power.php.

Singapore

Agency for Science, Technology and Research. “A*STAR Graduate Scholarship”. Accessed November 8, 2019. https://www.a-star.edu.sg/Scholarships/For-Graduate-Studies/A-STAR-Graduate-Scholarship-Singapore#2016874-service-commitment.

Agency for Science, Technology and Research. “About A*STAR Scholarships”. Accessed November 8, 2019. https://www.a-star.edu.sg/Scholarships/Overview#201505-post-doc.

Agency for Science, Technology and Research. “Faces of A*STAR”. Accessed March 7, 2019. https://www.a-star.edu.sg/News-and-Events/faces-of-a-star/2.

Agency for Science, Technology and Research. “Mother’s Day: Balancing Parenting, Work, Play, and Self-Care”. Accessed November 8, 2019. https://www.a-star.edu.sg/News-and-Events/faces-of-a-star/faces/faces/mother-s-day--balancing-parenting--work--play--and-self-care.

Defence Science & Technology Agency. “DSTA Internships”. Accessed October 15, 2019. https://www.dsta.gov.sg/join-us/student/internship/internship-programme/.

Defence Science & Technology Agency. “DSTA Scholarship Award Ceremony 2003”. Accessed October 15, 2019. https://dsta.gov.sg/latest-news/speeches/speeches-2003/welcome-address-by-mr-peter-ho-permanent-secretary-defence-and-chairman-dsta-at-the-dsta-scholarship-award-ceremony-2003-a.

Defence Science & Technology Agency. “DSTA Scholarships”. Accessed October 15, 2019. https://www.dsta.gov.sg/join-us/student/scholarships-awards/.

Defence Science & Technology Agency. “DSTA Young Defence Scientists Programme”. Accessed October 15, 2019. https://www.dsta.gov.sg/join-us/student/young-defence-scientists-programme/.

Defence Science & Technology Agency. “Investing in Talent for the Nation’s Defence”. Accessed October 15, 2019. https://dsta.gov.sg/latest-news/speeches/speeches-2002/investing-in-talent-for-the-nations-defence.

Department of Statistics Singapore. “Births and Fertility - Visualising Data”. Accessed August 5, 2021. http://www.singstat.gov.sg/find-data/search-by-theme/population/births-and-fertility/visualising-data.

Department of Statistics Singapore. “Singapore Census of Population 2020, Statistical Release 1: Demographic Characteristics, Education, Language and Religion”. Accessed November 25, 2021. http://www.singstat.gov.sg/publications/reference/cop2020/cop2020-sr1/census20_stat_release1.

Department of Statistics Singapore. “SingStat Table Builder – Employed Female Residents Aged 15 Years And Over By Industry And Age Group”. Accessed November 25, 2021. https://tablebuilder.singstat.gov.sg/table/TS/M182151.

Department of Statistics Singapore. *Yearbook of Statistics Singapore 2019.* 1-380. Singapore, 2019. https://www.singstat.gov.sg/-/media/files/publications/reference/yearbook_2019/yos2019.pdf

Inland Revenue Authority of Singapore. “Working Mother’s Child Relief (WMCR)”. Accessed August 24, 2018. https://www.iras.gov.sg/IRASHome/Individuals/Locals/Working-Out-Your-Taxes/Deductions-for-Individuals/Working-Mother-s-Child-Relief--WMCR-/.

Inland Revenue Authority Singapore. “Foreign Maid Levy (FML) Relief”. Accessed August 24, 2018. https://www.iras.gov.sg/IRASHome/Individuals/Locals/Working-Out-Your-Taxes/Deductions-for-Individuals/Foreign-Maid-Levy--FML--Relief/.

Ministry of Communications and Information. “Opening Speech by Mrs Josephine Teo, Minister of Communications and Information, at the Motion on Singapore Women’s Development on 5 April 2022”. Accessed 23 July 2023. https://www.mci.gov.sg/pressroom/news-and-stories/pressroom/2022/4/opening-speech-by-minister-josephine-teo-at-the-motion-on-singapore-womens-development-on-5-april-2022.

Ministry of Communications and Information. “Scholarship”. Accessed October 19, 2019. http://www.mci.gov.sg/careers-grants/scholarship.

Ministry of Communications and Information. “Transcript of Speech by Rahayu Mahzam, Parliamentary Secretary, Ministry of Communications and Information, in Response to Motion on Empowering Women”. August 3, 2021. https://www.mci.gov.sg/pressroom/news-and-stories/pressroom/2021/8/transcript-of-parliamentary-secretary-for-communications-and-information-rahayu-mahzam-response-to-motion-on-empowering-women.

Ministry of Communications and Information. “Who We Are”. Accessed October 19, 2019. http://www.mci.gov.sg/about-us.

Ministry of Education Singapore. *Education Statistics Digest 2022*. Singapore, October 2022. 1-120. https://www.moe.gov.sg/-/media/files/about-us/education-statistics-digest-2022.pdf.

Ministry of Education Singapore. “STEM”. Accessed August 28, 2023. https://www.moe.gov.sg/news/parliamentary-replies/20220111-stem.

Ministry of Education Singapore. “STEM: Parliamentary Replies”. Accessed January 29, 2022. https://www.moe.gov.sg/news/parliamentary-replies/20220111-stem.

Ministry of Finance. “Budget 2019-2020 Speech of Nirmala Sitharaman”. July 5, 2019. 1-66. https://www.indiabudget.gov.in/doc/bspeech/bs201920.pdf.

Ministry of Finance. “Budget Archives”. Accessed November 7, 2019. https://www.mof.gov.sg/singapore-budget/budget-archives.

Ministry of Finance. “Budget Speech 2021”. Accessed November 8, 2021. https://www.mof.gov.sg/singaporebudget/budget-2021/budget-speech

Ministry of Finance. “Budget Summary Slide 2018”. Accessed November 7, 2019. https://www.singaporebudget.gov.sg/data/budget_2018/download/FY2018_Budget_Summary_Slide_ENG.pdf.

Ministry of Finance. “Gender Budgeting to Determine Effect of Policies on Women”. Accessed November 7, 2019. https://www.mof.gov.sg/newsroom/parliamentary-replies.

Ministry of Health Singapore. “Changes to the Medical Registration Act Schedule”. Accessed August 24, 2018. https://www.moh.gov.sg/content/moh_web/home/pressRoom/pressRoomItemRelease/2002/changes_to_the_Medical_Registration_act_schedule.html.

Ministry of Manpower Singapore. “Address by Mrs Josephine Teo, Minister for Manpower, at the Women Entrepreneur Awards 2018 Award Ceremony and Gala Dinner”. Accessed September 6, 2021. https://www.mom.gov.sg/newsroom/speeches/2018/0711-address-by-mrs-josephine-teo-minister-for-manpower-at-the-women-entrepreneur-awards-2018-award-ceremony-and-gala-dinner.

Ministry of Manpower Singapore. “Oral Answer to PQ on Emerging Trends for Female Professionals”. Accessed September 4, 2023. https://www.mom.gov.sg/newsroom/parliament-questions-and-replies/2022/0112-oral-answer-to-pq-on-emerging-trends-for-female-professionals.

Ministry of Manpower. “Enhanced Work-Life Grant for Flexible Work Arrangements”. Accessed November 8, 2019. https://www.mom.gov.sg/employment-practices/good-work-practices/work-life-grant.

Ministry of Manpower. “Foreign Workforce Numbers”. Accessed November 8, 2019. https://www.mom.gov.sg/documents-and-publications/foreign-workforce-numbers.

Ministry of Manpower. “Maternity Leave Eligibility and Entitlement”. Accessed November 8, 2019. https://www.mom.gov.sg/employment-practices/leave/maternity-leave/eligibility-and-entitlement.

Ministry of Manpower. “Paternity Leave”. Accessed November 8, 2019. https://www.mom.gov.sg/employment-practices/leave/paternity-leave.

Ministry of Manpower. “Shared Parental Leave”. Accessed November 8, 2019. https://www.mom.gov.sg/employment-practices/leave/shared-parental-leave.

Ministry of National Development. “COS 2015 - Speech by Minister Khaw Boon Wan “Family Matters: A Tale of Five Families”. March 10, 2015. https://www.mnd.gov.sg/newsroom/speeches/view/cos-2015---speech-by-minister-khaw-boon-wan-family-matters-a-tale-of-five-families.

Ministry of Social and Family Development. “Conversations on Women Development”. September 28, 2020. https://www.msf.gov.sg/media-room/Pages/Conversations-on-Women-Development.aspx.

Ministry of Social and Family Development. “Labour Force and the Economy: Part Time Workforce”. Accessed November 5, 2019. https://www.msf.gov.sg/research-and-data/Research-and-Statistics/Pages/Labour-Force-and-the-Economy-Part-Time-Workforce.aspx.

Ministry of Social and Family Development. “Support for Women and How Men Can Take On More Household Responsibilities”. Accessed August 12, 2021. https://www.msf.gov.sg/media-room/Pages/Support-for-Women-and-How-Men-Can-Take-On-More-Household-Responsibilities-.aspx.

Ministry of Trade and Industry Singapore. “Speech by SMS Koh Poh Koon at the Women Entrepreneur Awards 2019”. Accessed September 6, 2021. https://www.mti.gov.sg/Newsroom/Speeches/2019/07/Speech-by-SMS-Koh-Poh-Koon-at-the-Women-Entrepreneur-Awards-2019.

MySkillsFuture. “Courses”. Accessed December 12, 2021. https://www.myskillsfuture.gov.sg/content/portal/en/training-exchange/course-directory.html?fq=Course_Supp_Period_To_1%3A%5B2021-12-18T00%3A00%3A00Z%20TO%20*%5D&fq=IsValid%3Atrue&q=Tags%3A%22Workfare_Training%20Commitment%22&start=21.

National Research Foundation: Prime Minister’s Office Singapore. “Human Health and Potential”. Accessed January 29, 2022. https://www.nrf.gov.sg/rie2025-plan/human-health-and-potential.

Parliament of Singapore. “Aspirations of Singapore Women (Motion) Volume 94, Sitting No 44”. Accessed 7 November 2019. https://sprs.parl.gov.sg/search/sprs3topic?reportid=motion-959.

Parliament of Singapore. “Debate on Annual Budget Statement Volume 94, Sitting No 12”. Accessed November 8, 2019. https://sprs.parl.gov.sg/search/sprs3topic?reportid=budget-696.

Parliament of Singapore. “Debate on Annual Budget Statement: Volume 94, Session 61”. Accessed November 8, 2019. https://sprs.parl.gov.sg/search/sprs3topic?reportid=budget-867.

Parliament of Singapore. “Debate on President’s Address: Volume: 94, Sitting No 73. Accessed November 8, 2019. https://sprs.parl.gov.sg/search/sprs3topic?reportid=president-address-25.

Parliament of Singapore. “Empowering Women (Motion) Volume 95, Sitting No 36”. Accessed November 12, 2021. https://sprs.parl.gov.sg/search/sprs3topic?reportid=motion-1738.

Parliament of Singapore. “Empowering Women (Motion) Volume 95, Sitting No 36”. Accessed November 30, 2021. https://sprs.parl.gov.sg/search/sprs3topic?reportid=motion-1734.

Parliament of Singapore. “Gender Budgeting to Determine Effect of Policies on Women: Volume 94, Sitting No 46”. Accessed November 20, 2019. https://sprs.parl.gov.sg/search/sprs3topic?reportid=written-answer-3572.

Parliament of Singapore. “Parliamentary Debates Singapore - Official Report Thirteenth Parliament: First Session Volume 94, Sitting No 44”. Accessed 8, 2019. https://sprs.parl.gov.sg/search/fullreport?sittingdate=03-04-2017.

Parliament of Singapore. “Parliamentary Debates Singapore - Official Report Thirteenth Parliament: First Session Volume 94, Sitting No 45”. Accessed 8, 2019. https://sprs.parl.gov.sg/search/fullreport?sittingdate=04-04-2017.

Parliament of Singapore. “Women’s Charter (Amendment) Bill: Volume 94, Sitting No 7”. Accessed November 8, 2019. https://sprs.parl.gov.sg/search/email/link/?id=021_20160229_S0003_T0001&fullContentFlag=false.

People’s Action Party: Women’s Wing. “Budget 2015 Is “Pro-Woman”, Timely Recognition for International Women’s Day 2015”. Accessed October 21, 2019. https://www.pap.org.sg/womens-wing/thought-leadership/budget-2015-is-pro-woman-timely-recognition-for-international-womens-day-2015.

President of the Republic of Singapore. “Speech by President Halimah Yacob at Women’s Forum Singapore”. Accessed October 14, 2019, https://www.istana.gov.sg/Newsroom/Speeches/2018/09/12/HY-at-Womens-Forum-Singapore.

Prime Minister’s Office Singapore. “PM Lee Hsien Loong’s Speech at the Closing Session of the Conversations on Singapore Women’s Development”. Last Modified September 18, 2021. https://www.pmo.gov.sg/Newsroom/pm-lee-conversations-on-singapore-womens-development.

Reach: Government Feedback Unit. “Conversations on Singapore Women’s Development”. Accessed July 23, 2021. https://www.reach.gov.sg/participate/conversations-on-singapore-womens-development.

SG Women in Tech. “Mentor Connect”. Accessed November 25, 2021. https://www.sgwomenintech.sg/community/mentor-connect/.

SGInnovate. “Singapore Women in Tech: Championing Future Generations of Females in STEM”. February 10, 2021. https://www.sginnovate.com/blog/singapore-women-tech-championing-future-generations-females-stem.

Singapore Ministry of Social and Family Development. “Labour Force and the Economy: IT Professionals”. Accessed October 14, 2019. https://www.msf.gov.sg/research-and-data/Research-and-Statistics/Pages/Labour-Force-and-the-Economy-IT-Professionals.aspx.

Singapore Ministry of Social and Family Development. “Labour Force and the Economy: Research Scientists & Engineers”. Accessed October 14, 2019. https://www.msf.gov.sg/research-and-data/Research-and-Statistics/Pages/Labour-Force-and-the-Economy-Research-Scientists-Engineers.aspx.

Singapore Statutes Online. “Women’s Charter: Bill No. 126/1961”. Accessed May 11, 2018. https://sso.agc.gov.sg/Bills-Supp/126-1961/Published/19610303?DocDate=19610303.

Singapore Statutes Online. “Women’s Charter: Rights and Duties 46”. Accessed November 20, 2019. https://sso.agc.gov.sg/Act/WC1961?ProvIds=pr46-.

Singapore Tourism Board. ”Faces of Singapore”. Accessed November 24, 2021. https://www.visitsingapore.com/en_au/travel-guide-tips/about-singapore/people-of-singapore/.

SkillsFuture. “SkillsFuture Work-Study Programmes”. Accessed November 8, 2019. https://www.skillsfuture.gov.sg/workstudy.

SkillsFuture. “About SkillsFuture”. Accessed November 8, 2019. https://www.skillsfuture.sg/AboutSkillsFuture.

