I'd blush if I could

CLOSING GENDER DIVIDES IN DIGITAL SKILLS THROUGH EDUCATION

EQUALS
GLOBAL PARTNERSHIP

United Nations
Educational, Scientific and
Cultural Organization

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This publication was prepared by UNESCO for the EQUALS Skills Coalition, one of three coalitions that comprise the EQUALS partnership.

EQUALS is a global partnership of governments and organizations dedicated to promoting gender balance in the technology sector by championing equality of access, skills and leadership for women and men alike.

The Skills Coalition, Access Coalition, Leadership Coalition and a transversal Research Group release knowledge products periodically, organize competitions and funds, and take actions in countries and internationally to advance EQUALS's mission.

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A dedicated working group composed of digital skills and gender experts guided the development of the content.

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About this publication

The title of this publication borrows its name from the response given by Siri, a female-gendered voice assistant used by hundreds of millions of people, when a human user would tell 'her', "Hey Siri, you're a bi***."

Although the AI software that powers Siri has, as of April 2019, been updated to reply to the insult more flatly ("I don't know how to respond to that"), the assistant's submissiveness in the face of gender abuse remains unchanged since the technology's wide release in 2011.

Siri's 'female' obsequiousness – and the servility expressed by so many other digital assistants projected as young women – provides a powerful illustration of gender biases coded into technology products, pervasive in the technology sector and apparent in digital skills education.

This publication seeks to expose some of these biases and put forward ideas to begin closing a digital skills gender gap that is, in most parts of the world, wide and growing.

Today, women and girls are 25 per cent less likely than men to know how to leverage digital technology for basic purposes, 4 times less likely to know how to programme computers and 13 times less likely to file for a technology patent. At a moment when every sector is becoming a technology sector, these gaps should make policy-makers, educators and everyday citizens 'blush' in alarm.

The publication explains the role gender-responsive education can play to help reset gendered views of technology and ensure equality for women and girls.

The publication has three parts: a policy paper and two think pieces.

The **POLICY PAPER** outlines the persistence and severity of the digital skills gender gap, provides a rationale for interventions, and makes recommendations to help women and girls develop strong digital skills through education.

THINK PIECE 1 explains the ICT gender equality paradox, UNESCO's finding that countries with the highest levels of gender equality such as those in Europe also have the lowest proportions of women pursuing advanced degrees in computer science and related subjects. Conversely, countries with low levels of gender equality such as those in the Arab region have the highest proportions of women completing advanced technology degrees.

THINK PIECE 2 examines how AI voice assistants projected as young women perpetuate harmful gender biases. It offers recommendations to ensure that the continued proliferation of digital assistants does not widen gender divides.

The think pieces are intended to complement the policy brief, but also function as stand-alone products.

The EQUALS Skills Coalition hopes that the three outputs, considered collectively, shine new light on the persistence of digital gender divides and, more importantly, inform education interventions to help women and girls cultivate the digital skills they need to thrive in life, learning and work.

Acknowledgements

This publication is part of a project on digital skills development for girls and women that was conceived and developed by Saniye Gülser Corat, Director of the Division for Gender Equality at UNESCO, and Norman Schraepel, Policy Adviser at the German Agency for International Cooperation (GIZ), within the framework of the EQUALS global partnership for gender equality in the digital age.*

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Rebecca Kraut co-authored the Policy Paper 'Rationales and recommendations for gender-equal digital skills education'. Han Ei Chew co-authored Think Piece 1 on 'The ICT gender equality paradox' and led the quantitative analysis, with support from Hiromichi Katayama, Mantas Sekmokas and Yemon Sung. Jennifer Breslin and Rachel Pollack contributed to Think Piece 2 on 'The rise of female-gendered AI and its troubling repercussions'.

The overarching work was overseen by Saniye Gülser Corat and Elspeth McOmish.

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* EQUALS is a multi-stakeholder partnership that aims to create a global movement whereby women and girls are equal participants in the technology revolution. It is hosted by the International Telecommunication Union, under the leadership of Doreen Bogdan-Martin.

POLICY PAPER

RATIONALES AND RECOMMENDATIONS FOR GENDER-EQUAL DIGITAL SKILLS EDUCATION

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INTRODUCTION

Digital skills and competencies have moved from optional to essential.

In today's technology-saturated societies, the ability to leverage digital technology is increasingly indispensable to an individual's well-being, on the same plane of necessity as numeracy and literacy. Without an ability to control technology, people risk being controlled by it, or isolated from local, national and global communities.

Against this backdrop, education systems are trying to ensure equitable, inclusive and high-quality digital skills education and training. These efforts carry special urgency because digital skills open pathways to further learning and skills development. Indeed, today it would be difficult to name two more powerful engines for lifelong learning than knowing how to read and write, and how to harness the power of digital technology and navigate the internet.

Nevertheless, the record on digital skills education is grim and abundant: Women and girls are being left behind. Globally, digital skills gender gaps are growing – despite at least a decade of national and international efforts to close them.

In response to this problem, this policy paper, produced by UNESCO for the EQUALS Skills Coalition, aims to:

1. outline the persistence and severity of the digital skills gender gap;
2. provide a rationale for interventions; and
3. set out recommendations, grounded in real-world examples, to help women and girls develop and strengthen digital skills.

While the content is intended for a broad audience, the reader the authors have foremost in mind is an individual working to justify, plan and implement digital skills interventions targeting women and girls in contexts where gender divides are greatest, whether a senior policy-maker in a Ministry of Education, a representative of a non-governmental organization (NGO), or a community leader.

To support this reader, the paper is organized into three chapters that reflect its three objectives:

CHAPTER 1 delineates the extent and depth of the problem, providing evidence that business-as-usual approaches to digital skills education and training are unlikely to narrow existing digital skills gender gaps and may exacerbate them further.

The text gives readers global context to the problems they are facing in local and national contexts.

CHAPTER 2 answers the often-ignored question of why digital skills matter for women and girls. It explains the many ways in which the problem outlined in Chapter 1 is, in fact, a problem. While many readers may consider this self-evident (of course girls need digital skills!), this section attempts to marshal arguments that are often overlooked or underemphasized. The chapter details the necessity of investments to bridge digital skills gaps across gender lines.

The text helps readers justify the expenditure of local, national and international resources for interventions.

CHAPTER 3 synthesizes large bodies of literature to offer recommendations for interventions. It attempts to answer the muddy question of how to address the problem explained in Chapter 1. While all approaches must be tailored for specific contexts and no solution is a panacea, this section gives advice to policy-makers and others involved in the design and implementation of gender-responsive and gender-transformative digital skills programmes.

The text proposes interventions that can be tailored for different contexts to close digital skills gender gaps.

The EQUALS Skills Coalition considers this paper a living document that can be updated to make it an ever-more-effective elaboration of the problem to be solved (CHAPTER 1); the rationale for solving it (CHAPTER 2); and, most vitally, strategies for how to solve it (CHAPTER 3). The Coalition and the wider EQUALS Partnership will produce follow-up work that builds on the findings, arguments and recommendations put forth here.

This work is important and timely. Gender equality will remain elusive until all people – men and women, boys and girls – learn how to use technology to thrive in the digital age.

> Today it would be difficult to name two more powerful engines for lifelong learning than knowing how to read and write, and knowing how to harness the power of digital technology and navigate the internet.

CHAPTER 1

Understanding the digital skills gender gap

Supporting publication

Taking Stock: Data and Evidence on Gender Equality in Digital Access, Skills and Leadership (2019) complements information contained in this chapter. It is an output of the EQUALS Research Group.

The sections in this chapter aim first to define digital skills and describe the work that has been accomplished thus far to create an internationally comparable digital skills framework. The chapter goes on to explain the severity of the digital skills gender gap and present evidence that, rather than narrowing, the gap is in fact widening. It further describes how the gender gap in digital skills is quickly surpassing the gender gap in digital access. Later sections explore the cultural roots of the skills gap and the effect of stereotypes on girls' self-confidence in their digital skills. The text goes into detail about the digital skills gender gap in secondary and tertiary education and the labour market. The chapter ends with a discussion of the gender equality paradox in information and communication technology (ICT), a phenomenon discovered by the EQUALS Skills Coalition that is the subject of Think Piece 1 contained in this publication.

