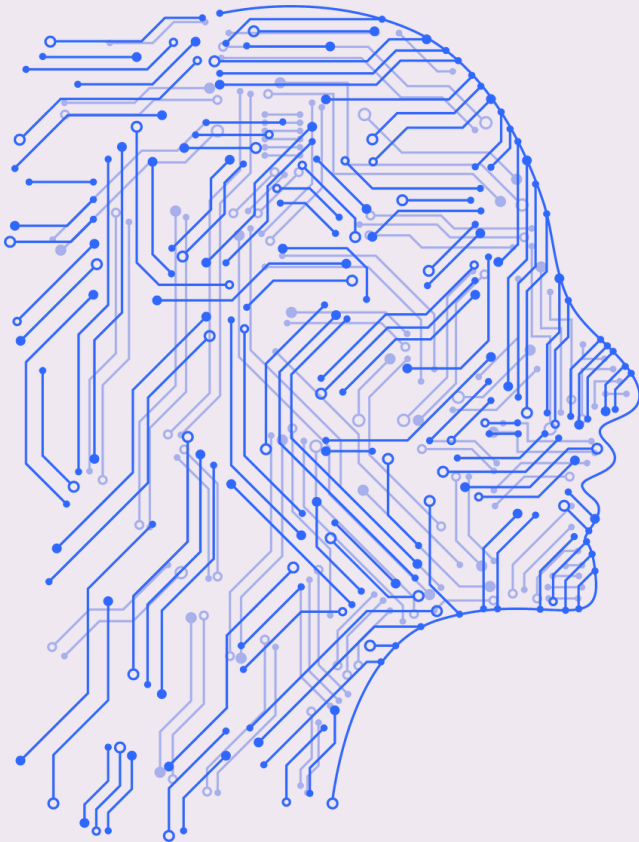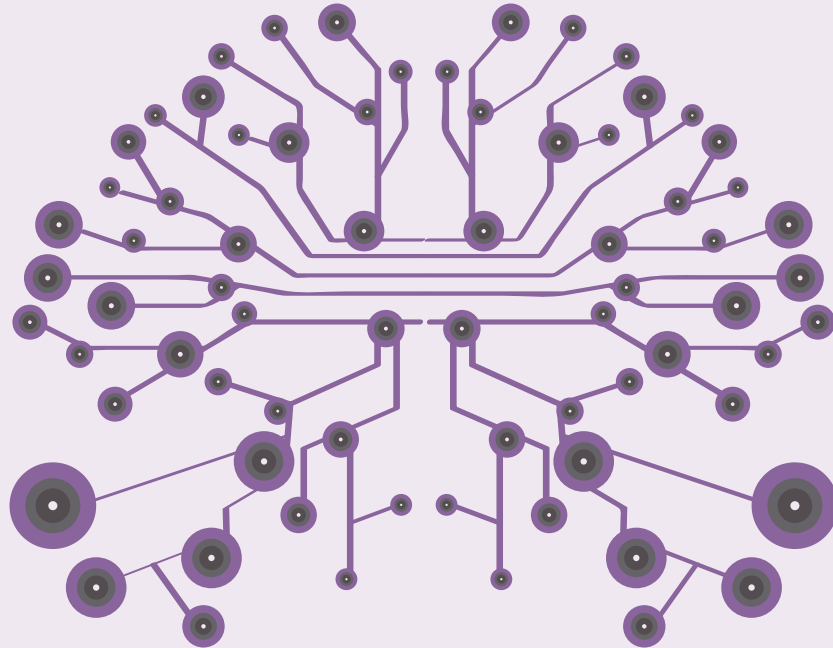# The Future of Work How Artificial Intelligence will impact working women in Queensland

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Author's note

Abstract

The employment of women in Queensland stands to be uniquely impacted by artificial intelligence. On one hand, occupations that are traditionally dominated by women such as healthcare and teaching are predicted not to be impacted by AI in any meaningful way. Conversely, there are also occupations dominated by women that stand to be almost entirely replaced by AI. There are also vital implications for women in the lack of representation in AI roles, which results in AI could discriminate on the basis of gender and race.