SkillsFuture. “Singapore Workforce Skills Qualifications (WSQ). Accessed November 8, 2019. https://www.ssg.gov.sg/wsq/wsq-for-individuals.html.

SkillsFuture. “SkillsFuture Credit”. Accessed August 24, 2018. https://www.skillsfuture.gov.sg/credit.

SkillsFuture. “SkillsFuture Mid-Career Enhanced Subsidy”. Accessed August 24, 2018. https://www.skillsfuture.gov.sg/enhancedsubsidy.

SkillsFuture. “SkillsFuture Series”. Accessed October 10, 2019. https://www.skillsfuture.sg/series#whoisitfor.

Women Entrepreneur Awards. “Submission Requirements”. Accessed September 6, 2021. https://wea-sg.com/application-guidelines/.

Women Entrepreneur Awards. “Women Entrepreneur Awards”. Accessed August 19, 2021. https://wea-sg.com/the-awards/.

Workforce Singapore. “Workfare Skills Support (WSS) Scheme”. Accessed December 12, 2021. https://www.wsg.gov.sg/programmes-and-initiatives/workfare-skills-support-scheme-individuals.html.

Secondary Sources

ABC News (AM). "Girls Just as Good at STEM Subjects as Boys, Study Shows". *ABC News (AM),* September 26, 2018. https://www.abc.net.au/news/2018-09-26/girls-just-as-good-at-stem-subjects-unsw-study-shows/10307266.

ACS. "Media Release - ACS Australia's Digital Pulse 2020". Accessed November 2, 2020. https://www.acs.org.au/insightsandpublications/media-releases/acs-australia-s-digital-pulse-2020-.html.

Agarwal, Ayushi. "A Fatherhood More Fulfilling". *The Indian Express,* November 8, 2020. https://indianexpress.com/article/opinion/a-fatherhood-more-fulfilling-7013342/.

Agarwal, Meha. "Startup Watchlist: Top Indian Edtech Startups To Look Out For In 2019". *Inc42,* February 18, 2019. https://inc42.com/features/startup-watchlist-top-indian-edtech-startups-to-look-out-for-in-2019.

Alford, Peter. "Age is No Barrier to Starting a Business". *The Australian,* March 19, 2019, https://www.theaustralian.com.au/higher-education/age-is-no-barrier-to-starting-a-business/news-story/178e012908b2e944f4428c7f878987b6.

Aljazeera. "As India's Population Soars, Number of Women in Workforce Shrinks". Accessed October 2, 2023. https://www.aljazeera.com/gallery/2023/4/10/as-indias-population-soars-number-of-women-in-workforce-shrinks.

Anderson, Jenny. "To See More Women in Science, Deal with Test-Taking Anxiety in Girls". *Quartz,* October 27, 2018. https://qz.com/1109075/the-lack-of-women-in-science-is-down-to-test-taking-anxiety-in-girls/.

Ang, Jerene. "Is Singapore Doing Enough for Gender Parity?" *Human Resources Online,* April 24, 2018. https://www.humanresourcesonline.net/is-singapore-doing-enough-for-gender-parity/.

Appleton, Nicola. "Let's Take Women's Businesses Seriously, and Ditch "Mumpreneur"". *The Sydney Morning Herald,* April 21, 2019. https://www.smh.com.au/lifestyle/gender/let-s-take-women-s-businesses-seriously-and-ditch-mumpreneur-20190418-p51f8u.html.

Arbib, Tamara. "Defining Yourself as a Mumpreneur Is a Powerful Statement". *The Guardian,* September 17, 2014. http://www.theguardian.com/women-in-leadership/2014/sep/17/mumpreneur-working-mother-proud-job-divides-opinion.

Arnold, David. *Science, Technology and Medicine in Colonial India*. Cambridge: Cambridge University Press, 2000. http://ebookcentral.proquest.com/lib/adelaide/detail.action?docID=202346.

Arya, Divya. "Why Motherhood Makes Women Quit Their Jobs". *BBC News,* April 23, 2015. https://www.bbc.com/news/world-asia-india-32377275.

Asia Pacific Mastercard Newsroom. "Eight in Ten Female First-Jobbers in Singapore Pursue a Career in STEM: Mastercard Research". Accessed October 14, 2019. https://newsroom.mastercard.com/asia-pacific/press-releases/eight-in-ten-female-first-jobbers-in-singapore-pursue-a-career-in-stem-mastercard-research/.

Australia Science Innovations. “STEM Coach Opportunity”. Accessed June 2, 2021. https://www.asi.edu.au/programs/curious-minds/how-to-participate-in-the-curious-minds-program/mentoring-program/.

Australia Science Innovations. “What Is Curious Minds?” Accessed June 2, 2021. https://www.asi.edu.au/programs/curious-minds/what-is-curious-minds/.

Australian Academy of Science. “Impact of the Pandemic on Australia’s Research Workforce”. Accessed November 24, 2021. https://www.science.org.au/covid19/research-workforce.

Australian Academy of Science. “STEM Equity Monitor Will Help Drive Universal Changes in Gender Equity”. Accessed March 24, 2021. https://www.science.org.au/news-and-events/news-and-media-releases/stem-equity-monitor-help-drive-universal-changes-gender-equity.

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

Australian Catholic University. “The Benefits of Postgraduate Study”. Accessed November 8, 2019. https://www.impact.acu.edu.au/study/the-benefits-of-postgraduate-study.

AWARE: Women’s Action. “Education”. Accessed July 20, 2019. http://womensaction.sg/article/education.

AWARE: Women’s Action. “Work & Economy”. Accessed July 20, 2019. http://www.womensaction.sg/article/work.

Bacchi, Carol Lee. *Women, Policy and Politics: The Construction of Policy Problems*. London: SAGE Publications, 1999.

Bacchi, Carol. “Policies as Gendering Practices: Re-Viewing Categorical Distinctions”. *Journal of Women, Politics & Policy* 38, no. 1 (2 January 2017): 20–41. https://doi.org/10.1080/1554477X.2016.1198207.

Bacchi, Carol and Jennifer Bonham. ““Reclaiming Discursive Practices as an Analytic Focus: Political Implications”. *Foucault Studies* 17 (2014): 173-192. https://doi.org/10.22439/fs.v0i17.4298.

Baird, Marian, and Sue Williamson. “Women, Work and Industrial Relations in 2008”. *Journal of Industrial Relations* 51, no. 3 (1 June 2009): 331–46. https://doi.org/10.1177/0022185609104301.

Bakker, Isabella. “Social Reproduction and the Constitution of a Gendered Political Economy”. *New Political Economy* 12, no.4 (2007): 541-556. https://doi.org/10.1080/13563460701661561.

Bakker, Isabella and Stephen Gill. “Rethinking Power, Production, and Social Reproduction: Toward Variegated Social Reproduction”. *Capital & Class* 43, no. 4 (8 November 2019): 503-523. https://doi.org/10.1177/0309816819880783.

Barbercheck, Mary. “Mixed Messages - Men and Women in Advertisements in Science”. In *Women, Science and Technology*, edited by Mary Wyer, Mary Barbercheck, Donna Geisman, Hatice Örün Öztürk, and Marta Wayne, 117–31. New York: Routledge, 2001.

Baron-Cohen, Simon. “The Essential Difference: The Male and Female Brain”. *Phi Kappa Phi Forum* 85, no. 1 (Winter/Spring 2005): 23–26.

Barres, Ben A. “Does Gender Matter?” *Nature* 442 (12 July 2006): 133–36. https://doi.org/10.1038/442133a.

Basu, Aparna. “Chapter 9 - A Century and a Half’s Journey: Women’s Education in India, 1850s to 2000”. In *Women of India: Colonial and Post-Colonial Periods*, edited by Bharati Ray, 183–207. New Delhi: SAGE Publications, 2005.

BCG. “Boosting Women in Technology in South East Asia: Shifting from Awareness to Action on Gender Diversity”. Accessed September 18, 2023. https://www.bcg.com/publications/2020/boosting-women-in-southeast-asia-tech-sector.

Belingheri, Paola, Filippo Chiarello, Andrea Fronzetti Colladon and Paola Rovelli. “Twenty Years of Gender Equality Research: A Scoping Review Based on a New Semantic Indicator”. *PLOS ONE* 16, no. 9 (21 September 2021): 1-27. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0256474.

Berglund, Henrik. “Hindu Nationalism and Gender in the Indian Civil Society”. *International Feminist Journal of Politics* 13, no. 1 (March 2011): 83–99. https://doi.org/10.1080/14616742.2011.534663.

Betz, Diana E., and Denise Sekaquaptewa. “My Fair Physicist? Feminine Math and Science Role Models Demotivate Young Girls”. *Social Psychological and Personality Science* 3, no. 6 (March 27, 2012): 738–46. https://doi.org/10.1177/1948550612440735.

Besen-Cassino, Yasemin and Dan Cassino, eds. “5. Literature Reviews”. In *Social Research Methods by Example: Applications in the Modern World*, 95-114. New York: Routledge, 2018.

Bhandare, Namita. “Motherhood Is Kicking Indian Women Out Of Work”. *Foreign Policy*, July 6, 2018. https://foreignpolicy.com/2018/07/06/motherhood-is-kicking-indian-women-out-of-work/.

Bhandare, Namita. “Why India’s Most Educated Women Are Leaving Jobs Faster than Others”. *Hindustan Times*, September 9, 2017. https://www.hindustantimes.com/india-news/why-india-s-most-educated-women-are-leaving-jobs-faster-than-others/story-9VqXXn511Xm3PyQZfIOzPN.html.

Bichell, Rae Ellen. “A Fix For Gender-Bias In Animal Research Could Help Humans”. *NPR*, 24 November 2020. https://www.npr.org/sections/health-shots/2016/02/10/464697905/a-fix-for-gender-bias-in-animal-research-could-help-humans.

Biswas, Soutik. “India’s Micro-Finance Suicide Epidemic”. *BBC News*, December 16, 2010. https://www.bbc.com/news/world-south-asia-11997571.

Biswas, Soutik. “Why Are Millions of Indian Women Dropping Out of Work?” *BBC News*, May 18, 2017. https://www.bbc.com/news/world-asia-india-39945473.

Blake, Brock. “Women Business Owners Still Face Difficulties in Obtaining Capital”. *Forbes*, October 14, 2019. https://www.forbes.com/sites/brockblake/2019/10/14/women-business-capital/.

Blockly Games. “Blockly Games”. Accessed May 24, 2021. https://blockly.games/.

Blueprint for Living. “Humans are Making Biased Algorithms that Entrench Discrimination – Without Even Trying”. *ABC Radio National*, September 7, 2019. https://www.abc.net.au/news/2019-09-07/why-artificial-intelligence-further-entrenching-discrimination/11473604

Boeri, Natascia. “Challenging the Gendered Entrepreneurial Subject: Gender, Development, and the Informal Economy in India”. *Gender & Society* 32, no. 2 (1 April 2018): 157–79. https://doi.org/10.1177/0891243217750119.

Borah, Porismita. “Examining Media Content: A Case Study of Newspaper Coverage of Dowry in India, 1999–2006”. *Asian Journal of Communication* 18, no. 4 (December 2008): 379–95. https://doi.org/10.1080/01292980802413110.

Boseley, Matilda. “AMA Condemns “Appalling” Approach of Governments to Ill-Fitting Masks for Covid Healthcare Workers”. *The Guardian*, 18 August 2020. http://www.theguardian.com/australia-news/2020/aug/19/ama-condemns-governments-appalling-approach-to-face-masks-for-covid-healthc-workers.

Breitenstein, Dave. “Asian Students Carry High Expectations for Success”. *USA Today*, August 4, 2013. https://www.usatoday.com/story/news/nation/2013/08/04/asian-students-carry-high-expectations-for-success/2615483/.

Bryans, Patricia, Helen Fraser, and Paul-Alan Armstrong. “Workplace: Women’s Place?” In *Re-Reading Spare Rib*, edited by Angela Smith, 99–118. Palgrave Macmillan, Cham, 2017. https://doi.org/10.1007/978-3-319-49310-7_6.

Burning Glass Technologies. “Is the Pace of Technology Driving the STEM Skills Gap?” Accessed November 30, 2021. https://www.burning-glass.com/pace-technology-driving-the-stem-skills-gap/.

Business Standard. “Equal Pay for Equal Work Still a Distant Dream for Indian Women (March 8 Is International Women’s Day)”. *Business Standard India*, March 8, 2018. https://www.business-standard.com/article/news-ians/equal-pay-for-equal-work-still-a-distant-dream-for-indian-women-march-8-is-international-women-s-day-118030800572_1.html.

Caballar, Rina Diana. “Programming Without Code: The Rise of No-Code Software Development”. *IEEE Spectrum*, March 11, 2020. https://spectrum.ieee.org/programming-without-code-no-code-software-development.

Cannady, Matthew A, Eric Greenwald, and Kimberly N Harris. “Problematizing the STEM Pipeline Metaphor: Is the STEM Pipeline Metaphor Serving Our Students and the

STEM Workforce?" *Science Education* 98, no. 3 (1 May 2014): 443–60. https://doi.org/10.1002/sce.21108.

Carey, Jane. "Taking to the Field: A History of Australian Women In Science". Interview by Robyn Williams. *The Science Show - ABC*, June 3, 2023, audio, 9:43, https://www.abc.net.au/radionational/programs/scienceshow/taking-to-the-field-a-history-of-australian-women-in-science/102421216.

Cassidy, Caitlin. "Female Scientists Found to be Almost Entirely Absent from Australian High School Curriculum". *The Guardian,* August 28, 2023. https://www.theguardian.com/australia-news/2023/aug/28/female-scientists-absent-australian-textbooks.

Cassidy-Vu, Lisa, Keli Beck, and Justin B. Moore. "Burnout in Female Faculty Members: A Statistic or an Opportunity?". *Journal of Primary Care & Community Health* 8, no. 2 (1 April 2017): 97–99. https://doi.org/10.1177/2150131916669191.

Castrillon, Caroline. "Why More Women Are Turning To Entrepreneurship". *Forbes,* February 4, 2019. https://www.forbes.com/sites/carolinecastrillon/2019/02/04/why-more-women-are-turning-to-entrepreneurship/.

Catalyst. "Women in Science, Technology, Engineering, and Mathematics (STEM) (Quick Take)". Accessed July 7, 2019. https://www.catalyst.org/research/women-in-science-technology-engineering-and-mathematics-stem/.

Ceci, Stephen J, Wendy M. Williams, and Richard F Thompson. "Understanding Current Causes of Women's Underrepresentation in Science". *Proceedings of the National Academy of Sciences of the United States of America* 108, no. 8 (2011): 3157–62.

Centre for Social Research. *Analysis on Effectiveness of the Implementation of the Maternity Benefit Act, 1961*. Supported by National Commission for Women: Govt. of India, May 2014, New Delhi. 1-65. http://ncw.nic.in/content/analysis-effectiveness-implementation-maternity-benefit-act-1961.

Chacko, Priya. "Gender and Authoritarian Populism: Empowerment, Protection, and the Politics of Resentful Aspiration in India". *Critical Asian Studies* 52, no. 2 (April 2020): 204–25. https://doi.org/10.1080/14672715.2020.1711789.