DEFINING DIGITAL SKILLS

Numerous national and international organizations, including the International Labour Organization, the International Telecommunications Union (ITU) and UNESCO, have worked to define what is meant by digital literacy. Because digital literacy skills are a specific target in the Sustainable Development Goals (SDGs) and mentioned explicitly in Indicators 4.4.1 and 4.4.2 of SDG 4 (the education goal), UNESCO and the Global Alliance to Monitor Learning (GAML) – the organization responsible for reporting on progress towards SDG 4 – have developed a Digital Literacy Global Framework.[1] The Framework is based on a review of more than 40 digital literacy frameworks used at country, regional and international levels, and builds most notably on the work of the European Commission's Digital Competence Framework for Citizens, also known as DigComp – the most widely recognized regional framework to date.[2] UNESCO defines digital literacy broadly as 'the ability to access, manage, understand, integrate, communicate, evaluate and create information safely and appropriately through digital devices and networked technologies for participation in economic and social life'.[3] To flesh out exactly what this means, the framework contains seven competence areas (adding to DigComp's five), each with underlying subcompetences.

It is still not clear how countries will use this framework to report on progress towards the SDG indicators. Like reading and writing, digital literacy should be understood as a continuum of skills, and proficiency levels need to be well-defined to facilitate measurement. The Broadband Commission identified three tiers of skill levels:

1. basic functional skills that enable access and engagement with digital technologies;
2. generic skills that allow for meaningful and beneficial use; and
3. higher-level skills that facilitate the use of digital technologies in empowering and transformative ways.[4]

The DigComp 2.1 framework goes into more detail, outlining and providing examples of eight proficiency levels, ranging from foundational to highly specialized, which cut across three aspects (complexity of tasks, autonomy and cognitive domain).[5]

In an effort to facilitate monitoring of progress, the European Union has developed instruments to approximate skill levels based on 'accomplished activities'.[6] For example, to gain insights into problem-solving proficiency with ICT, the EU survey asks respondents if they have in the past three months: 'transferred files between

Digital skills form the backbone of two SDG 4 indicators

4.4.1: The proportion of youth and adults with information and communications technology (ICT) skills, by type of skill

4.4.2: The percentage of youth and adults who have achieved at least a minimum level of proficiency in digital skills

Image 1:

Digital Literacy Global Framework

Source: UNESCO

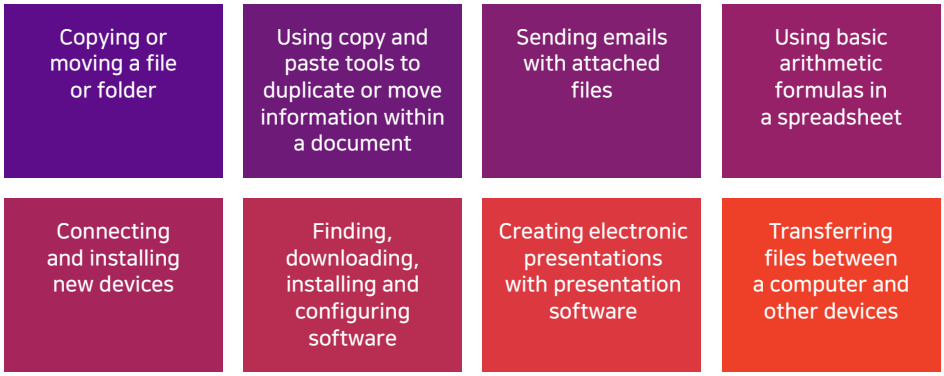
COMPETENCE AREA	COMPETENCES
DEVICES AND SOFTWARE OPERATIONS	Physical operations of digital devices Software operations in digital devices
INFORMATION AND DATA LITERACY	Browsing, searching and filtering data, information and digital content Evaluating data, information and digital content Managing data, information and digital content
COMMUNICATION AND COLLABORATION	Interacting through digital technologies Sharing through digital technologies Engaging in citizenship through digital technologies Collaborating through digital technologies Netiquette Managing digital identity
DIGITAL CONTENT CREATION	Developing digital content Integrating and re-elaborating digital content Copyright and licences Programming
SAFETY	Protecting devices Protecting personal data and privacy Protecting health and well-being Protecting the environment
PROBLEM-SOLVING	Solving technical problems Identifying needs and technological responses Creatively using digital technologies Identifying digital competence gaps Computational thinking
CAREER-RELATED COMPETENCES	Operating specialized digital technologies for a particular field Interpreting and manipulating data, information and digitial content for a particular field

computers or other devices', 'installed software and applications (apps)', or 'changed settings of any software, including operational system or security programmes'. Responses to these questions are used to attribute a basic or above-basic level to the individual. The ITU has proposed other indicators and potential instruments to measure progress towards SDG Indicator 4.4.1,[7] but a broader and more robust set of indicators and instruments are needed to capture the range of skills that comprise digital literacy.

Image 2:

Digital Skills Indicators

Source: ITU



While UNESCO has been drafting international comparable indicators, there is global recognition that digital literacy is highly contextual. In acknowledgement of this fact, GAML developed a pathway mapping methodology to help countries, sectors, groups and individuals craft strategies and plans for advancing their own digital literacy goals, based on the needs and priorities of their specific country and economic sector contexts.[8] The methodology entails using case examples from different sectors (e.g. agriculture or e-government) to identify the difference between baseline skills and target skills, allowing stakeholders to customize their digital literacy plans and indicators to address their specific context. Guidance on the successful use of this methodology and the Digital Literacy Global Framework is expected to grow as countries engage with measurement and begin to develop their own digital literacy pathways.

THE SEVERITY AND PERSISTENCE OF THE DIGITAL SKILLS GENDER GAP

While improved monitoring of digital skills will help hold governments accountable for progress and reveal opportunities for education and training, existing data are unambiguous about the severity of current gender gaps.[9] Worldwide, women are less likely to know how to operate a smartphone, navigate the internet, use social media and understand how to safeguard information in digital mediums – abilities that underlie innumerable life and work tasks and are relevant to people of all ages. The gap is apparent from the lowest skill proficiency levels, such as using apps on a mobile phone, to the most advanced skills like coding computer software to support the analysis of large data sets. According to cross-national skills assessments, women in numerous countries are 25 per cent less likely than men to know how to leverage ICT for basic purposes, such as using simple arithmetic formulas in a spreadsheet.[10] Further along the skills spectrum, the divides grow wider. UNESCO estimates that men are around four times more likely than women to have advanced ICT skills such as the ability to programme computers.[11] At the frontiers of technology, the gap becomes an ocean: Across G20 countries just 7 per cent of ICT patents are generated by women,[12] and the global average is even lower, at 2 per cent.[13] Recruiters for technology companies in Silicon Valley estimate that the applicant pool for technical jobs in artificial intelligence (AI) and data science is often less than 1 per cent female.[14] Also, while the gender gap in digital skills is evident across regional boundaries and income levels, it is more severe for women who are older, less educated, poor, or living in rural areas and developing countries.[15] Thus the digital skills gap intersects with, and is compounded by, issues of poverty and educational access.

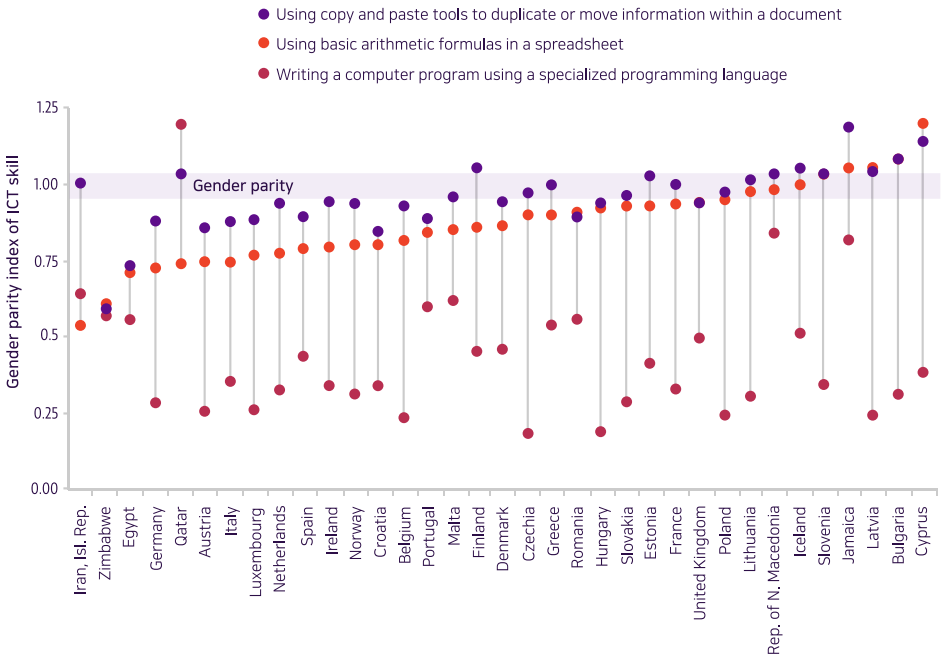
Digital skills gaps appear to be growing, despite at least two decades of interventions to move closer to gender equality. As the EQUALS Research Group has noted, 'gender divides widen as technologies get more sophisticated and expensive and enable more transformational uses and impacts'.[16] Global data from the ITU show that the gender

Image 3:

Gender gaps grow as digital tasks become more complex

Gender parity index among adults who performed a computer-related activity in the previous 3 months

Source: ITU



gap in internet user penetration rates actually increased between 2013 and 2017, from 11 per cent to 11.6 per cent worldwide, and from 29.9 per cent to 32.9 per cent in the least developed countries,[17] with the largest gaps in parts of South Asia and sub-Saharan Africa.[18] Reflecting this global trend, a 2018 European Commission study showed that women's enrolment in ICT-related studies has declined in the EU since 2011, even as related job opportunities have increased dramatically.[19]
In the United Kingdom, women currently hold just 12 per cent of the programming and software development jobs held by ICT professionals, down from 15 per cent a decade earlier.[20] In the United States, the percentage of female computer and information science majors has dropped steadily over the past 30 years and today stands at just 18 per cent, down from 37 per cent in the mid-1980s.[21] Similar declines have occurred throughout Latin America and the Caribbean as well as in numerous high-income countries including Australia, New Zealand and the Republic of Korea.[22]
What these data show is that the education and training of the past 20 years has been – and continues to be – gender-imbalanced. The digital space is becoming more male-dominated, not less so.