A brief history of women & AI

There is a rich history of women working in science and technology that often goes unacknowledged in discussions about the development of our modern technology.

Computer programming was originally considered to be 'women's work' following the advent of electronic computing after the Second World War.[1] The word 'computer' originally referred to highly skilled female workers that coordinated between scientists and the machines that calculated their formulas.[2] Much of current computational labour is also performed by women and individuals of the global south.[3] While it is difficult to quantify the impact that the lack of knowledge around women's achievements in science and technology has on the employment choices of women today, it is important to acknowledge that despite any historical and structural barriers, women have always been part of the technological history leading up to artificial intelligence.

Artificial intelligence & women's work

Artificial intelligence is defined in its simplest terms as the use of data and algorithms to create more efficient decision-making.[4] The field of artificial intelligence is, much like other areas of science and technology, an area of employment that is predominantly occupied by men. The World Economic Forum estimated in 2018 that women hold only 22% of world-wide AI positions.[5] A separate study found that only 12% of machine learning researchers are women.[6] It begs the question why there are so few women working in the field AI. Unfortunately, there is little research why women do not work in AI, however the trends in STEM generally can be extrapolated into AI.

[1] Young, E., Wajcman, J. & Sprejer, L. (2023) Mind the gender gap: inequalities in the emergent professions of artificial intelligence (AI) and data science. New Technology, Work and Employment, 1–24. https://doi.org/10.1111/ntwe.12278
[2] Mosseri, S, Cooper, R and Foley, M. (2020) The future of work and gender: Insight paper, WGEA Commissioned Research Paper, University of Sydney, Sydney, Australia.
[3] Ibid.
[4] What Is Ai? (24 April 2023) McKinsey & Company <https://www.mckinsey.com/featured-insights/mckinsey-explainers/what-is-ai#/>
[5] Kumar, Shailendra and Sanghamitra Choudhury, 'Gender and Feminist Considerations in Artificial Intelligence from a Developing-World Perspective, with India as a Case Study' (2022) 9 Humanities and Social Sciences Communications.
[6] Ibid.

Female employment in information technology sector is plagued by what is referred to as the 'leaky pipeline,' which references the phenomenon in which that women's participation in those roles decreased by age as they move up the career ladder.[7] A range of causes have been identified for these high attrition rates, including (but not limited to) a dominant male culture, lack of female support networks, long and inflexible working hours clashing with care duties, the gender pay gap, and low chances of career advancement.[8] Women's participation in ICT careers has actually dropped across the globe in recent decades. In the EQUALS report on AI, over 40% of technical workers in STEM responding to their survey cited unfair treatment as the reason they left their employer.[9]

The lack of female participation in STEM (and AI roles by extension) can be attributed at least in part, to the entrenchment of gender norms that start as early as childhood. Research shows that children classify jobs as male and female by as early as age 6.[10] By age 8, girls beginning limiting their career aspirations and by age 13 rule out careers that do not fit with gender stereotypes. At ages 16-17, 60% of girls aspire to work in jobs stereotypically held by women.[11] In Australia, women make up only 36% of enrolments in university STEM courses, 27% of the workforce across all STEM industries and just 23% of senior management in STEM-qualified industries are women.[12] This reflects the research that when women participate in male-dominated occupations, they are often concentrated in the lower-paying and lower-status subfields (Reskin & Roos, 1990). As women have begun to enter certain technological subdomains in recent years, such as front-end development, these fields have started to lose prestige and experience salary drops (Broad, 2019; Posner, 2017).[13] Meanwhile, men are flocking to the new (prestigious and highly remunerated) data science and AI subspecialities.[14]

The case for involving women in the design and implementation of AI is simple – it is a "question of how the world we live in is designed and for whom."[15]

[7] Gomez-Herrera, Estrella; Köszegi, Sabine T. (2022) : A gender perspective on artificial intelligence and jobs: The vicious cycle of digital inequality, Bruegel Working Paper, No. 15/2022, Bruegel, Brussels.