Chakraborty, Rituparna, and Manish Sabharwal. "Maternity Benefit Act: The New Amendments Might Cause Some Pangs in the Short Run". *The Economic Times*, July 1, 2018. https://economictimes.indiatimes.com/news/politics-and-nation/maternity-benefit-act-the-new-amendments-might-cause-some-pangs-in-the-short-run/articleshow/64809703.cms.

Chan, Julia. "How Can Singapore Be A More Gender-Inclusive Place to Work?" *The New Savvy*, April 16, 2018. https://thenewsavvy.com/career/gender-inclusive-work-singapore/.

Chandran, Nyshka. "India Becomes a Leader in Maternity Leave at Its Own Expense". *CNBC*, April 6, 2017. https://www.cnbc.com/2017/03/30/india-maternity-leave-increase.html.

Chaudhry, Samena. “Women Medical Students Exceed Quota in Singapore”. Student BMJ. Accessed November 5, 2019. https://search-proquest-com.proxy.library.adelaide.edu.au/docview/1786249235?OpenUrlRefId=info:xri/sid:primo&accountid=8203.

Cheng, Kelvin Seah Kah. “Commentary: Government Matchmaking Programmes Need a Rethink to Get Singles to Mingle”. *Channel News Asia*, October 28, 2018. https://www.channelnewsasia.com/commentary/sdu-singles-singapore-dating-total-fertility-rate-marriage-791931.

Chew, Phyllis Ghim Lian. “The Singapore Council of Women and the Women’s Movement”. *Journal of Southeast Asian Studies* 25, no. 1 (1994): 112–40.

Chin, Audrey, and Constance Singam. “At Work”. In *Singapore Women Re-Presented*, edited by Audrey Chin and Constance Singam, 165-94. Singapore: Landmark Books, 2004

Choo, Yun Ting. “Gender Equality and Women Leaders Benefit Companies and Society: President Halimah”. *The Straits Times*, September 18, 2019. https://www.straitstimes.com/business/gender-equality-and-women-leaders-benefit-companies-and-society-president-halimah.

Ciccia, Rossella. “Qualitative Comparative Analysis as a Tool for Concept Clarification, Typology Building, and Contextualized Comparisons in Gender and Feminist Research”. *Politics & Gender* 12 no. 3 (2016): 1-7. doi:10.1017/S1743923X16000374.

Civil Service College Singapore. “Meritocracy: Time For An Update?” Accessed September 28, 2021. https://www.csc.gov.sg/articles/meritocracy-time-for-an-update.

Collins, Joshua C, and Yogita Abichandani. “Change in the Face of Resistance: Positioning Hope for Women Returnees to the Indian Workforce”. *Advances in Developing Human Resources* 18, no. 1 (February 2016): 11–25. https://doi.org/10.1177/1523422315614928.

Cornwall, Andrea. “Beyond “Empowerment Lite”: Women’s Empowerment, Neoliberal Development and Global Justice”. *Cadernos Pagu*, no. 52 (2018): 1-30. https://doi.org/10.1590/18094449201800520002.

Craig, Lyn, and Brendan Churchill. “Dual-Earner Parent Couples’ Work and Care during COVID-19”. *Gender, Work & Organization* 28, no. S1 (2021): 66–79. https://doi.org/10.1111/gwao.12497.

Crittenden, Victoria L., William F. Crittenden, and Haya Ajjan. “Empowering Women Micro-Entrepreneurs in Emerging Economies: The Role of Information Communications Technology”. *Journal of Business Research* 98 (1 May 2019): 191–203. https://doi.org/10.1016/j.jbusres.2019.01.045.

Crowe, David. “Flouting Discrimination Rules No Barrier to Winning Government Contracts”. *The Sydney Morning Herald*, March 22, 2021. https://www.smh.com.au/politics/federal/gender-reporting-federal-funds-to-companies-flouting-rules-20210321-p57cpm.html.

Crowe, Sarah, Kathrin Cresswell, Ann Robertson, Guro Huby, Anthony Avery, and Aziz Sheikh. “The Case Study Approach”. *BMC Medical Research Methodology* 11, no. 1 (27 June 2011): 100. https://doi.org/10.1186/1471-2288-11-100.

Dalingwater, Louise. “Neo-Liberalism and Gender Inequality in the Workplace in Britain”. *Revue Française de Civilisation Britannique. French Journal of British Studies* XXIII, no. XXIII–1 (15 March 2018). https://doi.org/10.4000/rfcb.1802.

Darke, Afifah. “Number of Babies Born in Singapore Falls to Lowest in 8 Years”. *Channel News Asia*, July 22, 2019. https://www.channelnewsasia.com/news/singapore/number-of-babies-born-in-singapore-falls-to-lowest-in-8-years-11743722.

Dasgupta, Nilanjana, and Jane G. Stout. “Girls and Women in Science, Technology, Engineering, and Mathematics: STEMing the Tide and Broadening Participation in STEM Careers”. *Policy Insights from the Behavioral and Brain Sciences* 1, no. 1 (1 October 2014): 21–29. https://doi.org/10.1177/2372732214549471.

Defence Science & Technology Agency. “The Business Times, Page 16- Thursday, 7 March, 2003”. Accessed October, 15, 2019. https://dsta.gov.sg/latest-news/in-the-news/dsta-in-the-news/the-business-times-page-16-thursday-7-march-2003.

Deloitte. *ACS Australia’s Digital Pulse 2020*. Australia Computer Society, 2020. 1-102. https://www2.deloitte.com/au/en/pages/economics/articles/australias-digital-pulse.html.

De Roock, Roberto Santiago and Mark Baildon. “"MySkillsFuture for Students, STEM Learning, and the Design of Neoliberal Citizenship in Singapore". *Cognition and Instruction* 37, no. 3 (3 July 2019): 285-305. https://doi.org/10.1080/07370008.2019.1624545.

Dickey, Megan Rose. “The U.S. Department of Labor Is Suing Google for Compensation Data”. *TechCrunch*, January 6, 2017. http://social.techcrunch.com/2017/01/05/the-u-s-department-of-labor-is-suing-google-for-compensation-data/.

Digital Learning and Teaching Victoria. “Digital Learning and Teaching Victoria”. Accessed May 28, 2021. https://dltv.vic.edu.au/.

DNA India. “’Women’s Day Gift’: Parliament Passes Bill to Raise Maternity Leave to 26 Weeks”. *DNA India,* March 9, 2017. https://www.dnaindia.com/india/report-par-passes-bill-to-raise-maternity-leave-to-26-weeks-2347889.

Dogra, Aashima and Nandita Jayaraj. “What Will It Take for Science in India to Have Its #MeToo Movement?” *The Wire,* November 4, 2018. https://thewire.in/the-sciences/what-will-it-take-for-science-in-india-to-have-its-metoo-movement.

Dollars and Sense. “(2019 Edition) How Much Does It Cost To Hire A Maid In Singapore?” Accessed November 8, 2019. https://dollarsandsense.sg/2019-edition-much-cost-hire-maid-singapore/.

Douglas, Julie, and Katherine Ravenswood. “’We Can’t Afford Pay Equity’: Examining Pay Equity and Equal Pay Policy in a Neoliberal Environment”. *New Zealand Sociology* 34, no. 2 (2019): 175–99. https://doi.org/10.3316/informit.901226625196284.

DSpace Repository. “Education of Women: A Key to Progress”. Accessed July 4, 2019. https://dspace.gipe.ac.in/xmlui/handle/10973/47239.

DSpace Repository. “Report of the National Committee on Women’s Education May 1958 to January 1959”. Accessed July 4, 2019. https://dspace.gipe.ac.in/xmlui/handle/10973/47089.

Dutta, Debalina. “Women’s Discourses of Leadership in STEM Organizations in Singapore: Negotiating Sociocultural and Organizational Norms”. *Management Communication Quarterly* 32, no. 2 (1 May 2018): 233–49. https://doi.org/10.1177/0893318917731537.

Dugo, Andrea. “Neoliberal Singapore: Nation-State and Global City”. In *Singapore’s First Year of COVID-19*, edited by Andrea Dugo, 23-51. Singapore: Palgrave Macmillan, 2022.

Duxbury, Linda Elizabeth, and Christopher Alan Higgins. “Gender Differences in Work-Family Conflict”. *Journal of Applied Psychology* 76, no. 1 (February 1991): 60–74.

Eagly, Alice H. “Has the Psychology of Women Stopped Playing Handmaiden to Social Values?” *Feminism & Psychology* 26, no. 3 (1 August 2016): 282–91. https://doi.org/10.1177/0959353516636150.

Economic Times - Government. “Delhi Government to Launch STEM Education for Girls in Schools”. *Economic Times*, August 28, 2023. https://government.economictimes.indiatimes.com/news/education/delhi-government-to-launch-stem-education-for-girls-in-schools/71561801.

Education Services Australia. “The Girls in STEM Toolkit – The GIST”. Accessed May 24, 2021. https://www.esa.edu.au/solutions/our-solutions/girls-in-stem-toolkit.

Elias, Juanita. “The Gender Politics of Economic Competitiveness in Malaysia’s Transition to a Knowledge Economy”. *The Pacific Review* 24, no. 5 (December 2011): 529-552. https://www.tandfonline.com/doi/full/10.1080/09512748.2011.596564.

Elias, Juanita and Adrienne Roberts, ed. *Handbook on the International Political Economy of Gender.* Cheltenham; Edward Elgar Publishing Limited, 2018.

Emont, Jon. “Singapore Isn’t Kidding When It Comes to Fostering Fertility”. *Wall Street Journal*, February 22, 2020. https://www.wsj.com/articles/singapore-isnt-kidding-when-it-comes-to-fostering-fertility-11582376400.

Engeli, Isabelle, and Christine Rothmayr Allison, ed. “Conceptual and Methodological Challenges in Comparative Public Policy”. In *Comparative Policy Studies: Conceptual and Methodological Challenges* 1–13. London: Palgrave Macmillan UK, 2014. https://doi.org/10.1057/9781137314154_1.

Engeli, Isabelle, Christine Rothmayr Allison, and Éric Montpetit. ‘Beyond the Usual Suspects: New Research Themes in Comparative Public Policy’. *Journal of Comparative Policy Analysis: Research and Practice* 20, no. 1 (1 January 2018): 114–32. https://doi.org/10.1080/13876988.2017.1413869.

Fleer, Marilyn. “Re-Imagining Play Spaces in Early Childhood Education: Supporting Girls’ Motive Orientation to STEM in Times of COVID-19”. *Journal of Early Childhood Research* 19, no. 1 (1 March 2021): 3–20. https://doi.org/10.1177/1476718X20969848.

Flinders University. (@Flinders University). “Aus Women Will Be Encouraged to Study #STEM While They’re Working, Through the Fed Gov Expanded $124.8 Mill Women in STEM Cadetships and Advanced Apprenticeships Program”, Twitter. March 9, 2021. https://twitter.com/Flinders/status/1369177886289055745.

Foley, Meraiah. “Becoming a ‘Mumpreneur’ Is an Option of Last Resort for Many Working Mothers”. *The Sydney Morning Herald*, 4 May 2016. https://www.smh.com.au/opinion/becoming-a-mumpreneur-is-an-option-of-last-resort-for-many-working-mothers-20160504-golrkl.html.

Foley, Meraiah, Marian Baird, Rae Cooper, and Sue Williamson. “Is Independence Really an Opportunity? The Experience of Entrepreneur-Mothers”. *Journal of Small Business and Enterprise Development* 25, no. 2 (1 January 2018): 313–29. https://doi.org/10.1108/JSBED-10-2017-0306.

Foley, Meraiah and Rae Cooper. “Workplace Gender Equality in the Post-Pandemic Era: Where to Next?” *Journal of Industrial Relations* 63, no.4 (2021): 463-476. https://journals.sagepub.com/doi/epub/10.1177/00221856211035173.

Fred Dallmayr. “Beyond Monologue: For a Comparative Political Theory”. *Perspectives on Politics* 2, no. 2 (2004): 249–57.

Freeman, Brigid Simon Marginson and Russell Tytler. “Federal and State STEM Policies and Programmes Spanning Australian Education, Training, Science and Innovation”. In *The Age of STEM*, edited by Brigid Freeman, Simon Marginson and Russell Tytler, 178-200. London: Routledge, 2014.

Freeman, Brigid, Simon Marginson and Russell Tytler. “Widening and Deepening the STEM Effect”. In *The Age of STEM*, edited by Brigid Freeman, Simon Marginson and Russell Tytler, 1-21. London: Routledge, 2014.

Frevert, Tonya K., Satoris S. Culbertson, and Ann H. Huffman. “Exploring the Double Jeopardy Effect: The Importance of Gender and Race in Work–Family Research”. In *Gender and the Work-Family Experience: An Intersection of Two Domains*, edited by Maura J. Mills, 57–75. Cham: Springer International Publishing, 2015. https://doi.org/10.1007/978-3-319-08891-4_4.

Frize, Monique, Lenka Lhotska, Loredana G. Marcu, Magdalena Stoeva, Gilda Barabino, Fatimah Ibrahim, Sierin Lim, et al. “The Impact of COVID-19 Pandemic on Gender-Related Work from Home in STEM Fields—Report of the WiMPBME Task Group”. *Gender, Work & Organization* 28, no. S2 (2021): 378–96. https://doi.org/10.1111/gwao.12690.

Gaida, Jamie, Jennifer Wong Leung, Stephen Robin and Danielle Cave. “ASPI’s Critical Technology Tracker – The Global Race for Future Power”. *Australian Strategic Policy Institute*, March 2, 2023. https://www.aspi.org.au/report/critical-technology-tracker.

Galea, Natalie, Abigail Powell, Martin Loosemore and Louise Chappell. "Designing Robust and Revisable Policies for Gender Equality: Lessons from the Australian Construction Industry". *Construction Management and Economics* 33, no. 5–6 (3 June 2015): 375–89. https://doi.org/10.1080/01446193.2015.1042887.

Gan, Eveline. "More Women in Singapore Giving Birth in Their 40s". *The Straits Times*, December 27, 2016. https://www.straitstimes.com/singapore/health/more-women-in-singapore-giving-birth-in-their-40s.

Garbee, Elizabeth. 'The Problem With the "Pipeline" Metaphor in STEM Education". *Slate Magazine*, October, 20 2017. https://slate.com/technology/2017/10/the-problem-with-the-pipeline-metaphor-in-stem-education.html.

Gellecum, Yolanda van, Janeen Baxter, and Mark Western. "Neoliberalism, Gender Inequality and the Australian Labour Market". *Journal of Sociology* 44, no. 1 (1 March 2008): 45–63. https://doi.org/10.1177/1440783307085842.

George, Alexander, and Andrew Bennett. *Case Studies and Theory Development in the Social Sciences*. Cambridge: MIT Press, 2004.

Get Education. "Expanding STEM Options for All Australian Students". Last Modified August 16, 2017. http://geteducation.com.au/expanding-stem-options-australian-students/.