THE ACCESS DIVIDE VS THE SKILLS DIVIDE

In recent years, due to the rapidly declining price of connectivity and hardware, skills deficits have eclipsed barriers of access as the primary contributor to the digital gender divide. For years, this divide was assumed to be symptomatic of technical challenges: The thinking went that women would catch up with men when the world had cheaper devices and lower connectivity prices, due to the limited purchasing power and financial independence of women compared with men. While the cost of ICT access remains an urgent and salient issue (and is the focus of the EQUALS Access Coalition), this challenge is surpassed by educational

> Women were 1.6 times more likely than men to report lack of skills as a barrier to internet use.

gaps. For instance, the gender gap in internet penetration is around 17 per cent in the Arab States and the Asia and Pacific region,[23] whereas the gender gap in ICT skills is as high as 25 per cent in some Asian and Middle Eastern countries.[24] Today billions of people have access to affordable devices and broadband networks, but do not have the requisite skills to take advantage of this technology to improve their lives. Brazil is illustrative: In this country, lack of skills – rather than cost of access – was found to be the primary reason low-income groups are not using the internet.[25] A similar pattern was identified in India, where lack of skills and lack of perceived need for the internet were the primary limiting factors across all income groups.[26] In cross-national surveys, lack of understanding, interest or time was more commonly cited than affordability or availability as the reason for not using the internet, even in countries such as Colombia, where subscription prices were highest relative to average income.[27] While skills deficits prevent both men and women from using digital technologies, they tend to be more severe for women. In a study conducted across 10 low- and middle-income countries, women were 1.6 times more likely than men to report lack of skills as a barrier to internet use.[28] Women are also far more likely to report that they do not see a reason to access and use ICT.[29] Interest and perception of need are closely related to skills, as people who have little experience with or understanding of ICTs tend to underestimate their benefits and utility.

GENDER DISPARITIES ACROSS SKILL LEVELS

Women are less likely to know how to leverage devices and internet access to their full potential, even when they do use digital technologies. In rural India, for example, a study found that the majority of women who owned mobile phones only knew how to answer calls; they could not dial numbers or read messages without assistance from their husbands, due to a lack of literacy and numeracy skills.[30] Research conducted across 25 countries found that adolescent boys with mobile phones used them for a wider range of activities, from playing games to accessing financial services online, while adolescent girls tended to use just the basic functionalities such as making phone calls and using the calculator.[31] Similar trends can be seen even in areas where internet access is near-universal. A survey of women in nine cities around the world revealed that although 97 per cent of women were using social media, only 48 per cent of them were expanding their networks, and only 21 per cent of internet-connected women had searched online for information related to health, legal rights or transport.[32] In some cities, less than one quarter of connected women had used the internet to look for a job. Women were also 25 per cent less likely than men to have used the internet to look for a job.

Image 4:

Men are more likely to use social media in many countries

Source: Pew Research

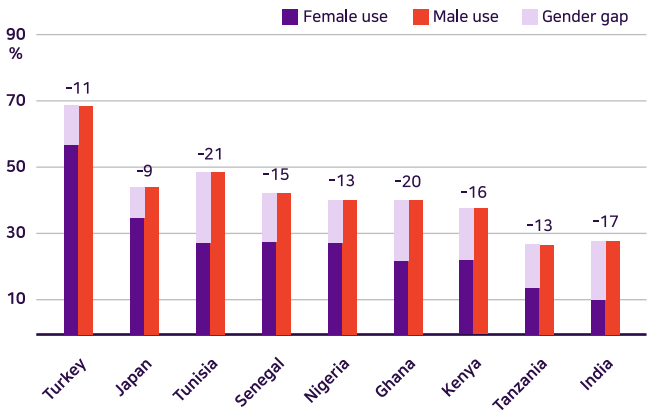


Image 5:

Access to higher education narrows the gender gap in internet access

Source:
World Wide Web Foundation

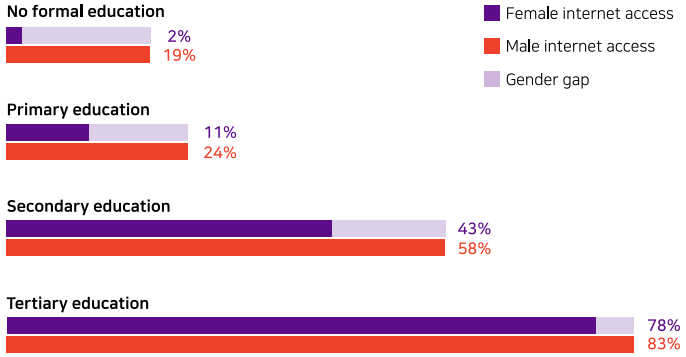


Image 6:

Gender gaps in internet use vary by location

Source:
World Wide Web Foundation

Kampala and Nairobi have **the widest gender gaps**, while **almost the same** number of men and women use the internet in Bogota, Manila and New Delhi.

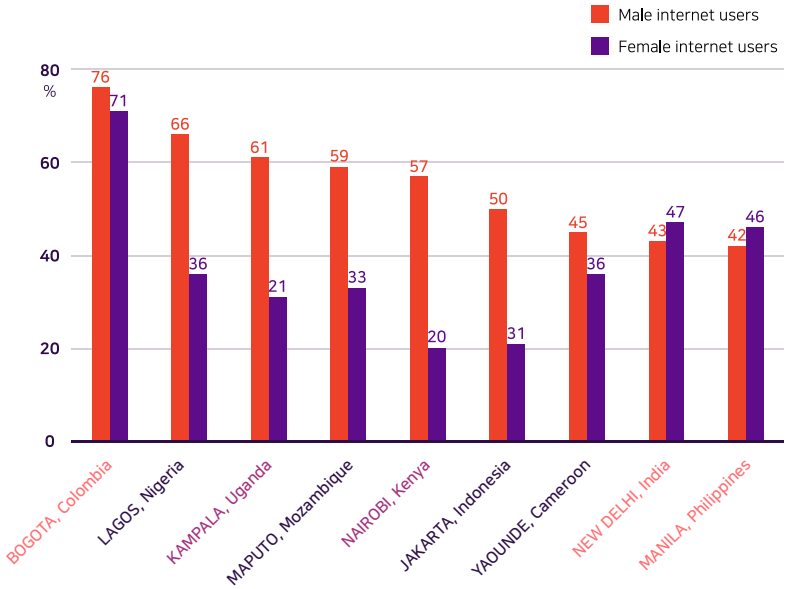
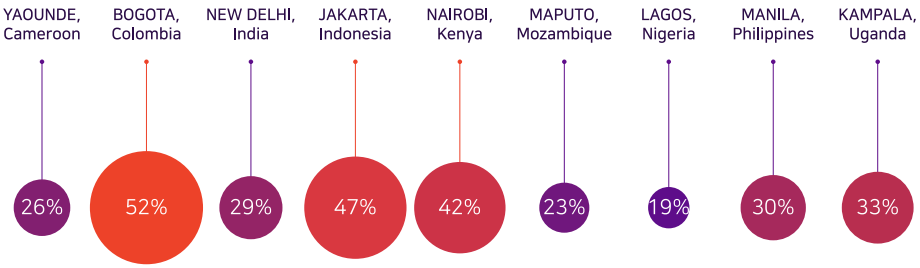


Image 7:

Percentage of female internet users who used the internet to look for a job

Source:
World Wide Web Foundation

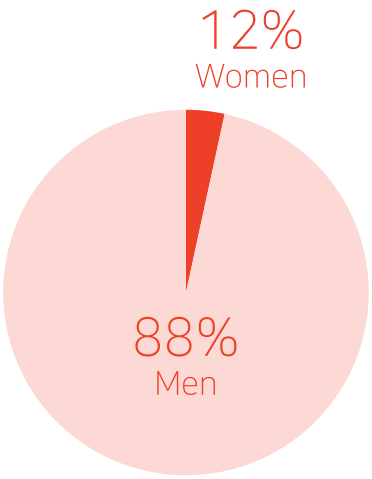


At the most sophisticated end of the skill spectrum, women are less likely to create content or use cutting-edge technology. A recent survey of undergraduate students in 29 countries found that early adopters of new technologies are overwhelmingly male.[33] Women are largely absent from the frontiers of technological innovation, where job growth is expected and which typically have the highest levels of compensation. At Google, for example, 21 per cent of technical roles are filled by women, but only 10 per cent of their employees working on machine intelligence are female.[34] Calculations based on the attendees of the world's top machine-learning conferences in 2017 indicate that only 12 per cent of the leading machine-learning researchers are female.[35] As men continue to dominate this space, the disparity only serves to perpetuate and exacerbate gender inequalities, as unrecognized bias is replicated and built into algorithms and artificial intelligence (a point that is developed in Think Piece 2 of this publication).

Image 8:

Gender balance in machine learning research

Source: Element AI



THE ROOTS OF THE DIGITAL SKILLS GENDER GAP

Ethnographic studies conducted at country and community levels indicate that patriarchal cultures often prevent women and girls from developing digital skills.[36] The social challenges can be myriad and overlapping. Women and girls may struggle to access public ICT facilities due to unsafe roads, limits on their freedom of movement, or because the facilities themselves are considered unsuitable for women. Additionally, women may not have the financial independence needed to purchase digital technology or pay for internet connectivity. Digital access, even when available, may be controlled and monitored by men or limited to 'walled gardens' containing only a limited selection of content – typically 'pink content' focused on women's appearances, dating, or their roles as wives or mothers.[37] Fears concerning safety and harassment – both online and offline – also inhibit many women and girls from benefiting from or even wanting to use ICTs.[38] In many contexts, women and girls face concerns of physical violence if they own or borrow digital devices – which in some cases leads to their using the devices in secret, making them more vulnerable to online threats and compounding the difficulty of gaining digital skills.[39]

The stereotype of technology as a male domain is pervasive in many contexts and appears to affect girls' confidence in their digital skills from a young age. Across OECD countries, for example, 0.5 per cent of girls aspire towards ICT-related careers at age 15, versus 5 per cent of boys.[40] This does not appear to have always been the case: At the advent of electronic computing following the Second World War, software programming in industrialized countries was largely considered 'women's work'. Managers of early technology firms deemed women well-suited for programming because of stereotypes characterizing them as meticulous and good at following step-by-step directions. Women, including many women of colour, flocked to jobs in the nascent computer industry because it was seen as more meritocratic than other fields.[41] One woman summed up the sentiment of the time, telling a reporter: 'The computer didn't care that I was a woman. . . . Most women had it much harder.'[42]

Image 9:

Prior to the 1980s, computer programming was commonly completed by women. The women in the photo are working with an ERA/UNIVAC 1103 computer in the 1950s.

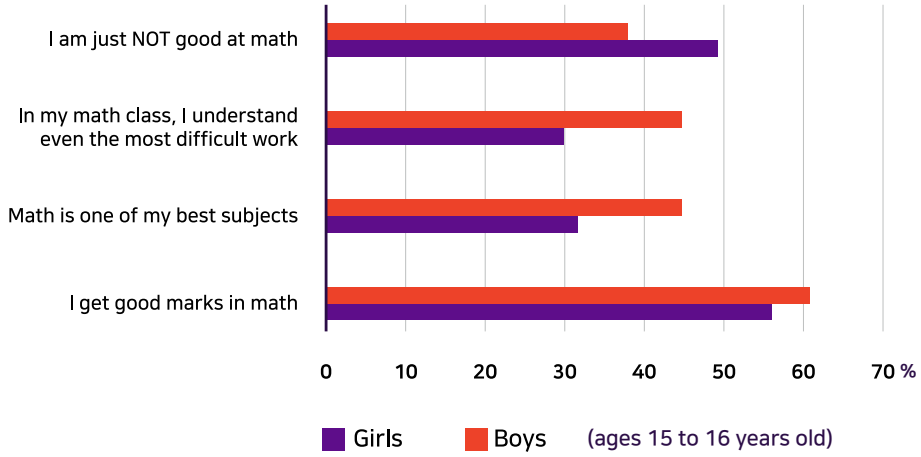
Source: New York Times

As computers became integrated into all aspects of life, it became clear that programmers wielded tremendous influence; women were pushed out and the field became more and more male-dominated.[43] Changes in how and when children learned to programme seem to have contributed to this decline.[44] Prior to the advent of personal computers, computer science students at the tertiary level generally started out on the same footing, with men and women being equally unlikely to have prior experience, due to the newness of the industry.[45] This changed once computers started making their way into homes. Research conducted in the USA in the 1990s showed that boys were more than twice as likely to have been given a computer by their parents than girls, and that parents were more likely to place a family computer in a son's room than a daughter's. Fathers were also far more likely to help and encourage boys in developing computer skills than they were to do the same for girls.[46] These changes corresponded with an increased demand for computer courses at universities, which made programmes more competitive and disadvantaged women because of their lack of prior experience.[47] As digital professions gained more attention in popular culture and media, the prevalence of men in the field further cemented the stereotype of programming as a male domain. Remarkably, the gendering of digital technology appears to have unfolded in a single generation.

Image 10:

Gender difference in students' self-concept

Source: OECD



The most compelling evidence of the impact of gender stereotypes around technology is the 'self-efficacy' gender gap, or the difference between girls' and boys' confidence and belief in their abilities. At the primary and lower secondary education levels, the gender gap in actual digital competence is either non-existent or reversed in favour of girls. Results from the most recently completed International Computer and Information Literacy Study (ICILS), a computer-based assessment of eighth grade students' skills conducted in 21 countries, showed that girls scored significantly higher than boys in all countries except Thailand and Turkey; and in these two countries, there was no statistically significant difference between female and male students' scores.[48] Yet despite demonstrating promising early performance, girls had lower levels of self-efficacy even when they outperformed or performed similarly to boys on measures of digital skills.[49] This discrepancy can be seen across countries

> Girls' self-efficacy scores – that is, their perceived as opposed to their actual abilities – for advanced ICT tasks were significantly lower than boys' in all countries.

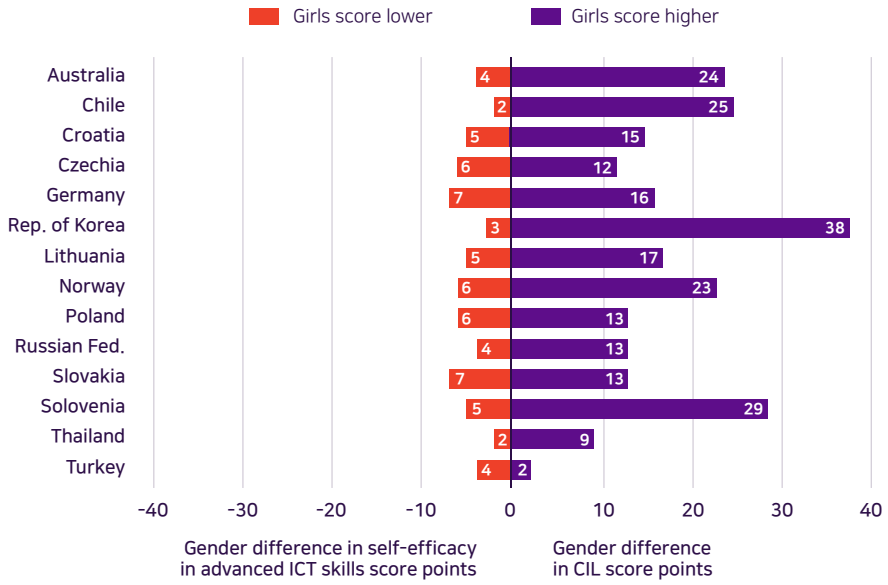
as early as the fifth grade and is particularly notable for more complex skills, such as locating specific information online or creating a multimedia presentation.[50] On the ICILS assessment, girls' self-efficacy scores – that is, their perceived as opposed to their actual abilities – for advanced ICT tasks were significantly lower than boys' in all countries.[51] While one recent study indicates that the self-efficacy gender gap may be diminishing in some high-income countries, the global trend still appears to be one of lower self-confidence and self-perceived digital skills for girls.[52]

Image 11:

Abilities and perceptions of abilities

Despite strong performance in computer and information literacy (CIL), girls do not have confidence in their ICT abilities.