[8] Girl Geek Guide, Submission to Department of Industry, Science and Resources, Diversity in STEM Review: let's talk solutions (2023) 11.

[9]Monica Barbovschi et al 'Taking stock: Data and Evidence on Gender Equality in Digital Access, Skills and Leadership' (Report of EQUALS Research Group, led by the United Nations University) 125.

[10] Above 10.

[11] Ibid.

[12] Department of Industry, Science and Resources, 'The state of STEM gender equity in 2022' (News article) <https://www.industry.gov.au/news/state-stem-gender-equity-2022>

[13] Young, E., Wajcman, J. & Sprejer, L. (2023) Mind the gender gap: inequalities in the emergent professions of artificial intelligence (AI) and data science. New Technology, Work and Employment, 1–24.

[14] Ibid.

[15] Ibid.

Bias in AI

On 10 November 2019, the New York Times reported a husband a credit limit twenty times that of what his wife's was, despite having the same income, expenses, debt and a slightly better credit score than her husband about an algorithm that gave.[16] Algorithmic Justice League founder Joy Buolamwini found that the share of input images on which various facial recognition algorithms were based consisted of 80% images of white persons and 75% male faces. As a result, the algorithms had a high accuracy of 99% in detecting male faces.[17] However, the system's ability to recognize black women was significantly lower at only 65% of the time.[18]

The Berkeley Haas Centre for Equity, Gender and Leadership tracks the publicly available instances of bias in AI systems.[19] Their analysis found that 4.2% (59 systems) demonstrate gender bias, with 25.7% (34 systems) exhibiting both gender and racial bias. [20] Research has found that some AI-based decision-making systems work better for certain groups of people over time, thus perpetuating inequalities in society by learning through biased outcomes.

For instance, researchers discovered that gender disparity was perpetuated by Facebook advertisements' targeted job posting algorithms in which female applicants failed to see the job advertisements of companies that predominately hired male applicants.[21] Likewise, the careers platform LinkedIn, had an issue where highly-paid jobs were not displayed as frequently for searches by women as they were for men because of the way its algorithms were written.[22]

[16] Neil Vigdor, 'Apple Card Investigated After Gender Discrimination Complaints' New York Times (online, 10 November 2019) <https://www.nytimes.com/2019/11/10/business/Apple-credit-card-investigation.html>.
[17] Carmen Neithammer, 'AI Bias Could Put Women's Lives At Risk – A Challenge For Regulators' (online, 2 March 2020) <https://www.forbes.com/sites/carmenniethammer/2020/03/02/ai-bias-could-put-womens-lives-at-riska-challenge-for-regulators/?sh=7aa5f848534f>.
[18] Ibid.
[19] Located at https://docs.google.com/spreadsheets/d/1eyZZW7eZAfzlUMD8kSU30IPwshHS4ZBOyZXfEBiZum4/edit#gid=1838901553
[20] Geneieve Smith & Ishita Rustagi, 'When Good Alogrithms Go Sexist: Why and How to Advance AI Gender Equity' Stanford Social Innovation Review (online, 31 March 2021) < https://ssir.org/articles/entry/when_good_algorithms_go_sexist_why_and_how_to_advance_ai_gender_equity>.
[21] Teodorescu, Mike & Morse, Lily & Awwad, Yazeed & Kane, Gerald. (2021). Failures of Fairness in Automation Require a Deeper Understanding of Human-ML Augmentation. MIS Quarterly. 45. 1483-1500. 10.25300/MISQ/2021/16535.
[22] Ayesha Nadeem et al, 'Gender bias in AI-based decision-making systems: a systematic literature review' (2022) 26 Australasian Journal of Information Systems, 7.