Glennie, Miriam, Anna von Reibnitz, Jananie William, Sally Curtis, and Sarbari Bordia. *Gender Pay Gap Reporting in Australia: Time for an Upgrade*. Global Institute for Women's Leadership, Australian National University and King's College London, October 2021. 1-48. https://giwl.anu.edu.au/research/publications/gender-pay-gap-reporting-australia-time-upgrade.

Global Citizen. "9 Reasons Why Dowries Are Horrible for Women". Accessed July 5, 2021. https://www.globalcitizen.org/en/content/8-reasons-dowries-are-bad-for-women/.

Global Is Asian. "Meritocracy in Singapore: Solution or Problem?" Accessed September 28, 2021. https://lkyspp.nus.edu.sg/gia/article/meritocracy-in-singapore-solution-or-problem.

Gorman, Alice. "Prejudice, Poor Pay and the 'Urinary Leash': Naming and Claiming Australia's Forgotten Women Scientists". *The Conversation*, February 9, 2023. https://theconversation.com/prejudice-poor-pay-and-the-urinary-leash-naming-and-claiming-australias-forgotten-women-scientists-198407.

Gottfried, Heidi, and Laura Reese. "Gender, Policy, Politics, and Work: Feminist Comparative and Transnational Research". *Review of Policy Research* 20, no. 1 (2003): 3–20. https://doi.org/10.1111/1541-1338.d01-2.

Goulden, Marc, Mary Ann Mason, and Karie Frasch. "Keeping Women in the Science Pipeline". *The ANNALS of the American Academy of Political and Social Science* 638, no. 1 (1 November 2011): 141–62. https://doi.org/10.1177/0002716211416925.

Grant, Aimee, ed. *Doing Excellent Social Research with Documents: Practical Examples and Guidance for Qualitative Researchers.* Oxon: Routledge, 2019.

Grasshopper. “Learn to Code for Free”. Accessed May 24, 2021. https://grasshopper.app/.

Green, Donald, and Ian Shapiro. “Eight: Responses to Likely Counterarguments”. In *Pathologies of Rational Choice Theory: A Critique of Applications in Political Science*, 179–204. Yale University Press, 1994.

Greg Hunt. “$8 Million to Support Women in STEM and Entrepreneurship”. Accessed December 19, 2021. https://www.greghunt.com.au/8-million-to-support-women-in-stem-and-entrepreneurship/.

Grinis, Inna. “The STEM Requirements of “Non-STEM” Jobs: Evidence from UK Online Vacancy Postings”. *Economics of Education Review* 70 (1 June 2019): 144–58. https://doi.org/10.1016/j.econedurev.2019.02.005.

Gristock, Jenny. “Why Aren’t There More Women in Science? The Industry Structure Is Sexist”. *The Guardian*, May 31, 2016. https://www.theguardian.com/commentisfree/2016/may/31/women-science-industry-structure-sexist-courses-careers.

Gross, Doug. “In Tech, Some Bemoan the Rise of “Brogrammer” Culture”. *CNN*, May 7, 2012. https://www.cnn.com/2012/05/07/tech/web/brogrammers/index.html.

Gu, Chao. “Women Scientists in China: Current Status and Aspirations”. *National Science Review* 8, no. 10 (October 2021): 1-5. https://doi.org/10.1093/nsr/nwab101.

Guglielmi, Giorgia. “US Kids’ Doodles of Scientists Reveal Changing Gender Stereotypes”. *Nature*, March 20, 2018. https://doi.org/10.1038/d41586-018-03346-7.

Gupta, Namrata, and A.K. Sharma. “Patrifocal Concerns in the Lives of Women in Academic Science: Continuity of Tradition and Emerging Challenges”. *Indian Journal of Gender Studies* 10, no. 2 (June 2003): 279–305. https://doi.org/10.1177/097152150301000205.

Gupta, Namrata, and Arun K Sharma. “Women Academic Scientists in India”. *Social Studies of Science* 32, no. 5/6 (2002): 901–15. https://www.jstor.org/stable/3183058.

Gupta, Vishal K., Daniel B. Turban, S. Arzu Wasti, and Arijit Sikdar. “The Role of Gender Stereotypes in Perceptions of Entrepreneurs and Intentions to Become an Entrepreneur”. *Entrepreneurship: Theory and Practice* 33, no. 2 (1 March 2009): 397–418. https://web-s-ebscohost-com.proxy.library.adelaide.edu.au/ehost/detail/detail?vid=0&sid=91f72701-0ed0-4b2e-bdcb-983901085682%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZSZzY29wZT1zaXRl#db=bsu&AN=36839781.

Gurumurthy, Anita, Nandini Chami, and Sanjana Thomas. “Unpacking Digital India: A Feminist Commentary on Policy Agendas in the Digital Moment”. *Journal of Information Policy* 6 (2016): 371–402. https://doi.org/10.5325/jinfopoli.6.2016.0371.

Haider, Saraswati. “National Policy for Women in India 1996: A Critique”. *Social Scientist* 25, no. 3/4 (1997): 38–64. https://doi.org/10.2307/3517642.

Han, Ling, Chengpang Lee, and Gracia Jieyi Lee. “Caught between State and Motherhood: The Public Image of Female Entrepreneurs in Singapore”. *Asian Women - The Research Institute of Asian Women* 37, no. 2 (30 June 2021): 35-60. http://e-asianwomen.org/_common/do.php?a=current&bidx=2610&aidx=29654.

Harris, Nonie. “Comparative, Feminist, and Qualitative: An Uncommon Perspective on Cross-National Social Policy Research”. *International Journal of Qualitative Methods* 6, no. 1 (1 March 2007): 27–35. https://doi.org/10.1177/160940690700600103.

Harvey, David. “Neoliberalism as Creative Destruction”. *The American Academy of Political and Social Science* 610, no. 1 (2007): 21-44. https://journals.sagepub.com/doi/10.1177/0002716206296780.

Harvey-Smith, Lisa. “Australia Has Hundreds of Programs to Get Women into Science, but Are They Working? Time to Find Out”. *The Conversation*, March 9, 2021. http://theconversation.com/australia-has-hundreds-of-programs-to-get-women-into-science-but-are-they-working-time-to-find-out-133061.

Harvey-Smith, Lisa. “Women in STEM Need Your Support – and Australia Needs Women in STEM”. *UNSW Newsroom*, March 8, 2019. https://newsroom.unsw.edu.au/news/science-tech/women-stem-need-your-support-%E2%80%93-and-australia-needs-women-stem.

Hathaway, Terry. “Neoliberalism as Corporate Power”. *Competition & Change* 24, no. 3–4 (July 2020): 315–37. https://doi.org/10.1177/1024529420910382.

Heymann, Jody, Aleta Sprague and Amy Raub, ed. “10. Achieving Gender Equality in the Economy in Our Lifetimes”. In *Equality Within Our Lifetimes*, 273-274. Oakland: University of California Press, 2023.

Hicks, Marie. “Why Tech’s Gender Problem Is Nothing New”. *The Guardian*, 12 October 2018. https://www.theguardian.com/technology/2018/oct/11/tech-gender-problem-amazon-facebook-bias-women.

Higgins, Tim. “Palantir Sued Over Alleged Hiring Discrimination – Update”. *Wall Street Journal*, September 27, 2016. https://www.wsj.com/articles/palantir-sued-over-alleged-hiring-discrimination-1474928585.

Hill, Elizabeth. *Worker Identity, Agency and Economic Development: Women’s Empowerment in the Indian Informal Economy.* Oxon: Routledge, 2010.

Hill, Elizabeth, Michele Ford and Marian Baird, eds. “Work/Care Regimes in the Asia-Pacific: A Feminist Framework”. In *Women, Work and Care in the Asia Pacific*, 1-22. London: Routledge, 2017.

Holloman, Teirra, Walter Lee, Jeremi London, Atota Halkiyo and Gilbert Jew. *A Historical and Policy Perspective on Broadening Participation in STEM: Insights from National Reports (1974-2016).* American Society for Engineering Education, 2018. 1-23. https://par.nsf.gov/servlets/purl/10080892.

Holmes, Oliver. “Singapore’s Ruling Party Batters Opposition in Huge Election Win”. *The Guardian*, 11 September 2015,

https://www.theguardian.com/world/2015/sep/11/singapore-election-early-count-shows-ruling-party-in-strong-position.

Hooker, Claire. *Irresistible Forces: Australian Women in Science*. Melbourne: Melbourne University Press, 2004.

Huang, Shirlena and Brenda S.A Yeoh. "Maids and Ma'ams in Singapore: Constructing Gender and Nationality in the Transnationalization of Paid Domestic Work". *Geography Research Forum* 18 (1998): 22-48. https://scholarbank.nus.edu.sg/handle/10635/20093.

Huang, Shirlena, and Brenda S. A. Yeoh. "Ties That Bind: State Policy and Migrant Female Domestic Helpers in Singapore". *Geoforum* 27, no. 4 (1 January 1996): 479–93. https://doi.org/10.1016/S0016-7185(96)00023-1.

Human Resources Director. "Flexi-Work "More Common" in Singapore: MOM". Accessed November 8, 2019. https://www.hcamag.com/asia/news/general/flexi-work-more-common-in-singapore-mom/172338.

Human Resources Director. "Most Working Dads Would Quit over Flexi-Work". Accessed November 8, 2019. https://www.hcamag.com/asia/news/general/most-working-dads-would-quit-over-flexi-work/170153.

Human Rights Watch. "India Media Freedom Under Threat". *Human Rights Watch*, May 3, 2022. https://www.hrw.org/news/2022/05/03/india-media-freedom-under-threat.

Hynes, Casey. "Singapore Tops New List Of Best Startup Cities". *Forbes*, August 9, 2017. https://www.forbes.com/sites/chynes/2017/08/09/singapore-tops-new-list-of-best-startup-cities/.

Iffert-Saleem, Audrey. "Why Lipstick and Nail Files Won't Draw Women Into Science". *Slate Magazine*, March 21, 2014. https://slate.com/technology/2014/03/science-its-a-girl-thing-and-other-flawed-attempts-to-bring-women-into-stem.html.

Inc42. "Govt Announces Online Ecommerce Platform Mahila E-Haat For Women Entrepreneurs". Accessed July 20, 2019. https://inc42.com/flash-feed/online-ecommerce-platform-mahila-e-haat.

International Chamber of Commerce. "Telecoms Liberalization Guide - Second Edition". Accessed July 6, 2021. https://iccwbo.org/publication/telecoms-liberalization-guide-second-edition/.

International Labour Organisation. *India Wage Report: Wage Policies for Decent Work and Inclusive Growth*. Office for India, 2018. 1-116. https://www.ilo.org/wcmsp5/groups/public/---asia/---ro-bangkok/---sro-new_delhi/documents/publication/wcms_638305.pdf.

Internet Archive. "National Perspective Plan For Women 1988-2000 A.D". Accessed July 12, 2019. http://archive.org/details/in.ernet.dli.2015.226927.

Ipsos and Kings College London. "International Women's Day: Global Opinion Remains Committed to Gender Equality, but Half Now Believe it is Coming at the Expense of

Men". Accessed September 17, 2023. https://www.ipsos.com/en/international-womens-day-global-opinion-remains-committed-gender-equality-half-now-believe-it.

Jayawarna, Dilani, Julia Rouse, and John Kitching. "Entrepreneur Motivations and Life Course". *International Small Business Journal* 31, no. 1 (1 February 2013): 34–56. https://doi.org/10.1177/0266242611401444.

Jean, Vanessa A., Stephanie C. Payne, and Rebecca J. Thompson. "Women in STEM: Family-Related Challenges and Initiatives". In *Gender and the Work-Family Experience: An Intersection of Two Domains*, edited by Maura J. Mills, 291–311. Cham: Springer International Publishing, 2015. https://doi.org/10.1007/978-3-319-08891-4_15.

Jeffery, Patricia. "Supply-and-Demand Demographics: Dowry, Daughter Aversion and Marriage Markets in Contemporary North India". *Contemporary South Asia* 22, no.2 (April 2014): 171-188. https://www-tandfonline-com.proxy.library.adelaide.edu.au/doi/abs/10.1080/09584935.2014.899982.

Jeffrey, Robin. "Governments and Culture: How Women Made Kerala Literate". *Pacific Affairs* 60, no. 3 (1987): 447–72. https://doi.org/10.2307/2758883.

Jehan, Kate. "Heroes or Hondas? Analysing Men's Dowry Narratives in a Time of Rapid Social Change". In *Dowry: Bridging the Gap Between Theory and Practice*, edited by Tamsin Bradley, Emma Tomalin, and Mangala Subramaniam, 59–86. London: Zed Books, 2009.

Johnson, Carol. "Gender Research and Discursive Policy Framing". In *Gender Innovation in Political Science: New Norms, New Knowledge*, edited by Marian Sawer and Kerry Baker, 195–219. London: Palgrave Macmillan, 2019.

Johnson, Carol. *Governing Change: Keating to Howard*. St Lucia: University of Queensland, 2000.

Johnson, Carol. *Social Democracy and the Crisis of Equality: Australian Social Democracy in a Changing World*. Singapore: Springer Singapore, 2019. https://doi.org/10.1007/978-981-13-6299-6_3.

Jones, Janice, and Pi-Shen Seet. "Industry Cadetships: A Good but Small Step to Tap the Talents of Women in STEM". *The Conversation.* October 28 2020. http://theconversation.com/industry-cadetships-a-good-but-small-step-to-tap-the-talents-of-women-in-stem-148170.

Jorgensen, Robyn, and Kevin Larkin. *STEM Education in the Junior Secondary: The State of Play*. Singapore: Springer, 2018. https://doi.org/10.1007/978-981-10-5448-8_2.

Kalpana, K. "Economic Entitlements via Entrepreneurial Conduct? Women and Financial Inclusion in Neoliberal India". *Journal of World-Systems Research* 21, no. 1 (2015): 50-68. http://jwsr.pitt.edu/ojs/jwsr/article/view/527.

Kar, Sanghamitra. "On Women's Day, Niti Aayog Launched Women Entrepreneurship Platform". *Economic Time*, March 8, 2018. https://economictimes.indiatimes.com/startups/on-womens-day-niti-aayog-launches-women-entrepreneurship-platform/articleshow/63217679.cms.

Karp, Paul. “Gender Gap Narrows but Push towards Science Has Lowered Wages”. *The Guardian*, September 16, 2018. https://www.theguardian.com/australia-news/2018/sep/16/gender-gap-narrows-but-push-towards-science-has-lowered-wages.

Kavarana, Aditi. “Equal Remuneration Act”. Centre For Civil Society, July 20, 2013. https://ccs.in/equal-remuneration-act.

Kelly, Emma. “Curious Minds Program Hopes to Foster Young Women’s Passion for Science, Maths”. *The Canberra Times*, 9 December 2015. https://www.canberratimes.com.au/story/6057279/curious-minds-program-hopes-to-foster-young-womens-passion-for-science-maths/.