Source: UNESCO



THE GAP WIDENS IN SECONDARY AND TERTIARY EDUCATION

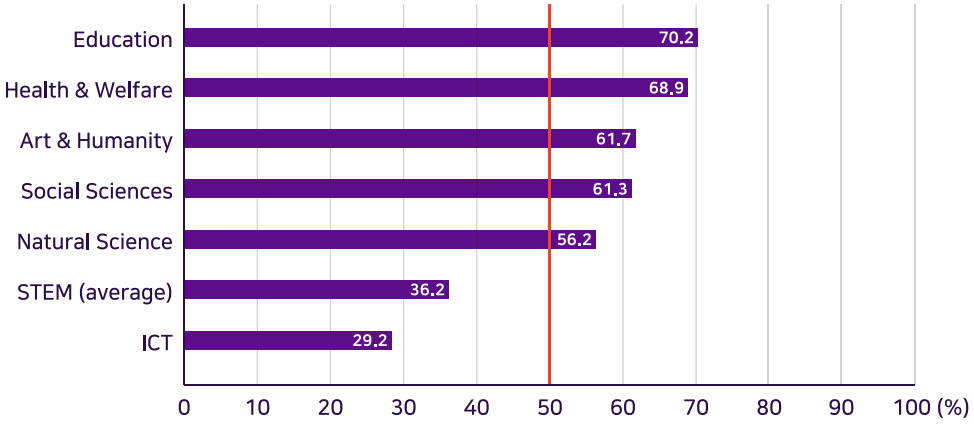
Changes in girls' self-efficacy around digital skills seem to begin at the upper primary levels and become more pronounced as girls enter and progress through secondary school. According to a study conducted in the United Kingdom (UK), for example, girls' and boys' interest in science, technology, mathematics and engineering (STEM) subjects are nearly equal at ages 10 and 11, with only a 3 per cent gap in favour of boys; by age 18, the interest gap increases to 14 per cent, possibly as a result of changes in perceived efficacy.[53] In the USA, girls in

secondary school are more than twice as likely to say they do not enjoy computing classes as girls in lower secondary school.[54] Unfortunately, this shift usually coincides with students' increased agency in choosing their subjects. While only limited global data are available on secondary school subject selection, particularly for ICT studies, evidence from cross-national assessments indicates that in most countries with data, the majority of students taking advanced-level STEM courses are boys.[55] Girls tend to opt out of STEM subjects earlier in secondary school than boys,[56] meaning that they are increasingly less likely to pursue technology-related studies as they move through secondary school and into higher education.

Image 12:

Global proportion of female enrolments by field of study

Source: EQUALS Research Group



> Girls' confidence drops slowly at first and then precipitously, so that by the time female students complete higher education, only a tiny fraction graduate with ICT degrees.

In many cases, the gender gap that appears during secondary school becomes even more pronounced at the tertiary level. Globally, women constitute less than one third of enrollees in higher education ICT studies – a gender disparity without parallel in other disciplines, including traditionally male-dominated fields such as medicine and science.[57] In the EU, only 2.4 per cent of female tertiary graduates earn ICT degrees, versus 9.2 per cent of male tertiary graduates.[58] While some countries like Denmark, Germany and Turkey have recorded a slight uptick in women studying computer science, the absolute numbers remain very low compared with male students.[59] These statistics are particularly discouraging because large numbers of women entered universities during this period and, at the same time, employer demand for advanced ICT skills grew dramatically. If anything, the percentage of women studying computer and information science should have increased.

The attrition rate is also disproportionately high for women in technology-related fields at the tertiary level,[60] likely due to gender discrimination, competitiveness and a lack of female peers. Thus the disparities in confidence and belief in self-efficacy that surface in late primary and early secondary school become prophetic as education advances: When girls lose faith in the strength of their digital skills, they abandon or steer clear of technology-oriented studies, and this, in turn, likely results in an amplification of self-doubt among the girls who remain. The data suggest that confidence drops slowly at first and then precipitously, so that by the time female students complete higher education, only a tiny fraction graduate with ICT degrees.[61]

THE DIGITAL SKILLS GENDER GAP AND THE LABOUR MARKET

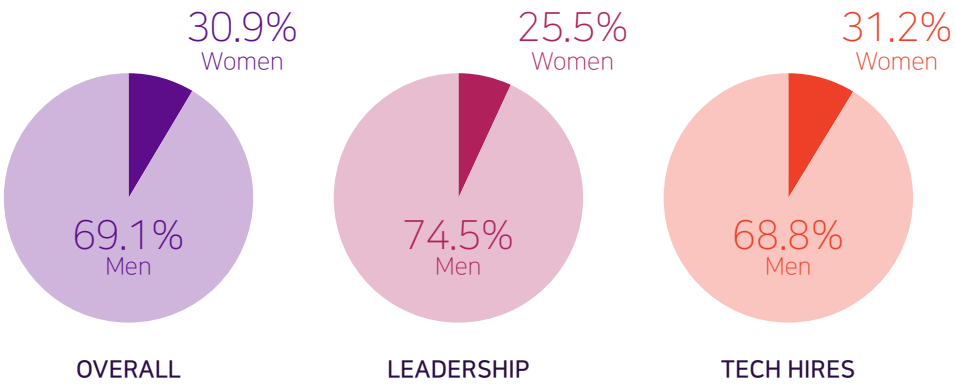
A smaller number of women studying ICT in secondary school and college translates into a gender gap in the labour market. Globally, women hold only 24 per cent of all digital sector jobs, and in developing countries, men are 2.7 times more likely than women to work in the digital sector.[62] While this figure is low, it obscures a much wider gender divide across the people performing technical-level work. According to the OECD, in G20 economies the proportion of female ICT specialists ranges from 13 per cent in the Republic of Korea to 32 per cent in South Africa. In North America, women hold only about one quarter of computing jobs – a fraction that has fallen over the past two decades, a period when women were making considerable advancements in other fields.[63] The software development field, despite its growing influence in day-to-day life, appears to be particularly devoid of women: Globally, only 6 per cent of mobile application and software developers are female, according to ITU.[64]

Image 13:

Google's workforce

The gender diversity of Google's workforce is similar to other multinational technology companies, with women representing less than one third of the total workforce and an even smaller proportion of employees in leadership roles.

Source:
Google 2018 Diversity Report



Even women who work in the digital sector are less likely to hold high-level positions, tending instead to work in general roles that are lower-skilled and administrative in nature.[65] In the mobile industry, for instance, women hold less than 20 per cent of senior leadership positions.[66] Data collected from online software developer

communities indicate that men are 15 per cent more likely than women to be senior developers or in hiring positions, almost twice as likely to be in management positions and nearly four times as likely to be executives.[67] Globally, board membership tends to be less diverse in the technology sector than in other sectors, although this is not the case in all regions.[68] Women working in the digital sector are also more likely to be underpaid for their work.[69] While there is conflicting evidence on the gender wage gap in the ICT sector, some research indicates that the gap for technology workers is more than 28 per cent, which is much higher than the average gap for all workers (around 6 per cent).[70] As the digital sector grows and more jobs become digital-intensive, this trend has the potential to further exacerbate the pay gap between men and women.[71]

Disparities in representation, promotion and compensation make retaining women a challenge for the digital sector. Women leave technology-related fields in disproportionate numbers, both during their transition from higher education and in their career cycles.[72] In the EU, more than half of men who graduate with ICT degrees end up working in digital jobs, whereas only one quarter of women do the same.[73] In India – an outlier in terms of strong female representation in technology studies at the tertiary level – women represent 45 per cent of computer science enrolments at universities, yet only make up 25 to 30 per cent of the human–computer interaction workforce, indicating a high attrition rate from technology-related careers.[74] In the USA, women who do enter the digital sector tend to leave such employment, on average, at twice the rate of men.[75] Women are also are more likely than men to cite gender bias, discrimination and harassment as their reason for leaving the field.[76]

THE RELATIONSHIP BETWEEN DIGITAL SKILLS AND GENDER EQUALITY

In many contexts, reducing gender inequality in society more broadly can help narrow the gender gap in digital skills. However, the connection between overall levels of gender equality and women participation in technology studies and jobs is inconsistent. Recent studies show that – despite expectations – countries with the highest levels of gender equality, such as Finland, Iceland, Norway and Sweden, often have very few women choosing to enter the technology field.[77] As shown in the first think piece accompanying this policy paper, the correlation between gender equality and the ratio of women studying ICT in higher education is actually negative.[78] Social scientists have floated different hypotheses to explain this apparent contradiction, including theories that women in countries with low levels of gender inequality are more attracted to ICT jobs because they provide the clearest pathways to financial independence.[79] While this topic is explored in depth in Think Piece 1, it is mentioned here because it illustrates that gender equality in society at large does not necessarily translate into gender equality in digital realms and digital professions. The digital sector appears to be an outlier in this regard. The persistence of wide and, in many instances, growing digital skills gender gaps – even in countries that rank at the top of the World Economic Forum's global gender gap index (reflecting strong gender equality) – demonstrates a need for aggressive and sustained interventions that cultivate the digital skills of women and girls.