The initial users of the site's job search function were predominantly male for these high-paying jobs so it just ended up proposing these jobs to men – thereby simply reinforcing the bias against women. One study found a similar issue with Google, still present in translate today (see screenshot inset).
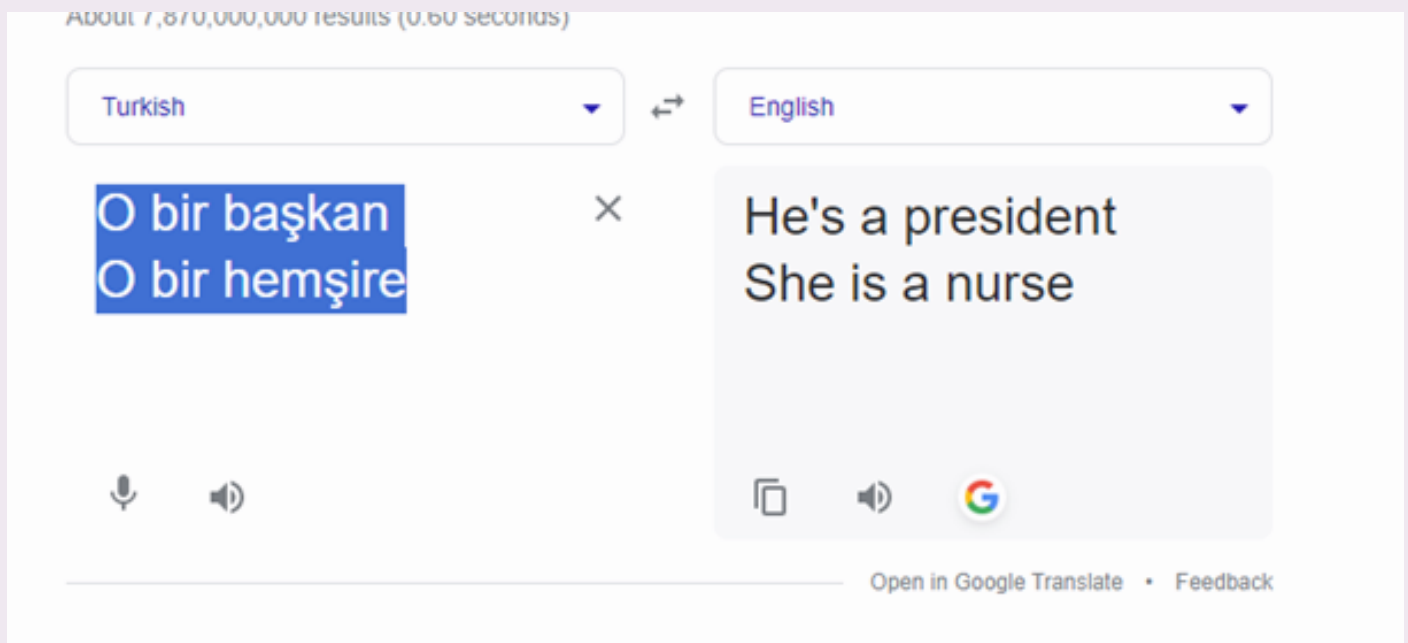
Turkish is a gender-neutral language).[23] Research confirms that the lack of gender diversity in the design of AI-based decision-making systems that create 'blind spots.'[24] Given the estimated impact of AI on employment in the future, it is important to make sure that bias is addressed before it results in discriminatory impact.

[23] Ibid.
[24] Ayesha Nadeem et al, 'Gender bias in AI-based decision-making systems: a systematic literature review' (2022) 26 Australasian Journal of Information Systems, 7.