Kermani, Hengameh, and Jale Aldemir. “Preparing Children for Success: Integrating Science, Math, and Technology in Early Childhood Classroom”. *Early Child Development and Care* 185, no. 9 (2 September 2015): 1504–27. https://doi.org/10.1080/03004430.2015.1007371.

Khan, Shifa. “9 Schemes For Women Entrepreneurs in India”. *News18*, September 19, 2017. https://www.news18.com/news/indiwo/work-and-career-9-schemes-for-women-entrepreneurs-in-india-1522125.html.

Kit, Tang See. “Narrowing Gender Gap Can Add S$26b to Singapore’s GDP by 2025: Report”. *Channel News Asia*, April 24, 2018. https://www.channelnewsasia.com/news/singapore/narrowing-gender-gap-can-add-s-26b-to-singapore-s-gdp-by-2025-10170686.

Kobia, Margaret, and Damary Sikalieh. “Towards a Search for the Meaning of Entrepreneurship”. *Journal of European Industrial Training* 34, no. 2 (1 January 2010): 110–27. https://doi.org/10.1108/03090591011023970.

Kohli, Atul. “State, Business, and Economic Growth in India”. *Studies in Comparative International Development* 42 (2007): 87–114. https://doi.org/10.1007/s12116-007-9001-9.

Kotz, David. “Globalization and Neoliberalism”. *Rethinking Marxism* 14, no. 2 (2022): 64-79. https://doi.org/10.1080/089356902101242189.

Kravets, David. “Palantir Settles US Charges That It Discriminated against Asian Engineers”. *Ars Technica*, April 26, 2017. https://arstechnica.com/tech-policy/2017/04/palantir-settles-us-charges-it-discriminated-against-asian-engineers/.

Kuehn, Bridget M. “Planning During Pregnancy”. *ELife* 8 (May 2019): 1-4. https://doi.org/10.7554/eLife.47985.

Kumar, Neelam. “Introduction’. In *Women and Science in India: A Reader*, edited by Neelam Kumar, xxiii–xxx. New Delhi: Oxford University Press, 2009.

Kung, Ong Ye. “Dealing with Two Paradoxes of Singapore’s Education System”. *TODAY Online*, July 11, 2018. https://www.todayonline.com/commentary/broad-agreement-meritocracy-and-inequality-key-developing-better-education-system.

Lab+Life Scientist. “STEM Study Encouraged as Kerry Chant Wins NSW Woman of the Year”. Accessed March 18, 2021. http://labonline.com.au/content/lab-business/news/stem-study-encouraged-as-kerry-chant-wins-nsw-woman-of-the-year-1021660308.

Lai, Linette. “No Let up in Efforts by Govt to Improve Lives of Singapore Women, Says Sun Xueling”. *The Straits Times*. August 3, 2021. https://www.straitstimes.com/singapore/community/no-let-up-in-efforts-by-govt-to-improve-lives-of-singapore-women-says-sun.

Lazar, Michelle M. “For the Good of The Nation: “Strategic Egalitarianism” in the Singapore Context”. *Nations and Nationalism* 7, no. 1 (2001): 59–74. https://doi.org/10.1111/1469-8219.00004.

Lee, Jean, Kathleen Campbell and Audrey Chia. *The 3 Paradoxes: Working Women in Singapore*. Singapore: Association of Women for Action and Research, 1999.

LEGO. “Girls Are Ready to Overcome Gender Norms but Society Continues to Enforce Biases That Hamper Their Creative Potential”. Accessed November 15, 2021. https://www.lego.com/en-us/aboutus/news/2021/september/lego-ready-for-girls-campaign/.

Leong, Wai Kum. “Fifty Years and More of the Women’s Charter of Singapore”. *Singapore Journal of Legal Studies* (July 2008): 1–24. https://heinonline-org.proxy.library.adelaide.edu.au/HOL/Page?handle=hein.journals/sjls2008&id=3&collection=journals&index=journals/sjls.

Lerchenmueller, Marc J., and Olav Sorenson. “The Gender Gap in Early Career Transitions in the Life Sciences”. *Research Policy* 47, no. 6 (1 July 2018): 1007–17. https://doi.org/10.1016/j.respol.2018.02.009.

Levin, Sam. “Accused of Underpaying Women, Google Says It’s Too Expensive to Get Wage Data”. *The Guardian*, May, 26 2017. https://www.theguardian.com/technology/2017/may/26/google-gender-discrimination-case-salary-records.

Levin, Sam. “Google Accused of “Extreme” Gender Pay Discrimination by US Labor Department”. *The Guardian*, April, 7 2017. http://www.theguardian.com/technology/2017/apr/07/google-pay-disparities-women-labor-department-lawsuit.

Levin, Sam. “Google Employees Deterred from Reporting Discrimination, US Official Says”. *The Guardian*, July 19, 2017, https://www.theguardian.com/technology/2017/jul/19/google-confidentiality-wage-gap-us-investigation.

Levin, Sam. “Women Say They Quit Google Because of Racial Discrimination: “I Was Invisible””. *The Guardian*, August 18, 2017. https://www.theguardian.com/technology/2017/aug/18/women-google-memo-racism-sexism-discrimination-quit.

Liang, Anabelle. "'Hard Choices' for Singapore Media After Controversial Law Passed". *Aljazeera*, October 13, 2021. https://www.aljazeera.com/news/2021/10/13/singapore-media-face-hard-choices-after-new-law-passed.

Lim, Linda and Pang Eng Fong. "Commentary: Can Education Fix Inequality in Singapore? If Not, What Can?" *Channel News Asia,* February 2, 2021. https://www.channelnewsasia.com/commentary/can-education-fix-growing-inequality-in-singapore-814696.

Lobb, Andrea. "The Agony and the Empathy: The Ambivalence of Empathy in Feminist Psychology". *Feminism & Psychology* 23, no. 4 (1 November 2013): 426–41. https://doi.org/10.1177/0959353513497556.

Lombardo, Emanuela, Petra Meier and Mieke Verloo, ed. *The Discursive Politics of Gender Equality: Stretching, Bending and Policy-Making.* New York: Routledge, 2009.

Lopes, Marina. "As Singapore Ages, Single Women Pay the Price of Caring for Elderly Parents". *The Washington Post,* April 12, 2021, https://www.washingtonpost.com/world/asia_pacific/women-asia-singapore-parents-ageing/2021/04/12/1479ef98-95da-11eb-8f0a-3384cf4fb399_story.html.

Luh Lan, and Jean Lee. "Force-field Analysis on Policies Affecting Working Women in Singapore". *Journal of Management Development* 16, no. 1 (1 February 1997): 43–52. https://doi.org/10.1108/02621719710155472.

Lyons, Kate. "Majority of Men in Middle East Survey Believe a Woman's Place Is in the Home". *The Guardian,* May 2, 2017. https://www.theguardian.com/global-development/2017/may/02/majority-of-men-in-middle-east-north-africa-survey-believe-a-womans-place-is-in-the-home.

Lyness, Karen and Madeline Heilman. "When Fit is Fundamental: Performance Evaluations and Promotions of Upper-Level Female and Male Managers". *Journal of Applied Psychology* 91, no. 4 (2006): 777-785. doi:10.1037/0021-9010.91.4.777.

MacDonald, Terri. "Women Are Bearing the Brunt of COVID Pain in Higher Ed". *Agenda* 28 (2020.): 16–17. https://doi.org/10.3316/informit.407670796784610.

Malay Mail. "Report: Lack of Women in STEM Due to Gender Stereotypes". *Malay Mail,* July 23, 2017, https://www.malaymail.com/s/1427029/report-lack-of-women-in-stem-due-to-gender-stereotypes.

Mangla, Akshay. "Elite Strategies and Incremental Policy Change: The Expansion of Primary Education in India". *Governance* 31, no. 2 (April 2018): 381–99. https://doi.org/10.1111/gove.12299.

Manolova, Tatiana S, Candida G Brush, Linda F Edelman, and Amanda Elam. "Pivoting to Stay the Course: How Women Entrepreneurs Take Advantage of Opportunities Created by the COVID-19 Pandemic". *International Small Business Journal* 38, no. 6 (1 September 2020): 481–91. https://doi.org/10.1177/0266242620949136.

Maroske, Sara. ""The Whole Great Continent as a Present": Nineteenth-Century Australian Women Workers in Science". In *On the Edge of Discovery - Australian*

Women in Science, edited by Farley Kelly, 13–34. Melbourne: The Text Publishing Company, 1993.

Marshall, Jill A. "Escape from the Pipeline: Women Using Physics Outside Academia". *The Physics Teacher* 46, no. 1 (18 December 2007): 20–24. https://doi.org/10.1119/1.2823995.

Masani, R. P. *Dadabhai Naoroji: Grand Old Man Of India*. London: George Allen & Unwin Ltd, 1939. http://archive.org/details/GrandOldManOfIndia.

Mastercard. "Eight in Ten Female First-Jobbers in Singapore Pursue a Career in STEM: Mastercard Research". Accessed October 14, 2019. https://newsroom.mastercard.com/asia-pacific/press-releases/eight-in-ten-female-first-jobbers-in-singapore-pursue-a-career-in-stem-mastercard-research/.

MasterCard. "Low Confidence Limits Number of Girls Pursuing STEM Careers in Singapore: Inaugural MasterCard Study". Accessed August 5, 2019. https://newsroom.mastercard.com/asia-pacific/press-releases/low-confidence-limits-number-of-girls-pursuing-stem-careers-in-singapore-inaugural-mastercard-study/.

Mauzy, Diane K and Robert Stephen Milne. *Singapore Politics Under the People's Action Party*. London: Routledge, 2002.

Mazur, Amy G., and Season Hoard. "Gendering Comparative Policy Studies: Towards Better Science". In *Comparative Policy Studies: Conceptual and Methodological Challenges*, edited by Isabelle Engeli and Christine Rothmayr Allison, 205–35. Palgrave Macmillan UK, 2014. https://doi.org/10.1057/9781137314154_10.

Mazur, Amy. "Feminist Comparative Policy: A New Field of Study". *European Journal of Political Research* 35, no. 4 (1999): 483–506. https://doi.org/10.1111/1475-6765.00457.

Mbirianjau, Lucy Wandiri. "Why Fewer Kenyan Women Are Choosing or Completing STEM Courses". *The Conversation.* September 20, 2018. http://theconversation.com/why-fewer-kenyan-women-are-choosing-or-completing-stem-courses-91706.

McGuire, Alison. "Females Are Studying STEM Degrees Just as Much as Males, Finally!". *Irish Tech News*, June 27, 2018. https://irishtechnews.ie/females-are-studying-stem-degrees-just-as-much-as-males-finally/.

McKendrick, Joe. "Technology Is Driving Entrepreneurial Growth, And We're Not Just Talking About Silicon Valley". *Forbes*, November 28, 2017. https://www.forbes.com/sites/joemckendrick/2017/11/28/technology-is-driving-entrepreneurial-growth-and-were-not-just-talking-about-silicon-valley/.

McKinnon, Merryn. 'The Absence of Evidence of the Effectiveness of Australian Gender Equity in STEM Initiatives'. *Australian Journal of Social Issues* (October 2020): 1-14 https://doi.org/10.1002/ajs4.142.

McKinnon, Merryn. "How to Keep More Women in Science, Technology, Engineering and Mathematics (STEM)". *The Conversation*, July 13, 2016.

http://theconversation.com/how-to-keep-more-women-in-science-technology-engineering-and-mathematics-stem-61664.

McKinsey Global Institute. “The Power of Parity: Advancing Women’s Equality in Asia Pacific’. McKinsey Global Institute”. April 23, 2018. https://www.mckinsey.com/featured-insights/gender-equality/the-power-of-parity-advancing-womens-equality-in-asia-pacific.

Mechanobiology Institute: National University of Singapore. “Mechanobiology Institute Outreach”. Accessed November 3, 2020. https://www.mbi.nus.edu.sg/education/outreach/.

Mediratta, Surinder. *Handbook of Law, Women, and Employment: Policies, Issues, Legislation and Case Law*. New Delhi: Oxford University Press, 2009.

Mellström, Ulf. “The Intersection of Gender, Race and Cultural Boundaries, or Why Is Computer Science in Malaysia Dominated by Women?” *Social Studies of Science* 39, no. 6 (2009): 885–907.

Merelli, Annalisa. “The West Is Way behind Iran and Saudi Arabia When It Comes to Women in Science”. *Quartz,* March 9, 2018. https://qz.com/1223067/iran-and-saudi-arabia-lead-when-it-comes-to-women-in-science/.

Metcalf, Heather. “Stuck in the Pipeline: A Critical Review of STEM Workforce Literature”. *InterActions: UCLA Journal of Education and Information Studies* 6, no. 2 (27 May 2010). https://escholarship.org/uc/item/6zf09176.

Miller, David I., and Jonathan Wai. “The Bachelor’s to Ph.D. STEM Pipeline No Longer Leaks More Women than Men: A 30-Year Analysis”. *Frontiers in Psychology* 6 (2015). https://doi.org/10.3389/fpsyg.2015.00037.

Milner-Barry, Sarah. “The Term “Mother Nature” Reinforces the Idea That Both Women and Nature Should Be Subjugated”. *Quartz,* December 2, 2015. https://qz.com/562833/the-term-mother-nature-reinforces-the-idea-that-both-women-and-nature-should-be-subjugated/.

Mint. “From One Year to 10 Days: A Look at Paternity Leaves around the World”. *Mint,* July 2, 2021. https://www.livemint.com/news/world/from-one-year-to-10-days-a-look-at-paternity-leaves-around-the-world-11625195516054.html.

Mitra, Asok, Lalit Pathak, and Shekhar Mukherji. *The Status of Women: Shifts in Occupational Participation 1961-71*. New Delhi: Abhinav Publications, 1980.

Moi, Kho Ee. “Construction of Femininity: Girls’ Education in Singapore, 1959-2000”. PhD Thesis, National University of Singapore, 2004. https://scholarbank.nus.edu.sg/handle/10635/14184?mode=full.

Moi, Kho Ee. “Economic Pragmatism and the “Schooling” of Girls in Singapore”. *HSSE Online: Research and Practice in Humanities & Social Studies Education* 4, no. 2 (2015): 62–77.
https://hsseonline.nie.edu.sg/sites/default/files/uploaded/journal_articles/khoem.pdf.

Molla, Rani. “For Women, Remote Work Is a Blessing and a Curse”. *Vox*, July 13, 2021. https://www.vox.com/recode/22568635/women-remote-work-home.

Moyal, Ann. “Invisible Participants. Women in Science in Australia, 1830 — 1950”. *Prometheus* 11, no. 2 (1 December 1993): 175–87. https://doi.org/10.1080/08109029308629352.

Mukhopadhyay, Carol and Susan Seymour. *Women, Education, and Family Structure in India*. Boulder: Westview Press, 1994.

Mukhopadhyay, Carol. “How Exportable Are Western Theories of Gendered Science? A Cautionary Word”. In *Women and Science: A Reader*, edited by Neelam Kumar, 137–77. New Delhi: Oxford University Press, 2009.