CHAPTER 2

Why closing the skills gap matters

As this chapter will show, helping women and girls develop digital skills translates into stronger women, stronger families, stronger communities, stronger economies and better technology. The first section begins by explaining that digital skills are no longer optional, but rather essential life skills required for full participation in society. The section that follows describes why digital skills are critical for ensuring women's and girls' safety, both online and offline. Further sections explore the impact of digital skills on women's ability to participate in government and politics and engage more actively with their communities. The text details the myriad economic benefits that stem from equipping women with digital skills – from enabling women to enter and compete in the labour market and reducing the gender wage gap, to increasing profits, productivity and innovation for technology companies. A later section discusses the importance of including women in the creation of digital content and technology, and laying foundations necessary for them to take leadership positions in order to help steer society towards gender equality as digitalization accelerates. The chapter ends with an explanation of how concerted efforts to close the digital skills gender gap can help countries meet their international commitments to education and gender equality.

DIGITAL SKILLS FACILITATE ENTRY INTO THE LABOUR MARKET

The proliferation of digital technology and digital services has made digital skills a prerequisite for full participation in society. Today, an inability to navigate the internet poses disadvantages that are hard to overstate. While these disadvantages were once somewhat contained to wealthy countries, they are now relevant globally, due to the rapid and continuing proliferation of internet-connected technology. Equipping women and girls with digital skills helps put them on equal footing with digitally savvy men, and opens up countless opportunities for increased agency and choice. Websites and mobile applications on health and legal rights, for example, can help women make informed decisions to safeguard and care for themselves and their families, while online social networks and digital communications allow women to disseminate information and share knowledge beyond their immediate community. Mobile learning opportunities, from literacy apps to massive open online courses (MOOCs) about subjects as diverse as astronomy and caring for older relatives with dementia, can open up new educational pathways, especially for out-of-school girls and adult women.[80] Job search engines and professional networking sites enable women to compete in the labour market, while e-commerce platforms and digital banking services can help increase their income and independence.

Image 14:

M-Pesa

Mobile moneny systems like M-Pesa have facilitated financial inclusion and empowerment for women in developing countries. Launched in Kenya in 2007, M-Pesa now serves over 30 million customers across 10 countries. In order to use M-Pesa, women and men need basic digital skills.

Source: World Bank

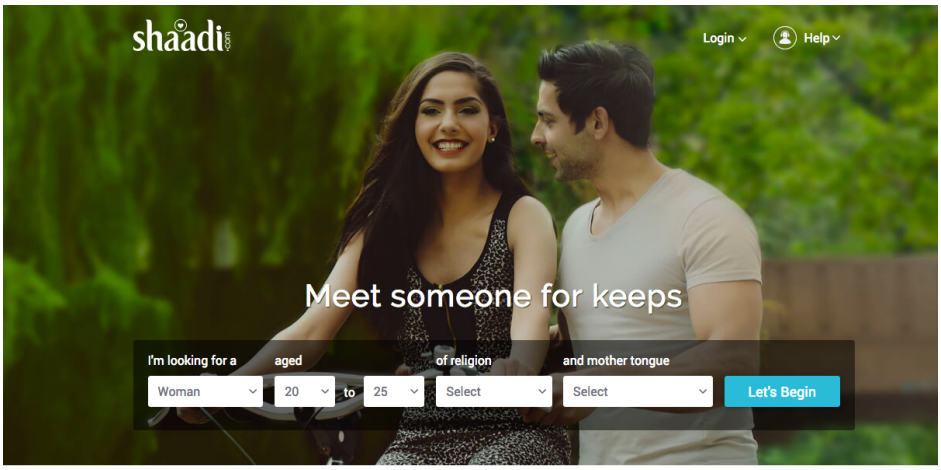
Digital skills are quickly becoming essential for financial inclusion.[81] In rural areas in particular, access to online markets and microloans has empowered many women to start their own small businesses and generate additional income for themselves, their families and their communities. Globally, digital data in the form of transaction records are used to determine creditworthiness, and women without a digital footprint may find themselves unable to secure a loan, rent an apartment or even connect utilities without a significant deposit. Digital skills also increasingly facilitate important life decisions such as selecting a partner, as dating moves more and more to online platforms. In India, for example, matchmaking websites have changed the way young people approach marriage. While the matchmaking process has been traditionally driven by

parents or siblings, one popular website reported that 73 per cent of its profiles are created by the people who are seeking marriage partners themselves, not for children or other family members.[82] Women who are able to leverage digital tools will have a greater range of options and information at their disposal when making choices that affect their health and well-being, their families and communities, their careers and their overall life trajectory.

Image 15:

Screenshot of Shaadi.com, a website widely used in India to help people find marriage partners. Over 70 per cent of the profiles on the site have been uploaded by people who are seeking partners for themselves, not by parents or brothers.

Source: Shaadi



DIGITAL SKILLS ARE ESSENTIAL FOR WOMEN'S SAFETY BOTH ONLINE AND OFFLINE

Some researchers have noted a correlation between women's access to ICTs and infringement on their human rights.[83] This is likely a reflection of offline patterns of abuse, exclusion and discrimination, which are mirrored and magnified when women enter the online space. Thus women need digital competence to ensure their safety, both online and offline. Knowledge of how to protect personal data and ensure privacy online is important for all internet users, but is particularly salient for women and girls, who are more likely to be the targets of internet crimes[84] and gender-based online violence.[85] While global data are limited, the Broadband Commission estimates that around 73 per cent of women have experienced or been exposed to some form of cyber-violence.[86] Certain groups of women are disproportionately targeted by ICT-facilitated violence, including women with disabilities and women belonging to ethnic minorities or other marginalized groups.[87] These women also tend to be those least likely to have ICT skills, making them even more vulnerable.

ICTs are routinely employed by men to intimidate and coerce women and girls, particularly those who transgress gender norms and expectations – for example, by wearing clothing deemed immodest or overly revealing, by being sexually

promiscuous or flouting prohibitions against dating before marriage, or by pursuing education and careers in male-dominated fields. Women may be subject to physical violence in reaction to online behaviours as well as psychological violence such as online harassment, manipulation, threats and public shaming. These forms of abuse have devastating and far-reaching effects, particularly in contexts where patriarchal and religious culture places a high value on women's chastity. In Pakistan, for instance, where the vast majority of mobile phone-based sexual harassment targets women, a survey found that nearly 80 per cent of respondents knew someone who had suffered from depression as a result of mobile harassment, 67 per cent knew someone who had been forced to marry against their will due to mobile harassment, and more than 40 per cent knew someone who had committed suicide due to mobile harassment.[88] Victim blaming is also common: in Pakistan, 32 per cent of survey respondents placed the blame for mobile harassment on women, and parents commonly respond to their daughters' being harassed by taking away their devices and restricting their mobility.[89] In sub-Saharan Africa, some anti-pornography laws criminalize all forms of electronic sexual expression, such that victims of revenge porn – or non-consensual pornography used to humiliate or blackmail women – may be subject to prosecution themselves if they report threats to authorities.[90]

> Around 73 per cent of women have experienced or been exposed to some form of cyber-violence.

Opting out does not ensure safety, as even women who avoid going online are vulnerable to ICT-facilitated abuse. Indeed, unconnected women are at particular risk if they are exposed to the empty threats and phishing schemes common in the digital world. Women lacking digital skills may also be unaware when technology is being used by men to control them. For instance, tracking applications commonly installed on mobile phones may be used by men to monitor women's movements and activities, often without their knowledge.[91] The potential for abuse only increases as technology becomes more advanced. In countries where smart home devices are increasingly common, domestic violence responders have noted an uptick in the number of women reporting abuse cases involving internet-connected locks, thermostats, cameras and other devices.[92] In many instances, the women do not initially understand what is happening when e-locks and other domestic technologies are deployed remotely, and they are unable to disable the devices. Women need digital skills to be able to safeguard against ICT-facilitated violence, recognize abuse when it is occurring and take steps to protect themselves and access recourse and help.