The impact of AI on employment

The estimate for how many jobs will be impacted by AI vary. A CSIRO report commissioned by the Queensland Government estimates that 36% of the Queensland Workforce are at risk of disruption and automation of the economy over the coming 20 years.[25] The estimated impact in Australia-wide is 10%[26] to 40%.[27] Estimates that 70% of the manufacturing workforce in Queensland is at risk over the coming 20 years.[28] Mining, accommodation and food services, construction, wholesale trade and transport, postal and warehousing are all industries containing high risk occupations. Technology will substantially automate tasks within these jobs while also creating new jobs. The workforces face considerable transition challenges. By comparison, healthcare, professional services and education have a lower risk of automation, with less than 33% of jobs impacted.[29]
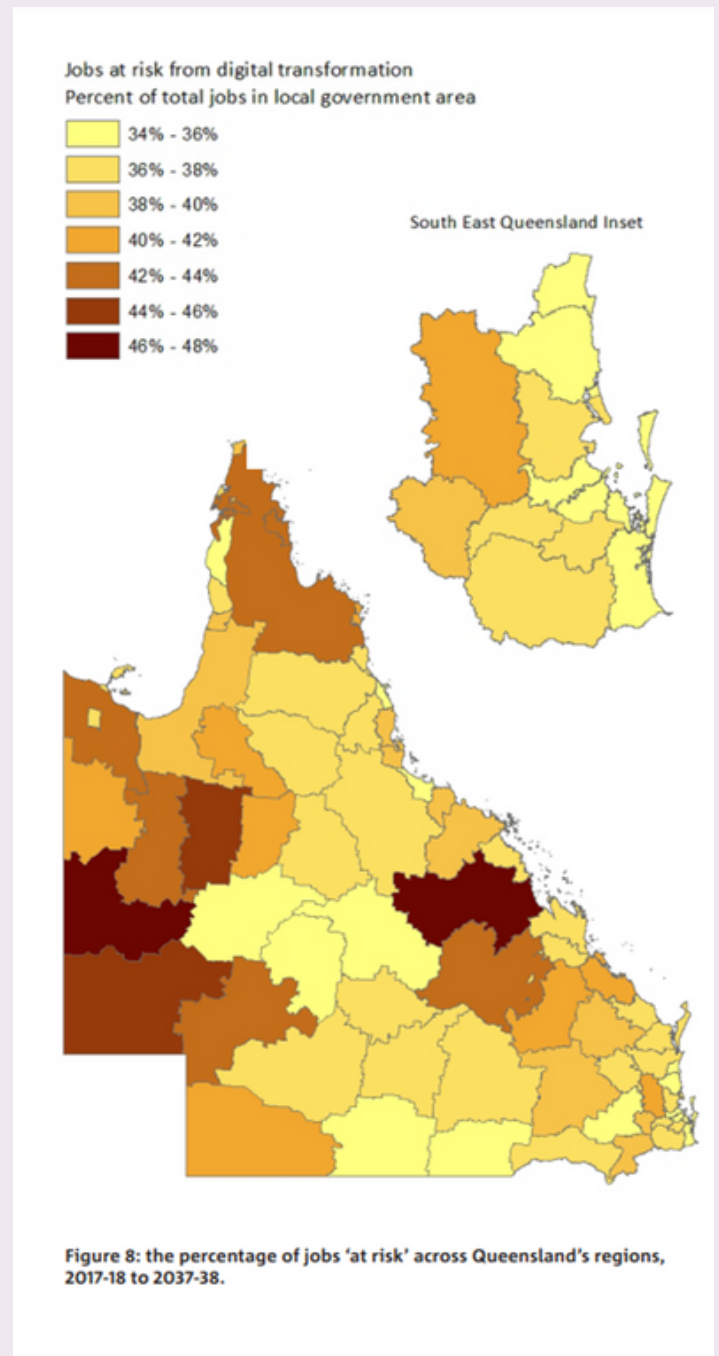
[25] Hajowicz et al, The innovation imperative: Risks and opportunities for Queensland over the coming decades of economic and technological transformation (A report by CISO Data 61 for the Queensland Government Department of Innovation, Tourism, Industry Development and the Commonwealth Games. Brisbane, Australia, 2018) 18.
[26] David Baeue. 'AI is disrupting Australian Industries' skills pipeline' (Blog Post, 29 August 2023)
[27] OECD, 'Employment outlook 2023: Artificial intelligence and jobs. An urgent need to act' (Web page)
[28] Above 22, 19.
[29] Ibid.

Jobs at risk from digital transformation
Percent of total jobs in local government area

34% - 36%
36% - 38%
38% - 40%
40% - 42%
42% - 44%
44% - 46%
46% - 48%

South East Queensland Inset

Figure 8: the percentage of jobs 'at risk' across Queensland's regions, 2017-18 to 2037-38.