Nash, Meredith and Brendan Churchill. "Caring during COVID-19: A Gendered Analysis of Australian University Responses to Managing Remote Working and Caring Responsibilities". *Gender, Work & Organization* 27, no. 5 (2020): 833-846. https://doi.org/10.1111/gwao.12484.

NASSCOM. “Indian Start-Up Ecosystem – Traversing The Maturity Cycle: Edition 2017”. Accessed February 22, 2020. https://smartnet.niua.org/sites/default/files/resources/nasscom-start-up-report-2017.pdf.

National Foundation for Australian Women. “Gender Lens on the Budget 2016-17”. May 15, 2016. https://nfaw.org/policy-papers/gender-lens-on-the-budget/a-gender-lens-budget-2016-17/.

National Foundation for Australian Women. “Gender Lens on the Budget 2020-2021”. October, 18 2020. https://nfaw.org/gender-lens-on-the-budget/gender-lens-on-the-budget-2020-2021/.

National Foundation for Australian Women. “Gender Lens on the Budget 2021-2022”. May 23, 2021. https://nfaw.org/policy-papers/gender-lens-on-the-budget/gender-lens-on-the-budget-2021-2022/.

National Science Foundation. “NSF Announces New Measures to Protect Research Community from Harassment”. Accessed February 7, 2019. https://nsf.gov/news/news_summ.jsp?cntn_id=296610&org=NSF&from=news.

Nelson, Camilla. “The Rise of the Digital ‘Mumpreneur’”. *ABC News*, October 19, 2018. https://www.abc.net.au/news/2018-10-19/rise-of-the-digital-mumpreneur-turning-kids-into-brands/10393140.

Neneh, Brownhilder. “Why Foreignness Matters: The Impact of Business-Family Interference on the Exit Intentions of Women Entrepreneur”. *Journal of Small Business Strategy* 30, no. 1 (2020): 83–96. https://www.proquest.com/docview/2465478601/fulltextPDF/8F4DFA591C524B82PQ/1?accountid=8203.

Nerurkar, Sonal. “Building a Case for Equal Pay”. *Mint*, September 2, 2021. https://www.livemint.com/news/business-of-life/building-a-case-for-equal-pay-1541869869183.html.

Ng, Michelle. “Concrete Proposals to Tackle Women’s Issues to Be Presented in Early 2022: PM Lee”. *The Straits Times*, September 18, 2021. https://www.straitstimes.com/singapore/community/concrete-proposals-to-tackle-womens-issues-to-be-presented-in-early-2022-pm-lee.

Niazi, Shuriah. “India Has Reached ‘Watershed’ for Science and Innovation”. *University World News*, June 18, 2021. https://www.universityworldnews.com/post.php?story=20210618133004502.

Nobel, Emma. “The X-Files and the Scully Effect – Fake Aliens Real-World Phenomenon For Women in STEM”. *ABC News*, August 19, 2020. https://www.abc.net.au/news/2020-08-19/x-files-and-scully-effect-real-world-phenomenon-women-in-stem/12562440.

NUS Institute of Real Estate and Urban Studies. “Workplace Flexibility and Entrepreneurship”. Accessed September 6, 2021. https://ireus.nus.edu.sg/2019/03/07/workplace-flexibility-and-entrepreneurship/.

O’Hara, Mary Emily. ‘Trump Pulls Back Obama-Era Protections for Women in the Workplace’. *NBC News*, April, 4 2017. https://www.nbcnews.com/news/us-news/trump-pulls-back-obama-era-protections-women-workers-n741041.

O’Shaughnessy, Sara and Naomi Krogman. “A Revolution Reconsidered? Examining the Practice of Qualitative Research in Feminist Scholarship”. *Signs: Journal of Women in Culture and Society* 37, no. 2 (2012): 493-520. https://doi.org/10.1086/661726.

Orifici, Adriana and Dominque Allen. “Expecting More: Rethinking the Rights and Protections Available to Pregnant Workers under the Fair Work Act 2009 (Cth)”. *Federal Law Review* 50, no. 4 (2022): 504-526. https://journals.sagepub.com/doi/epdf/10.1177/0067205X221126556.

Ortner, Sherry B. “Is Female to Male as Nature Is to Culture?” *Feminist Studies* 1, no. 2 (1972): 5–31. https://doi.org/10.2307/3177638.

Padma, T.V. “A Year Since Launch of Govt Scheme to Get Girls Into Science, What’s Happened?” *The Wire,* September 5, 2018. https://thewire.in/the-sciences/a-year-since-launch-of-govt-scheme-for-women-in-science-what-has-happened.

Pal, Leslie. “Chapter 11: Case Study Method and Policy Analysis”. In *Thinking Like a Policy Analyst: Policy Analysis as a Clinical Profession*, edited by Iris Geva-May, 227-258 New York: Palgrave Macmillan, 2005.

Palriwala, Rajni, and N Neetha. *India Research Report 3-The Care Diamond: State Social Policy and the Market*. UNRISD, February 2009. 1-48. https://www.unrisd.org/80256B3C005BCCF9/(httpAuxPages)/4177D0C917369239C1257566002EA0C7/$file/IndiaRR3.pdf.

Palriwala, Rajni. “The Spider’s Web: Seeing Dowry, Fighting Dowry”. In *Dowry: Bridging the Gap Between Theory and Practice*, edited by Tamsin Bradley, Emma Tomalin, and Mangala Subramaniam, 144–76. London: Zed Books, 2009.

Pande, Rekha. “The History of Feminism and Doing Gender in India”. *Revista Estudos Feministas* 26, no. 3 (2018): 1-17. https://doi.org/10.1590/1806-9584-2018v26n358567.

Panizzon, Debra, and Deborah Corrigan. “Innovation and Entrepreneurship as Economic Change Ages: The Role of STEM Education in Australia”. *XVII IOSTE Symposium* 12 (July 2016): 1–9. https://www.researchgate.net/publication/322244731_Innovation_and_entrepreneurship_as_economic_change_ages_The_role_of_STEM_education_in_Australia

Panizzon, Debra, Deborah Corrigan, Helen Forgasz, and Sarah Hopkins. “Impending STEM Shortages in Australia: Beware the “Smoke and Mirrors””. *Procedia - Social and Behavioral Sciences* 167 (January 2015). https://doi.org/10.1016/j.sbspro.2014.12.644.

Park, Lora E., Ariana F, Young, Jordan D, Troisi, and Rebecca T, Pinkus. “Effects of Everyday Romantic Goal Pursuit on Women’s Attitudes Toward Math and Science”. *Personality and Social Psychology Bulletin* 37, no. 9 (1 September 2011): 1259–73. https://doi.org/10.1177/0146167211408436.

Pawley, Alice, and Jordana Hoegh. “Exploding Pipelines: Mythological Metaphors Structuring Diversity-Oriented Engineering Education Research Agendas”. (June 2011): 1-21. https://peer.asee.org/exploding-pipelines-mythological-metaphors-structuring-diversity-oriented-engineering-education-research-agendas.

Perez, Caroline Criado. *Invisible Women: Exposing Data Bias in a World Designed for Men*. London: Chatto & Windus, 2019.

Pew Research Center. “Women and Men in STEM Often at Odds Over Workplace Equity”. January, 9 2018. http://www.pewsocialtrends.org/2018/01/09/women-and-men-in-stem-often-at-odds-over-workplace-equity/.

Pierce, Roger. *Research Methods in Politics - A Practical Guide*. Los Angeles: SAGE Publications: 2008.

Plantz, Kyle. “The #MeToo Movement Shook up Workplace Policies in Science”. *Science News*, December 20, 2018. https://www.sciencenews.org/article/metoo-movement-workplace-policies-science-2018-yir.

Press Trust of India. “Modi Govt Disbursed 27 Crore Mudra Loans To Women: Home Minister Amit Shah”. *Outlook India*, 6 June 2023. https://www.outlookindia.com/national/modi-govt-disbursed-27-crore-mudra-loans-to-women-home-minister-amit-shah-news-292532.

Professionals Australia. “Professionals Australia Releases Women in STEM Report”. Last Modified August 30, 2018. http://www.professionalsaustralia.org.au/blog/professionals-australia-releases-women-stem-report/.

Professionals Australia. *The Slower Track: Women in the STEM Professions Survey Report.* (Melbourne, 2015). http://www.professionalsaustralia.org.au/professional-women/wp-content/uploads/sites/48/2014/03/2015-Women-in-the-STEM-Professions-Survey-Report.pdf.

Professionals Australia. *Women in STEM in Australia.* Professionals Australia Women in STEM Position Paper, 2014. 1-7. http://www.professionalsaustralia.org.au/professional-women/wp-content/uploads/sites/48/2014/03/WOMEN_IN_STEM_v2.pdf.

Professions Australia. *All Talk: Gap Between Policy and Practice A Key Obstacle to Gender Equity in STEM.* (Melbourne, 2018). 1-56. http://www.professionalsaustralia.org.au/professional-women/wp-content/uploads/sites/48/2018/08/2018-Women-in-STEM-Survey-Report_web.pdf.

Prügl, Elizabeth and Jacqui True. "Equality Means Business? Governing Gender through Transnational Public-Private Partnerships". *Review of International Political Economy* 21, no.6 (2014): 1137-1169. https://www.tandfonline.com/doi/full/10.1080/09692290.2013.849277.

Pybus, Julie. "Singapore's Social Entrepreneurs Are Young - and Mostly Female". *Pioneers Post,* March 1, 2021. https://www.pioneerspost.com/news-views/20210301/singapore-s-social-entrepreneurs-are-young-and-mostly-female.

Quah, Jon. "Singapore: Towards a National Identity". *Southeast Asian Affairs* (1977): 207–19. https://www-jstor-org.proxy.library.adelaide.edu.au/stable/27908317?seq=1#metadata_info_tab_contents.

Raja, Tasneem. '"Gangbang Interviews" and "Bikini Shots": Silicon Valley's Brogrammer Problem". *Mother Jones*. April 26, 2012. https://www.motherjones.com/media/2012/04/silicon-valley-brogrammer-culture-sexist-sxsw/.

Rankin, Katherine. "Governing Development: Neoliberalism, Microcredit, and Rational Economic Woman". *Economy and Society* 30, no. 1 (2001): 18-37. https://www.tandfonline.com/doi/abs/10.1080/03085140020019070.

Real Play Coalition. "Design Your Own Car". Accessed May 27, 2021. https://www.realplaycoalition.com/uk/activities-for-kids/design-your-own-car/.

Real Play Coalition. "Stargazing". Accessed May 27, 2021. https://www.realplaycoalition.com/uk/activities-for-kids/stargazing/.

Rimmer, Susan Harris, and Marian Sawer. "Neoliberalism and Gender Equality Policy in Australia". *Australian Journal of Political Science* 51, no. 4 (1 October 2016): 742–58. https://doi.org/10.1080/10361146.2016.1222602.

Riordan, Primrose. "Women to STEM Imbalance in Major Projects". *The Australian*, October 12, 2018. https://www.theaustralian.com.au/national-affairs/women-to-stem-imbalance-in-major-projects/news-story/b90687d07a4b7f3198ceea66ba018223.

Roach, Catherine M. *Mother / Nature: Popular Culture and Environmental Ethics*. Bloomington: Indiana University Press, 2003. http://ebookcentral.proquest.com/lib/adelaide/detail.action?docID=151940.

Roberts, Adrienne. “The Political Economy of ‘Transnational Business Feminism’”. *International Feminist Journal of Politics* 17, no.2 (2014): 209-231. https://www.tandfonline.com/doi/full/10.1080/14616742.2013.849968.

Robertson, Adi. “Google Announces New Sexual Assault and Harassment Policies after Mass Protest”. *The Verge*. November 8, 2018. https://www.theverge.com/2018/11/8/18075780/google-sexual-assault-harassment-policy-sundar-pichai-walkout-changes.

Romero, Juan David. “Study Urges a Movement Away from Traditional STEM Pipelines to Embrace Diversity of STEM Educational Pathways”. *American Association for the Advancement of Science*, January 29, 2016. https://www.aaas.org/news/study-urges-movement-away-traditional-stem-pipelines-embrace-diversity-stem-educational.

Rosser, Sue V. “Using POWRE to ADVANCE”. In *Removing Barriers: Women in Academic Science, Technology, Engineering, and Mathematics*, 69–92. Bloomington: Indiana University Press, 2006.

Rosser, Sue V. *Academic Women in STEM Faculty: Views beyond a Decade after POWRE,* Cham: Springer International Publishing, 2017. https://doi.org/10.1007/978-3-319-48793-9_5.

Rowbotham, Jill. “Revamping the Effort to Shift the Data on Girls and STEM”. *The Australian*, March 7, 2021. https://www.theaustralian.com.au/nation/revamping-the-effort-to-shift-the-dial-on-girls-and-stem/news-story/b5cd8dd87ffaf03194dff0906ad3c410.

Ruppanner, Leah, and Sophie Squires. *The Future of Women @ Work*. The Policy Lab: The University of Melbourne, 2020. 1-17. https://arts.unimelb.edu.au/the-policy-lab/projects/women-at-work/the-future-of-women-@-work.

Russell-Kraft, Stephanie. “Will the Supreme Court Prevent Employees From Bringing Workplace Grievances Collectively?” *The Nation*. October, 3 2017. https://www.thenation.com/article/will-the-supreme-court-prevent-employees-from-bringing-workplace-grievances-collectively/.

Ryan, Charlotte and William Gamson. “The Art of Reframing Political Debates”, *Contexts* 5, no.1 (2006):13-18. https://www.jstor.org/stable/41802788.

Sadler, Denham. “Tech Jobs on the Rise in Australia”. *Information Age*, September 2, 2019. https://ia.acs.org.au/article/2019/tech-jobs-on-the-rise-in-australia.html.

Sahay, Sandeepa. “India’s National Education Budget for 2023-24”. *British Council*, 16 February 2023. https://opportunities-insight.britishcouncil.org/blog/india%E2%80%99s-national-education-budget-2023-24.

Sangwan, Navjot. “Loan Sharks Are Circling for Poor Indian Debtors Failed by Microfinance”. *The Guardian*, October 29 2018/ https://www.theguardian.com/global-development/2018/oct/29/loan-sharks-circling-poor-indian-debtors-failed-by-microfinance.

Sawer, Marian. “Australia: The Fall of the Femocrat”. In *Changing State Feminism*, edited by Joyce Outshoorn and Johanna Kantola, 20–40. London: Palgrave Macmillan UK, 2007. https://doi.org/10.1057/9780230591424_2.

SBS News. “Women in Science Ambassador Will Be Appointed to Inspire Schoolgirls”. *SBS News*, March 8 2018. https://www.sbs.com.au/news/women-in-science-ambassador-will-be-appointed-to-inspire-schoolgirls.

SBS News. “Women Leave STEM over Pay Gap, Study Finds”. *SBS News*, September 23, 2018. https://www.sbs.com.au/news/women-leave-stem-over-pay-gap-study-finds.