DIGITAL SKILLS ENHANCE WOMEN'S COMMUNITY AND POLITICAL ENGAGEMENT

Digital skills can facilitate women's engagement with local government and increase their decision-making power in their communities. The Women-gov project in Brazil and India, for instance, has helped women improve their understanding of and communication with local government via ICTs. In Brazil, the project trained female community leaders to access and utilize online data on government health services to better respond to public health concerns in their communities. In India, the project worked with women's collectives to establish women-run, internet-connected community information centres to facilitate applications for government assistance (including welfare and entitlements), which in turn improved linkages between the collectives, local authorities and public institutions.[93] These examples show that women with digital skills are better able to make their voices heard on local issues and influence the outcome of decisions that affect themselves and their communities.

Digital skills can also empower women to participate in political movements. For instance, the anonymity of ICTs may allow some women to circumvent limitations on freedom of speech in repressive societies, while collective mobilization through online networks can enable women to campaign on gender-based issues.[94] An Iraqi women's group used a multimedia campaign, including an online component, to successfully lobby the Kurdish regional government to outlaw the practice of female genital mutilation.[95] Images taken on mobile phones and distributed via social media have called attention to domestic violence in China and influenced media treatment of court cases on forced abortion.[96] The digital tool HarassMap enables women in Cairo and Mumbai to report and geotag instances of harassment, while the online forum Hollaback! provides a venue for women to share and discuss experiences of public harassment in 70 cities across 24 countries.[97] In Iran, the social media movement #MyStealthyFreedom sparked a nationwide protest against forced wearing of the hijab, while the #MeToo movement that began in the USA spread around the world, calling attention to the prevalence of sexual assault and the necessity of listening to female victims. These examples show how local feminist activism can quickly coalesce into broad-based, high-speed and high-impact social and political movements through the use of digital platforms.

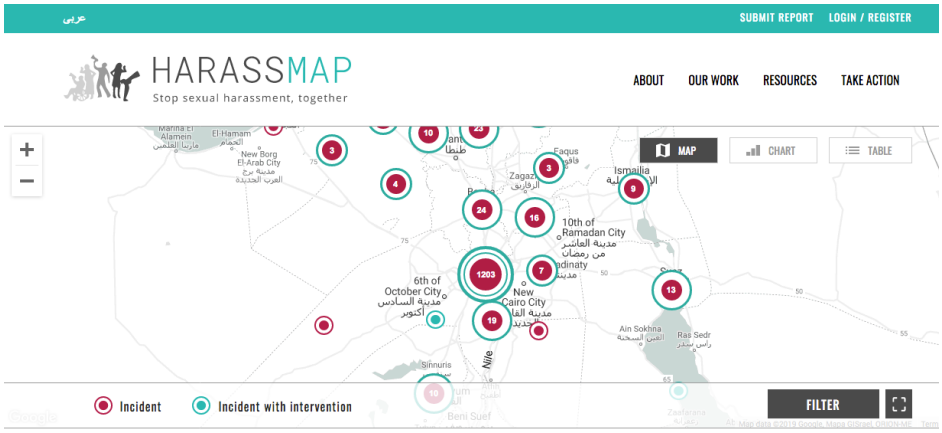


Image 16:

A screenshot of HarassMap, a website and mobile app that allow women to report and geotag incidents of sexual harassment, or instances when someone intervened to stop a sexual harassment incident or support a person who has been harassed

Source: HarassMap

More broadly, the process of developing digital skills has been found to increase women and girls' self-confidence, independence, social status and power, and give them access to new opportunities for self-expression and engagement in the public sphere.[98] Internet-facilitated exposure to representations of women in other cultures and contexts can also lead women to reflect on traditional gender roles and change their personal aspirations.[99] Learning to use ICTs effectively can be a transformative experience for women and girls, and lay the foundations for movements and activism that further the cause of gender equality.

DIGITAL SKILLS BRING ECONOMIC BENEFITS TO WOMEN AND SOCIETY

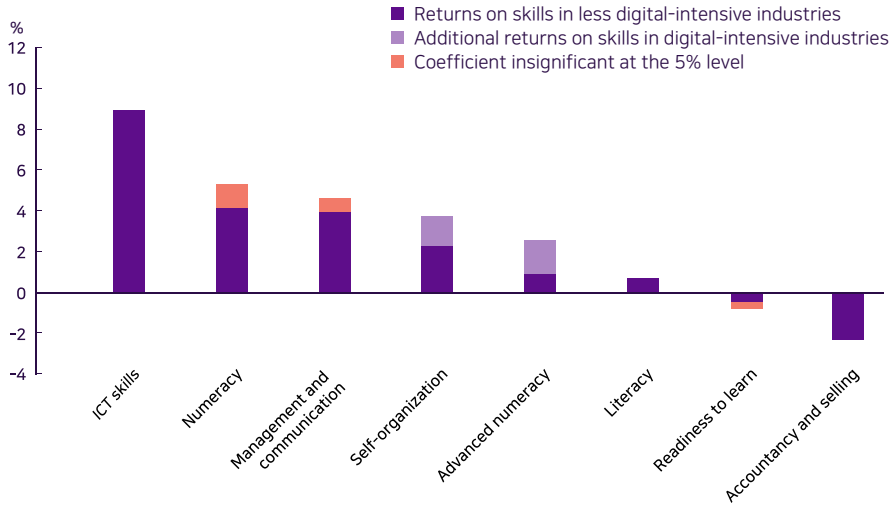
The potential economic benefits associated with improving the digital skills and competencies of women are significant. The European Commission estimates that by 2020, 90 per cent of all jobs will require digital skills,[100] and women who do not have these skills are at risk of being left behind. As the World Economic Forum has pointed out, 'equipping a girl with even rudimentary ICT skills can make a difference in her productivity when she grows up, and this is especially true in developing regions, and even in jobs that are viewed as low tech.'[101] For example, knowing how to use the internet to get handicrafts or textiles to market can dramatically increase the earning power of women who produce these goods, in addition to opening up avenues to microloans and other financial services in areas that may be far from brick-and-mortar banks. ICT skills can also benefit women engaged in agriculture by helping them learn new farming techniques, understand crop pricing or anticipate weather conditions. Digital technologies – and the ability to use them effectively – can enable women to join the workforce and earn an income through new and flexible pathways, from accessing online education to starting their own businesses or participating in the informal economy.[102] This is important for women and has additional benefits for society as a whole, because when women earn an income they tend to reinvest it back into their families and communities at a higher rate than men.[103] Countries concerned with accelerating development should make efforts to lower digital barriers for women and encourage digital gender equality.

Fostering women's ICT skills may represent an effective policy lever for narrowing the gender wage gap.[104] Analysis performed by the OECD indicates that labour market returns for women with ICT skills are considerably higher than the returns generated by other skills. The returns are also higher for women than for men. Data from the OECD Survey of Adult Skills show that the most skilled occupations, such as managers and professionals, exhibit a more intensive use of ICTs than less skilled occupations.[105] This means that regardless of the sector in which women work, digital skills can open up opportunities for career advancement and higher pay. Women who develop more advanced digital skills will have also access to the rapidly expanding ICT job market, which tends to produce jobs that are more highly compensated than those in other fields.

Image 17:

Additional labour market returns for various types of skills in digital-intensive industries

Source: OECD



> Companies in the top quartile for gender diversity are 15 per cent more likely to have above-average financial returns for their industry.

This evidence led the director of the European Institute for Gender Equality to say that attracting women and girls into careers in the digital sector is the key to future prosperity.[106] Within developed country contexts, research shows that dramatically increasing the number of women in computing carries a potential to generate hundreds of billions of USDs in cumulative earnings.[107] In the USA, for example, computing jobs are growing at three times the rate of overall job creation, and supply is failing to meet demand.[108] By 2020, there will be a skills gap of over 800,000 ICT jobs in the EU alone.[109] Increasing the number of women pursuing ICT careers will help fill these gaps and strengthen countries' economies. There is also evidence that technology companies would benefit from hiring more gender-diverse workforces. According to research conducted in Latin America, North America and the UK, companies in the top quartile for gender diversity are 15 per cent more likely to have above-average financial returns for their industry.[110] In a global survey of 2,400 companies, it was found that companies with at least one woman on their board performed significantly better in terms of profits and growth than industry peers with no women on their boards.[111] In the EU, it is estimated that having a gender-balanced staff can boost company revenue by 40 per cent, compared with companies that are more homogenous,[112] and a study in Spain found that gender diversity is positively related to innovation on research and development teams.[113] These data suggest that the lack of women in the digital sector may be hurting companies financially, providing a rationale for public–private collaboration on interventions aimed at closing the digital skills gender gap.