Hajkowicz SA, Neale N, Cameron L, Horton J, Naughtin C, Bratanova A, Sauer K, 2018. The innovation imperative: Risks and opportunities for Queensland over the coming decades of economic and technological transformation, accessed 8 December 2023 < https://www.csiro.au/en/news/all/news/2018/august/the-innovation-imperative>

Australia has some of the most gender segregated occupations, as well as some of the most gendered division of labour among OECD member countries.[30] Less than half of Australian industries have gender-balanced workforces (at least 40 per cent women and 40 per cent men).[31] Gendered occupations have persisted over the past 20 years, with the proportion of women in traditionally female-dominated industries increasing.In Queensland, women make up the vast majority of administrative and clerical workers (78%) yet remain underrepresented in traditionally male-dominated occupations and industries, particularly in science, technology, engineering, mathematics, building and construction.[32]

Benefits of artificial intelligence on women's employment

Some of the occupations with the highest risks of automatability (e.g. data entry keyers; paralegals and legal assistants; bookkeeping, accounting, and auditing clerks; models, demonstrators, and product promoters; tellers; receptionists, secretaries and administrative assistants; hosts and hostesses in restaurants, lounges, and coffee shops) have very high female employment—while some others amongst the lowest automatability scores also have high female employment (registered nurses; preschool and kindergarten teachers; meeting, convention, and event planners; maids and housekeeping cleaners; hairdressers, hairstylists, and cosmetologists; occupational therapists; dietitians and nutritionists).[33] Unfortunately, feminised occupations consistently suffer from insufficient pay and high levels of insecurity (England, 2005; Piasna and Drahokoupil, 2017; García-Mainar, Montuenga and García-Martín, 2018).[34] Thus, it might be said that women have the potential for significant employment gains, but in relatively lower paying jobs. At the other end of the spectrum – high-value, high-growth jobs in science, technology, engineering and math (STEM) have proven difficult for women to break into in large numbers due to persistent social norms that challenge their entry and success in these fields (Charles,2017; Sassler et al., 2017; Malmström et al., 2018).[35] Until such gender barriers are addressed, STEM is likely to remain male dominated. There are also barriers for women upskilling in the event that their jobs are automated or replaced by AI.

[30] Women's Economic Equality Taskforce, A 10-year plan to unleash the fully capacity and contribution of women to the Australian Economy, (2023) 57.
[31] Ibid.
[32] Queensland Government, 'Queensland Women's Strategy 2016-21' (2016) 11.
[33] David Peetz and Georgina Murray, 29(1) 'Women's employment, segregation and skills in the future of Work' (29 (1) Labour & Industry: a journal of the social and economic relations of work, 6 February 2019) 24.
[34] Mosseri et al, The future of work and gender (Insight paper, 2020), 4.
[35] Ibid.

If entry level roles are automated at the rate expected, the question then becomes how will workers of the future get the experience and knowledge required in order to progress in their careers? If law firms are able to automate the work of what has been traditionally junior lawyers, how will those lawyers build the skills to become senior practitioners? Even where automation has occurred in present-day, such as in the airline industry, pilots still need to know how to manually fly planes, and over-reliance or misunderstanding of autopilot has been the cause of accidents.[36] Nancy Altobello, EY's global head of talent, says she expects technology to eat into much of the routine work that EY's nearly 65,000 annual hires complete during their first years at the firm. Entry-level employees will likely have to handle more complex work earlier in their careers. Training programs won't have to teach them the automated processes, but they will need to identify and teach skills that they would have learned by doing manual processes repeatedly.[37]

The training crisis

A recent study by Google and consulting firm AlphaBeta found Australian workers will, on average, need to increase time spent learning new skills by 33% over their lifetime and that job tasks will change 18% per decade.[38] The need to upskill is primarily because digital technology (including AI) will shift the workforce skills demand profile. A solution to the jobs lost has been education, but when offered, these initiatives tend to target only the most highly skilled workers to maximize returns (OECD, 2019).[39] As a result, those most at risk of automation – precarious and low-skilled workers – are the least likely to access and participate in ongoing training (Cooper, 2019). [40]

[36] Kessler, Sarah, 'Technology Is Setting Us up for a Training Crisis', Quartz (17 July 2017) <https://qz.com/1028532/technology-is-setting-us-up-for-a-training-crisis>
[37] Ibid.
[38] Hajkowicz et al, Artificial intelligence: Solving problems, growing the economy and improving our quality of life (CISRO Report Commissioned by the Australian Government, 2019), 54.
[39] Above 29, 4.
[40] Ibid.
[41] Ibid.