Schladebeck, Jessica. “U.S. Department of Labor Accuses Google of “Extreme” Gender Pay Discrimination”. *New York Daily News,* April 8, 2018. http://www.nydailynews.com/news/national/google-accused-extreme-gender-pay-discrimination-article-1.3033235.

Schmuck, Claudine. *Women in STEM Disciplines*, 13–24. Cham: Springer International Publishing, 2017. https://doi.org/10.1007/978-3-319-41658-8_2.

Schulte, Brigid. “Black and Latina Women Scientists Sometimes Mistaken for Janitors”. *Washington Post,* February 6, 2015. https://www.washingtonpost.com/news/local/wp/2015/02/06/black-and-latina-women-scientists-sometimes-mistaken-for-janitors/.

Science and Technology Australia. “Science Gender Pay Gap Too Wide and Job Insecurity Persists: New Report”, November 19, 2018. https://scienceandtechnologyaustralia.org.au/science-gender-pay-gap-too-wide-and-job-insecurity-persists-new-report/.

Scratch. “Scratch - Imagine, Program, Share”. Accessed May 24, 2021. https://scratch.mit.edu/.

Segar, Julia. “Under-Representation of Women on Governing Bodies: Women General Practitioners on Clinical Commissioning Groups in England”. *Journal of Health Services Research & Policy* 20, no. 4 (1 October 2015): 257–60. https://doi.org/10.1177/1355819614567912.

Seow, Joanna. “More Workers Can Opt for Flexible Work Arrangements: MOM Report”. *The Straits Times,* January 16, 2019. https://www.straitstimes.com/singapore/manpower/more-workers-can-opt-for-flexible-work-arrangements-mom-report.

Seymour, Susan. “Family Structure, Marriage, Caste and Class, and Women’s Education: Exploring the Linkages in an Indian Town”. *Indian Journal of Gender Studies* 2, no. 1 (March 1995): 67–86. https://doi.org/10.1177/097152159500200104.

Shah, Suhaila Zainal. “Overcoming the Challenges Women Face in the Wake of Covid-19 and Digital Disruption. *TODAY Online,* March 8, 2021. https://www.todayonline.com/commentary/overcoming-challenges-women-face-wake-covid-19-and-digital-disruption.

Sharma, Aradhana. *Logics of Empowerment: Development, Gender, and Governance in Neoliberal India*. Minnesota: Minnesota Press, 2008.

Shenoy-Packer, Suchitra. *India's Working Women and Career Discourses: Society, Socialization, and Agency*, Lanham: Lexington Books, 2014. http://ebookcentral.proquest.com/lib/adelaide/detail.action?docID=1767180.

Shopify. "Women Entrepreneurs We Love". Accessed November 26, 2021. https://www.shopify.com.au/blog/women-owned-businesses.

Sigelman, Matt. "Why the STEM Gap Is Bigger Than You Think". *LinkedIn*, April 28, 2016. https://www.linkedin.com/pulse/why-stem-gap-bigger-than-you-think-matt-sigelman/.

Silva, Marianny Jessica de Brito, Salomão Alencar de Farias, Michelle Kovacs Grigg, and Maria de Lourdes de Azevedo Barbosa. "Online Engagement and the Role of Digital Influencers in Product Endorsement on Instagram". *Journal of Relationship Marketing* 19, no. 2 (2 April 2020): 133–63. https://doi.org/10.1080/15332667.2019.1664872.

Simons, Helen. *Case Study Research in Practice*. London: SAGE Publications, 2009. http://ebookcentral.proquest.com/lib/adelaide/detail.action?docID=743724.

Simos, Martina. "Curious to Explore Science". *The Advertiser*, April 12, 2016, https://infoweb-newsbank-com.proxy.library.adelaide.edu.au/apps/news/document-view?p=AWNB&t=&sort=YMD_date%3AD&page=1&fld-base-0=alltext&maxresults=20&val-base-0=%22curious%20minds%22%20STEM%20girls%20Australia&docref=news/15C2FAEA71E4DB90.

Sindwani, Prerna. "India Tops the World in Producing Female Graduates in STEM But Ranks 19th in Employing Them". *Business Insider India*, February 28, 2020. https://www.businessinsider.in/careers/news/india-tops-the-world-in-producing-female-graduates-in-stem-but-ranks-19th-in-employing-them/articleshow/74117413.cms.

Singapore Business Federation. "SBF Launches the Singapore Women Entrepreneurs Network to Connect Women Entrepreneurs". Accessed November 2, 2021. https://www.sbf.org.sg/sbf-launches-the-singapore-women-entrepreneurs-network-to-connect-women-entrepreneurs.

Singapore Council of Women's Organisations. "Women's Charter". Accessed May 11, 2018. http://www.scwo.org.sg/resources/womens-charter/.

Singh, Nidhi. "Why It's Time to Embrace Workplace Flexibility". *Entrepreneur*, January 16, 2019. https://www.entrepreneur.com/article/326431.

Singh, Sajai, Lakshmi Ramachandran, Craig Ridder, and Jeffrey Hutchings. "Indian Maternity Benefit (Amendment) Act, 2017". *Pillsbury Law*, February 22, 2018. https://www.pillsburylaw.com/en/news-and-insights/indian-maternity-benefit-amendment-act-2017.html.

Society of Women Engineers. “Singapore Research Scientists and Engineers”. Accessed November 25, 2021. https://swe.org/research/2021/singapore-research-scientists-and-engineers/.

Soe, Louise, and Elaine K. Yakura. “What’s Wrong with the Pipeline? Assumptions about Gender and Culture in IT Work”. *Women’s Studies* 37, no. 3 (11 April 2008): 176–201. https://doi.org/10.1080/00497870801917028.

Soherwordi, Syed Hussain Shaheed. “Hindu Nationalism and the Political Role of Hindu Women: Ideology as a Factor”. *South Asian Studies* 28, no. 1 (2013): 39-54. http://proxy.library.adelaide.edu.au/login?url=https://www.proquest.com/scholarly-journals/hindu-nationalism-political-role-women-ideology/docview/1369670738/se-2?accountid=8203.

Soin, Kanwaljit. “Keynote Address”. In *Singapore Women’s Charter: Roles, Responsibilities and Rights in Marriage*, edited by Theresa W Devasahayam, xiii–xxiv. Singapore: ISEAS Publishing, 2011.

Spencer, Stephanie. *Gender, Work and Education in Britain in the 1950s*. Houndmills: Palgrave Macmilan, 2005.

Srinivasan, Padma, and Gary R. Lee. “The Dowry System in Northern India: Women’s Attitudes and Social Change”. *Journal of Marriage and Family* 66, no. 5 (2004): 1108–17.

Srivastava, Suresh. “Equal Remuneration For Men and Women”. *Journal of the Indian Law Institute* 32, no. 1 (January 1990): 82–92. https://www.jstor.org/stable/43951301.

Stanford Graduate School of Business. “Better If It’s Man-Made?” Accessed March 2, 2020. https://www.gsb.stanford.edu/insights/better-if-its-man-made.

Stanford Social Innovation Review. “Microfinance Misses Its Mark”. Accessed July 1, 2019. https://ssir.org/articles/entry/microfinance_misses_its_mark.

Strijbosch, Karlien. “Single and the City: State Influences on Intimate Relationships of Young, Single, Well-Educated Women in Singapore”. *Journal of Marriage and Family* 77, no. 5 (2015): 1108–25. https://doi.org/10.1111/jomf.12221.

Sturmer, Jake. ‘Tokyo Medical University Apologises After Women Deliberately Marked Down to Limit Numbers”. *ABC News*, 8 August 2018. https://www.abc.net.au/news/2018-08-08/tokyo-university-apologises-for-rigging-marks-to-exclude-women/10086924.

Sturmer, Jake. “Japanese University Scandal Signals Broader Issue of Gender Inequality in Japan”. *ABC News*, November 9, 2018. https://www.abc.net.au/news/2018-11-09/gender-bias-at-tokyo-medical-university-not-isolated-case/10478764.

Subrahmanyan, Lalita. “Patrifocality and the Entry of Women into Science”. *Higher Education* 30 (1995): 1-15. https://doi.org/10.1007/BF01384050.

Subrahmanyan, Lalita. *Women Scientists in the Third World: The Indian Experience*, New Delhi: SAGE Publications, 1998.

Suliman, Adela. “Educated but Not at Work: Lack of Women in Middle East Workforce Hinders Growth”. *Reuters*, October 17, 2017. https://www.reuters.com/article/us-population-mideast/educated-but-not-at-work-lack-of-women-in-middle-east-workforce-hinders-growth-idUSKBN1CM1AC.

Sundar, K.R Shyam. “India’s Expert Committee on Minimum Wages – A Questionable Exercise?” *The Wire,* June 5, 2021. https://thewire.in/labour/indias-expert-committee-on-minimum-wages-a-questionable-exercise.

Sunter, Anne Beggs. “Rich Vein of Learning: An Historical Assessment of Ballarat’s Role in Australian Engineering Education”. *9th National Conference on Engineering Heritage: Proceedings*, (1998): 129-134, https://search.informit.org/doi/epdf/10.3316/informit.546616252043720.

Suri, Manveena. “Beyoncé, Couture and Palaces: India’s Growing Taste for Lavish Weddings”. *CNN Style*, February 3, 2019. https://www.cnn.com/style/article/india-wedding-culture/index.html.

Suseno, Yuliani, and Ling Abbott. “Women Entrepreneurs’ Digital Social Innovation: Linking Gender, Entrepreneurship, Social Innovation and Information Systems”. *Information Systems Journal* 31, no. 5 (2021): 717–44. https://doi.org/10.1111/isj.12327.

Swee-Hock, Saw. “Population Trends in Singapore, 1819-1967”. *Journal of Southeast Asian History* 10, no. 1 (1969): 36–49. https://www-jstor-org.proxy.library.adelaide.edu.au/stable/20067730?sid=primo.

Tan, Jolene. “Women’s Charter Should Be Family Charter”. *The Straits Times*, May 8, 2018. https://www.straitstimes.com/forum/letters-on-the-web/womens-charter-should-be-family-charter.

Tan, Theresa. “Marital Satisfaction for Women Fell during Circuit Breaker: Study”. *The New Paper*, May 27, 2021. https://www.tnp.sg/news/singapore/marital-satisfaction-women-fell-during-circuit-breaker-study.

Tan, Theresa. “Women in Singapore Less Satisfied with Their Marriages during and after Circuit Breaker: Study”. *The Straits Times*, May 26, 2021. https://www.straitstimes.com/singapore/women-in-singapore-less-satisfied-with-their-marriages-during-covid-19-pandemic-study.

Taylor, Chloe. “A Third of the World’s Female Entrepreneurs Face Gender Bias from Investors, HSBC Claims”. *CNBC*, October 3, 2019. https://www.cnbc.com/2019/10/03/hsbc-a-third-of-the-worlds-female-entrepreneurs-face-gender-bias.html.

Technology Decisions. “Funding to Boost STEM Opportunities for Women”. Accessed March 12, 2021. http://technologydecisions.com.au/content/it-management/news/funding-to-boost-stem-opportunities-for-women-1095983861.

TechSpirit. “Mahila E-Haat An Online Marketing Platform For Women Launched”. Accessed July 20, 2019. http://techspirit.in/mahila-e-haat-online-marketing-platform-women-launched/.

Teng, Amelia. “SkillsFuture, Four Years On”. *The Straits Times*, July 2, 2018. https://www.straitstimes.com/singapore/education/skillsfuture-four-years-on.

Teo, Tang Wee, and Leck Yeo. “Gender Studies of Science and Science Education in Singapore”. *Asian Women* 33 (1 September 2017): 1–21. https://doi.org/10.14431/aw.2017.09.33.3.1.

Teo, Youyenn. “Gender Disarmed: How Gendered Policies Produce Gender-Neutral Politics in Singapore”. *Signs* 34, no. 3 (2009): 533–58. https://doi.org/10.1086/593332.

Teoh, Karen M. *Schooling Diaspora: Women, Education, and the Overseas Chinese in British Malaya and Singapore, 1850s-1960s*. Oxford University Press, 2018. https://www-oxfordscholarship-com.proxy.library.adelaide.edu.au/view/10.1093/oso/9780190495619.001.0001/oso-9780190495619-chapter-7.

Tham, Yuen-C. “Review on Women’s Issues to Be Extended for More Input”. *The Straits Times*. January 17, 2021. https://www.straitstimes.com/singapore/politics/review-on-womens-issues-to-be-extended-for-more-input.

The Association of Academies and Societies of Sciences in Asia. *Women in Science and Technology in Asia.* The Korean Academy of Science and Technology, 2015. 1-192. https://nassl.org/wp-content/uploads/2016/01/AASSA_Report_Women_in_S_T_in_Asia.pdf.

The Clayman Institute for Gender Research. “Alignment with Gender Stereotypes Predicts Success in Tech”. Accessed November 5, 2018. https://gender.stanford.edu/news-publications/gender-news/alignment-gender-stereotypes-predicts-success-tech.

The Economic Times. “120 Startups Get Patents under Expedited Examination Process: DPIIT Secy”. *Economic Times*, April 26, 2019. https://economictimes.indiatimes.com/small-biz/startups/newsbuzz/120-startups-get-patents-under-expedited-examination-process-dpiit-secy/articleshow/69057960.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst.

The Economic Times. “69% of Indian Girls Pick STEM Courses: Mastercard Survey”. *The Economic Times,* February 15, 2017. http://tech.economictimes.indiatimes.com/news/people/69-of-indian-girls-pick-stem-mastercard-survey/57158194.

The Economic Times. “DST Launches Schemes for Women Scientists, Researchers in Science and Engineering”. *The Economic Times*, October 29, 2020. https://economictimes.indiatimes.com/news/science/dst-launches-schemes-for-women-scientists-researchers-in-science-and-engineering/articleshow/78931290.cms?from=mdr.

The Economic Times. “Faster Patents for Women, Small Business”. *Economic Times*, December 26, 2018. https://economictimes.indiatimes.com/small-biz/sme-sector/faster-patents-for-women-small-business/articleshow/67252078.cms.

The Economist. "Baby Strike". *The Economist,* May 25, 2019. https://www.proquest.com/docview/2229868174/abstract/252CC517BBE24C6CPQ/1?parentSessionId=R68TZEcgqnV5gOoxS9pPkYR1j98DTSq4YH1efYqiDJA%3D&accountid=8203

The Lee Kuan Yew School of Public Policy. "Foreign Domestic Workers in Singapore: Social and Historical Perspectives". Accessed November 8, 2019. https://lkyspp.nus.edu.sg/docs/default-source/case-studies/fdws_in_singapore.pdf?sfvrsn=2ac5960b_2.

The National Academies of Sciences, Engineering, and Medicine. *Transforming Trajectories for Women of Color in Tech.* Washington: The National Academies Press, 2021. 1-223. https://www.nap.edu/catalog/26345/transforming-trajectories-for-women-of-color-in-tech.

The Straits Times. "Gender Discrimination Costs Middle East and North Africa Region $779 Billion a Year: OECD". *The Straits Times*, October 11, 2017. https://www.straitstimes.com/world/europe/gender-discrimination-costs-middle-east-and-north-africa-region-779-billion-a-year-oecd.

The Straits Times. "New Award to Recognise Aspiring Women Entrepreneurs". *The Straits Times,* November 23, 2017. https://www.straitstimes.com/business/companies-markets/new-award-to-recognise-aspiring-women-entrepreneurs.

The Telegraph. "The Ultimate Business Cost Efficiency Guide". *The Telegraph*, June 16, 2021. https://www.telegraph.co.uk/business/ready-and-enabled/cost-efficiency/guide-for-businesses/.

The Times of India. "Only 14% of Indian Researchers Are Women; Science Seen as Male Profession". *The Times of India,* April 2, 2018. https://timesofindia.indiatimes.com/india/there-are-too-few-women-in-science/articleshow/63575929.cms.

The White House – Office of the Press Secretary. "Fact Sheet: The Equal Futures Partnership to Expand Women's Political and Economic Participation". September 24, 2012. https://obamawhitehouse.archives.gov/the-press-office/2012/09/24/fact-sheet-equal-futures-partnership-expand-women-s-political-and-econom.

The White House: Office of the Press Secretary. "Executive Order – Fair Pay and Safe Workplaces". Accessed November 13, 2018. https://obamawhitehouse.archives.gov/the-press-office/2014/07/31/executive-order-fair-pay-and-safe-workplaces.

The World Bank. "Population, Female – India". Accessed July 29, 2019. https://data.worldbank.org/indicator/SP.POP.TOTL.FE.IN?end=2017&locations=IN&start=1960&view=chart.

Thompson, Piers, Dylan Jones-Evans, and Caleb Kwong. "Women and Home-Based Entrepreneurship: Evidence from the United Kingdom". *International Small Business Journal* 27, no. 2 (1 April 2009): 227–39. https://doi.org/10.1177/0266242608100492.

Tilak, Jandhyala B. G. *Education and Development in India.* Singapore: Springer, 2018. https://doi.org/10.1007/978-981-13-0250-3_7.

Tillin, Louise. “Does India Have Subnational Welfare Regimes? The Role of State Governments in Shaping Social Policy”. *Territory, Politics, Governance* (June 2021): 1–17. https://doi.org/10.1080/21622671.2021.1928541.

Times of India. “Government Must Review Maternity Act”. *Times of India,* June 26, 2018. https://timesofindia.indiatimes.com/blogs/toi-editorials/government-must-review-maternity-act/.

Timms, Michael, Katherine Moyle, Paul Weldon, and Pru Mitchell. ‘”Policy Insights: Challenges in STEM Learning in Australian Schools”. Issue 7, (Australian Council for Educational Research, May 2018.) https://research.acer.edu.au/cgi/viewcontent.cgi?article=1007&context=policyinsights.

Tukdeo, Shivali. *India Goes to School: Education Policy and Cultural Politics*. New Delhi: Springer India, 2019. https://doi.org/10.1007/978-81-322-3957-4_5.

Ukpere, Celestine Lugaye, Andre D. Slabbert, and Wilfred I. Ukpere. “Rising Trend in Social Media Usage by Women Entrepreneurs across the Globe to Unlock Their Potentials for Business Success”. *Mediterranean Journal of Social Sciences* 5, no. 10 (3 June 2014): 551.

UN Women. “Women in Informal Economy”. Accessed May 2, 2019. http://www.unwomen.org/en/news/in-focus/csw61/women-in-informal-economy.

UN Women. “Women in the Changing World of Work: Facts You Should Know”. Accessed May 2, 2019. http://interactive.unwomen.org/multimedia/infographic/changingworldofwork/en/index.html.

UNESCO. “Women Still a Minority in Engineering and Computer Science”. February 9, 2017. http://www.unesco.org/new/en/media-services/single-view/news/women_still_a_minority_in_engineering_and_computer_science/.

United Nations Conference on Trade and Development. *Empowering Women Entrepreneurs through Information and Communications Technologies: A Practical Guide* (New York and Geneva, 2014). https://unctad.org/system/files/official-document/dtlstict2013d2_en.pdf.

United Nations Development Programme – China. “Women in Science Can Change the World”. Accessed April 25, 2023. https://www.undp.org/china/blog/women-science-can-change-world.

University of Canberra. “From Girls to Men: Social Attitudes to Gender Equality in Australia – Survey Snapshot”. *50/50 by 2030 Foundation*, 2018. 1-64. www.broadagenda.com.au/wp-content/uploads/attachments/From-Girls-to-Men.pdf.

Urban, Rebecca. “Budget to Deliver STEM Boost For Women”. *The Australian*, March, 29 2019. https://www.theaustralian.com.au/federal-budget/budget-to-deliver-stem-boost-for-women/news-story/8c4f07111c1206e3cfd02f8bfdb0dd32.

US Department of Commerce. “Women in STEM: 2017 Update”. Accessed November 13, 2018. https://www.commerce.gov/news/fact-sheets/2017/11/women-stem-2017-update.

Van Cleaf, Kara. ““Of Woman Born” to Mommy Blogged: The Journey from the Personal as Political to the Personal as Commodity”. *Women’s Studies Quarterly* 43, no. 3/4 (2015): 247–64.

Venugopal, Rajesh. “Neoliberalism as Concept”. *Economy and Society* 44, no. 2, (2015): 165-187. https://doi.org/10.1080/03085147.2015.1013356.

Verick, Sher Singh. “Employment Policy to Promote the Participation of Women in the Indian Labour Force”. In *Employment Policy in Emerging Economies: The Indian Case,* edited by Elizabeth Hill and Amitendu Palit, 199-136. Oxon: Routledge, 2018.

Verma, Mimansa. “India’s No-Code Boom Is Ushering in a New Wave of Entrepreneurs”. *Quartz,* October 11, 2021. https://qz.com/india/2066451/indias-no-code-boom-is-ushering-in-a-new-wave-of-entrepreneurs/.

W3Schools. “W3Schools Online Web Tutorials”. Accessed March 5, 2020. https://www.w3schools.com/.

Wade, Anna Patty, Matt. ““They Know the Drill”: Women Happier Working from Home than Men”. *The Sydney Morning Herald*, October 27, 2020. https://www.smh.com.au/business/workplace/they-know-the-drill-women-happier-working-from-home-than-men-20201026-p568pw.html.

Wakabayashi, Daisuke, and Jessica Silver-Greenberg. “Facebook to Drop Forced Arbitration in Harassment Cases”. *The New York Times,* 10 November 2018. https://www.nytimes.com/2018/11/09/technology/facebook-arbitration-harassment.html.

Wakabayashi, Daisuke, and Katie Benner. “How Google Protected Andy Rubin, the “Father of Android””. *The New York Times,* October, 25 2018. https://www.nytimes.com/2018/10/25/technology/google-sexual-harassment-andy-rubin.html.

Wallon, Gerlind. “Aptitude or Attitude?” *EMBO Reports* 6, no. 5 (1 May 2005): 400–402. https://doi.org/10.1038/sj.embor.7400414.

Walker, Maggie, ed. *Social Research Methods: Fourth Edition.* Victoria: Oxford University Press, 1994.

WEConnect International. “Singapore Launch of the ‘Women Entrepreneurs Development Program’”. Accessed September 3, 2021.https://weconnectinternational.org/procter-gamble-and-weconnect-international-launch-the-women-entrepreneurs-development-program-to-support-womens-majority-owned-businesses-in-singapore/.

Weingarten, Elizabeth. ‘The STEM Paradox: Why Are Muslim-Majority Countries Producing So Many Female Engineers?” *Slate Magazine*, November, 9 2017.

https://slate.com/human-interest/2017/11/the-stem-paradox-why-are-muslim-majority-countries-producing-so-many-female-engineers.html.

Weinstock, Maia. “LEGO Adds More Women in Science to Its Lineup”. *Scientific American*, June 24, 2015. https://blogs.scientificamerican.com/voices/lego-adds-more-women-in-science-to-its-lineup/.

Westcott, Ben and Katie Hunt. “Most Singapore Foreign Workers Exploited, Survey Says”. *CNN*, December 4, 2017, https://www.cnn.com/2017/11/28/asia/singapore-domestic-helpers-maids/index.html.

White, Elizabeth H. “Purdah”. *Frontiers: A Journal of Women Studies* 2, no. 1 (1977): 31–42. https://doi.org/10.2307/3346105.

Whitehouse, Gillian, and Michelle Brady. “Editorial: New Social Inequalities and the Future of Work”. *Labour & Industry: A Journal of the Social and Economic Relations of Work* 29, no. 3 (3 July 2019): 238–42. https://doi.org/10.1080/10301763.2019.1679422.

Wiederkehr, Virginie, Virginie Bonnot, Silvia Krauth-Gruber, and Céline Darnon. “Belief in School Meritocracy as a System-Justifying Tool for Low Status Students”. *Frontiers in Psychology* 6 (July 2015): 1-10. https://doi.org/10.3389/fpsyg.2015.01053.

Williams, Joan C, Katherine W Phillips and Erika Hall. “Double Jeopardy? Gender Bias Against Women in Science”. The Center for WorkLife Law, 2014, https://worklifelaw.org/publication/double-jeopardy-gender-bias-against-women-of-color-in-science/.

Williams, Mary Elizabeth. “Men Aren’t Being Encouraged to Take Caring Jobs — and That’s Hurting Everyone”. *Salon*, March 28, 2021. https://www.salon.com/2021/03/28/women-are-being-encouraged-to-go-into-stem-fields-why-arent-we-pushing-for-more-men-in-heed-jobs/.

Williams, Melissa, and Mark Warren. “A Democratic Case for Comparative Political Theory”. *Political Theory* 42, no. 1 (February 2014): 26–57. https://doi.org/10.1177/0090591713507934.

Williams, Shawna. “The Year in #MeToo”. *The Scientist Magazine*, December 27, 2018. https://www.the-scientist.com/news-opinion/the-year-in--metoo-65244.

Williams, Wendy M., and Stephen J. Ceci. “Introduction: Striving for Perspective in the Debate on Women in Science”. In *Why Aren’t More Women in Science?* edited by Wendy M. Williams and Stephen J. Ceci, 1–24. Washington: American Psychological Association, 2007.

Wilson, Kalpana. “Towards A Radical Re-Appropriation: Gender, Development and Neoliberal Feminism”. *Development and Change* 46, no.4 (2015): 803-832. https://doi.org/10.1111/dech.12176.

Winn, Joan. “Women Entrepreneurs: Can We Remove the Barriers?” *International Entrepreneurship and Management Journal* 1, no. 3 (2005): 381-397. https://link-springer-com.proxy.library.adelaide.edu.au/article/10.1007/s11365-005-2602-8.

Women in STEMM Australia. “Free Membership”. Accessed May 28, 2021. https://womeninscienceaust.org/free-registration/.

Wood, Jonathan. “A Woman’s Place”. *Materials Today* 8, no. 3 (1 March 2005): 1. https://doi.org/10.1016/S1369-7021(05)00719-4.

Workplace Gender Equality Agency. “Future of Work: Where Technology and Work Intersect”. Last Modified May 12, 2020. https://www.wgea.gov.au/publications/future-of-work-technology-and-work.

Workplace Gender Equality Agency. “Lowest Ever National Gender Pay Gap Good Result But Still More to Be Done”. Accessed October 2, 2023, https://www.wgea.gov.au/newsroom/gender_pay_gap_media_release_Aug_2023.

World Economic Forum. "3 Things to Know about Women in STEM". Accessed 23 November 2021. https://www.weforum.org/agenda/2020/02/stem-gender-inequality-researchers-bias/.

World Economic Forum. “Exam Anxiety Could Be Holding Women Back in the Sciences”. Accessed November 22, 2018. https://www.weforum.org/agenda/2017/11/want-to-keep-more-women-in-science-theres-a-simple-solution/.

World Economic Forum. “Gender Equality in STEM Is Possible. These Countries Prove It”. Accessed July 9, 2019. https://www.weforum.org/agenda/2019/03/gender-equality-in-stem-is-possible/.

World Economic Forum. “In Countries with Higher Gender Equality, Women Are Less Likely to Get STEM Degrees”. Accessed December 3, 2018. https://www.weforum.org/agenda/2018/02/does-gender-equality-result-in-fewer-female-stem-grads/.

World Economic Forum. “Why Aren’t Venture Capitalists Backing Female Entrepreneurs?” Accessed August 31, 2021. https://www.weforum.org/agenda/2016/05/why-arent-venture-capitalists-backing-female-entrepreneurs/.

World Economic Forum. *The Global Gender Gap Report 2016*. Cologny/Geneva, 2016. 1-391. https://www3.weforum.org/docs/GGGR16/WEF_Global_Gender_Gap_Report_2016.pdf.

WP Beginner. “How to Choose the Best Website Builder in 2021 (Compared)”. Last Modified December 15, 2021. https://www.wpbeginner.com/beginners-guide/how-to-choose-the-best-website-builder/.

Wynarczyk, Pooran, and Chloe Renner. “The “‘Gender Gap’” in the Scientific Labour Market”. In *International Investigation into ‘Gender Inequality’ in Science, Technology, Engineering and Mathematics (STEM),* edited by Pooran Wynarczyk, 41–54. Bradford: Emerald Publishing Limited, 2006. http://ebookcentral.proquest.com/lib/adelaide/detail.action?docID=285511.

Xinghui, Kok. “Singapore’s Domestic Workers Vulnerable to Forced Labour: Report”. *South China Morning Post*, January 15, 2019. https://www.scmp.com/news/asia/southeast-asia/article/2182233/singapores-foreign-domestic-workers-vulnerable-forced.

Yang, Tiantian, and María del Carmen Triana. “Set Up to Fail: Explaining When Women-Led Businesses Are More Likely to Fail”. *Journal of Management* 45, no. 3 (1 March 2019): 926–54. https://doi.org/10.1177/0149206316685856.

Yeo, Stefanie. “Ups, Downs, and Advice from 3 Women Entrepreneurs in Singapore”. *Tech in Asia*, March 11, 2021. https://www.techinasia.com/ups-downs-advice-3-women-entrepreneurs-singapore.

Yeoh, Brenda, Shirlena Huang, and Katie Willis. “Global Cities, Transnational Flows and Gender Dimensions: The View from Singapore”. *Tijdschrift Voor Economische En Sociale Geografie* 91, no. 2 (May 2000): 147–58. https://doi.org/10.1111/1467-9663.00102.

Yi, Seow Bei. “Women in Singapore Earn 13% Less than Men as Gender Wage Gap Persists: Glassdoor”. *The Straits Times*, March 27, 2019. https://www.straitstimes.com/business/economy/women-in-singapore-earning-13-less-than-men-as-gender-wage-gap-persists-glassdoor.

Zillman, Claire. “India’s Extraordinary New Maternity Leave Could Work Against Women”. *Fortune*, March 31, 2017. http://fortune.com/2017/03/30/us-maternity-leave-india-downside/.