The training crisis is particularly acute for women. Women are more likely than men to be in low-skilled and precarious jobs that do not offer employer-funded training, and they are more likely to be time poor – and thus less able to pursue self-initiated training – due to their disproportionate burdens in the realm of unpaid work (Wajcman, 2008; AWWF, 2017; Piasna and Drahokoupil, 2017; McKinsey Global Institute, 2019).[41] In many low- and middle-income countries, reskilling for the digital age is even more difficult for women due to obstructed access to mobile phones and the internet. Unless gender issues are directly addressed, researchers have argued that automation will entrench gender work inequalities.

Accessibility is also an issue when considering the training crisis. The 2019 Digital Inclusion Index provides some insights into the scope of the digital gender divide in Australia.[42] Compared to men, women score lower across all three measured dimensions of digital inclusion; access, affordability and digital ability.[43] Furthermore, digital inclusion scores are substantially lower for Australians who are low-income, unemployed, without tertiary education, Indigenous, disabled, older, and living in rural areas, highlighting the need for an intersectional response to the digital gender divide.[44] Taken together, this lack of representation and diversity in ICT education, employment, skills and innovation mean that women often cannot influence the very technologies that are shaping their lives.[45]

Conclusion & Recommendations

Women in Queensland stand to be uniquely impacted by artificial intelligence – some women may see their occupation disappear, while others will see their profession change and adapt to AI. There is clearly however, a risk that women will be left behind if participation in AI roles is not increased, and if structural reforms are not considered for how a future workforce will be trained to mitigate the job losses that will occur because of automation and artificial intelligence.

[42]Professor Jo Barraket et al, Measuring Australia's Digital Divide: The Australian Digital Inclusion Index 2019' (Report by RMIT University and Swinburne University of Technology, Melbourne commissioned by Telstra, 2019)
[43] Ibid.
[44] Ibid.
[45] Ibid.

As the impact of bias in AI will have real-world discriminatory impact, it is important that systematic barriers to women's involvement in AI roles are removed and that best practices are implemented to reduce bias in AI. The Australian government has released its interim response to the "Safe and responsible AI in Australia" discussion paper commissioned by the Department of Industry, Science and Resources.[46] While the response does discuss bias, it does not specifically refer to gender or the impact bias will have on women and marginalised groups. This paper has illustrated that failure to properly consider a gendered perspective on AI will result in real-world consequences. However, there are some recommended best practices for curbing bias in artificial intelligence and encouraging women to enter AI jobs. The Harvard Business review recommends the following four best practices for machine-learning teams to avoid gender bias:[47]

- Ensure diversity in the training samples (e.g. use roughly as many female audio samples as males in your training data);
- Ensure that humans labeling the audio samples come from diverse backgrounds;
- Encourage machine-learning teams to measure accuracy levels separately for different demographic categories and to identify when one category is being treated unfavorably.
- Solve for unfairness by collecting more training data associated with sensitive groups. From there, apply modern machine learning de-biasing techniques that offer ways to penalize not just for errors in recognizing the primary variable, but that also have additional penalties for producing unfairness.

We can also increase women's participation in AI (and STEM generally) by:[48]
- Encouraging students' technology in years 11 and 12 by offering bonus points for completing digital and other technology subjects and applying for technology related courses;
- Improve diversity and inclusion data capture across STEM industries so that participation can be easily disaggregated; and
- Partner with women led education, training and communities of practice in STEM through the provision of annual, stable funding.

[46] Department of Industry, Science and Resources, Safe and Responsible AI in Australia consultation (Interim response paper, January 2024).
[47] Josh Feast, '4 Ways to Address Gender Bias in AI' (2019) Harvard Business Review.
[48] Above 10.

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