DIGITAL SKILLS EMPOWER WOMEN TO HELP STEER THE FUTURE OF TECHNOLOGY AND GENDER EQUALITY

The lack of diversity in technology can have a serious multiplier effect as big data and algorithms become influential in day-to-day life.[114] Artificial intelligence is now used to automate decision-making from the health care industry to the legal system, and may be responsible for making choices that affect people's life trajectory, such as which medical treatment they receive, whether they are eligible for life insurance or a loan, or which jobs they are invited to interview for.[115] When deep learning systems are trained on data that contain gender biases, these biases are reproduced in the software. As one prominent female researcher in the AI field put it, such systems are 'bias in, bias out'.[116]

> Amazon's AI recruiting software downgraded résumés that contained the word 'women's', as in 'women's chess club captain'.

New business models in the digital economy, such as algorithms used in job matching, have been shown to perpetuate gender bias.[117] Amazon's AI recruiting software, for example, was found to downgrade résumés that contained the word 'women's', as in 'women's chess club captain', because it had been trained on men's résumés.[118] Research conducted in the USA showed that when image-recognition software was trained on sets of photos that displayed gender bias – e.g. disproportionate representation of women cooking and men playing sports – the software not only mirrored the gender bias but amplified it, creating a stronger association between gender and activities than was found in the original photo set.[119] Similar research on text-based machine learning showed that software trained on articles collected from Google News adopted sexist views of women's career options, associating men with computer programming and women with homemaking.[120] Up to this point, men have been steering the development of the new digital solutions that spread through society and influence culture, with limited contributions from women. As more and more digital tools are built by men, the more gendered the digital space becomes and the more difficult it is for women to establish a toehold and become digital users and creators. Today it is hardly a secret that technology is shaping the future and is a lever of power. Women cannot continue to be absent or nearly absent from the labs, companies and offices where technology takes shape. This risks the perpetuation or even an acceleration of gender inequality.

As the European Commission has affirmed: 'Technology reflects the values of its developers, and that of the information they draw from. It is clear that having more diverse teams working in the development of such technologies might help in identifying biases and prevent them.'[121] Beyond merely preventing bias, empowering

women to become digital creators will add value to the digital space by making it more accommodating for both sexes. With digital skills, girls and women will be better able to identify and build digital solutions to solve problems that confront them and others, including gender-based problems. If technology is to help communities and countries become more gender-equal, women, as well as men, must steer the development of this technology.

> The teams working at the frontiers of technology are also the most heavily male.

Complementary resource

The gendering of artificial intelligence and its implications for gender equality is the subject of Think Piece 2 that accompanies this publication. Using the example of digital voice assistants such as Amazon's Alexa and Apple's Siri technology, it explains how gender imbalances in the digital sector can be 'hard-coded' into technology products.

The reach and impact of technology is so great that the limited representation of women on technology teams threatens to both perpetuate existing gender inequalities and impose new types of gender imbalances. As an example, concerns about the widespread use of AI-powered digital assistants gendered as women simply did not exist 20 years ago. Troublingly, the teams working at the frontiers of technology are also the most heavily male. Yet the vanguard of technology – whether machine learning, advanced robotics, big data analytics or some other wing – is where norms, including those related to gender, are negotiated and set. The early decisions made by these male-dominated teams ripple through society with unprecedented speed and can be hard to fix when gender biases are pointed out. As one example, Google's widely used speech-recognition software is 70 per cent more likely to accurately recognize male speech than female speech, according to research conducted at the University of Washington.[122] Overall, strong arguments can be made that the digital world is often less gender-equal and less gender-safe than the analogue world, and this is almost certainly symptomatic of the dearth of women involved in the creation of digital spaces. As more and more human activity moves online, the considerable progress societies have made towards gender equality in offline environments is at risk if women do not play a more active role in building, as well as simply using, the digital tools and applications where people spend increasing amounts of time.

DIGITAL SKILLS FOR WOMEN ACCELERATE PROGRESS TOWARDS INTERNATIONAL GOALS

International agreements are unambiguous about the need to close digital gender divides, both as a goal in and of itself, and as an action that will enable the realization of other goals.[123] The United Nations Sustainable Development Goals, specifically those dedicated to education (SDG 4) and gender equality (SDG 5), call on countries to 'substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship', and 'enhance the use of enabling technology, in particular information and communications technology, to promote the empowerment of women'. Other international conventions that touch on digital gender equality include the World Summit on the Information Society (WSIS) Outcomes from Geneva and Tunis and the WSIS+10 Review; the Beijing Declaration and Platform for Action and the Beijing+20 Review; the Connect 2020 Agenda and ITU Resolution 70; the Addis Ababa Action Agenda; and the Agreed Conclusions of the Commission on the Status of Women.

Through these agreements, governments have committed to developing gender-responsive policies and strategies for ICT; ensuring access to ICTs by women and girls; mitigating and responding to online threats that hinder women's access to and use of technology; building the digital capacities of women and girls and supporting the development of content, applications and services that meet women's needs; promoting women in the technology sector, including in decision-making positions; and establishing multistakeholder partnerships to strengthen international cooperation on shared goals.[124] For governments to make progress towards achieving these targets, they will need to implement interventions aimed at women and girls in particular, and in contexts where gender deficits are greatest. They will also need to take steps to address gender bias and discrimination in digital education and training, ensuring more gender-responsive teaching and learning processes.

CHAPTER 3

Recommendations for closing the digital skills gender gap

This chapter offers 18 recommendations to help women and girls develop and strengthen their digital skills. The recommendations are complemented with supporting examples drawn from initiatives and projects active in different parts of the world.

#01
ADOPT SUSTAINED, VARIED AND LIFE-WIDE APPROACHES

Increasing girls' and women's digital skills involves early, varied and sustained exposure to digital technologies.[125] Interventions must not be limited to formal education settings but rather should reflect a multifaceted approach, enabling women and girls to acquire skills in a variety of formal and informal contexts – at home, in school, in their communities and in the workplace. In addition, because the digital divide cuts across age groups, solutions need to assume a lifelong learning orientation. The quick pace of technological change adds impetus to this 'across life' perspective, as skills learned today will not necessarily be relevant in 10, 5 or even 2 years. Digital skills – arguably more than other skills – require regular updating, lest women and girls fall further behind.

Motivating girls to become skilled ICT users is likely to require new and varied learning pathways. The 'one-size-fits-all' approaches attempted in countries have tended to magnify rather than reconcile existing gender inequalities. Recently, however, models of learning techniques to better accommodate girls and women have been coming into focus. The additional recommendations that follow are grounded in factors that have been shown to help women and girls adopt digital technologies, improve their digital skills, and increase their interest and motivation to pursue ICT studies and careers.

#02
ESTABLISH INCENTIVES, TARGETS AND QUOTAS

Enrolment can be incentivized through scholarships for women who choose to specialize in ICT fields at the undergraduate and graduate levels, in order to increase the number of women pursuing technology-related studies at the tertiary level. However, care should be taken in designing and marketing such scholarships, so as not to perpetuate gender stereotypes about ICT as a male space. For example, funding opportunities labelled as 'diversity scholarships' to technology programmes may be less effective at boosting women's self-confidence and sense of accomplishment than academic scholarships. Such wording may reinforce women's outsider status and make them question whether they have the aptitude to succeed in a field currently dominated by men.

Governments should also consider making scholarship funding available to women to complete non-degree ICT training programmes for career changes or advancement. Even when such programmes are free or subsidized, women who have already entered the workforce may not be able to afford the time in lost wages to complete a training course. Funding should cover the cost of tuition as well as living expenses, supplies and transport. In addition, tertiary institutions may consider instituting

Incentives are important to facilitate the transition from education and training to the labour market, since women are more likely than men to drop out of technology-related fields after completing tertiary education.

gender admissions quotas, at least as a temporary measure to help address severe enrolment gaps in technology-related fields. While quotas are controversial, some organizations, including Think20 (T20), a think tank group associated with the G20, have suggested they may be useful for education programmes in order to 'strengthen women's participation in decision-making and leadership' within the STEM and ICT sectors.[126]

Incentives are important to facilitate the transition from education and training to the labour market, since women are more likely than men to drop out of technology-related fields after completing tertiary education.[127] This is likely due to myriad factors, including a professional culture of exclusion and discrimination in many technology industries; the expectation of long hours and a lack of policies in place to ensure an appropriate work–life balance; gendered language in job postings that discourage women from applying; and biased recruiting processes that favour male candidates over equally or more qualified women. While all of these issues must be addressed, there is evidence that efforts to help women bridge education and work can help. Secondary schools, colleges, universities, and technical and vocational education and training (TVET) programmes should partner with employers in the technology sector to create more opportunities for women to enter ICT firms, and to ensure that female students are informed about these opportunities and encouraged to apply. As with scholarships, internships, fellowships and other work placement programmes should avoid using language that emphasizes women's outsider status.

Quotas and hiring targets have also been suggested as effective strategies for technology companies to ensure more gender-balanced staff, management and boards.[128] Companies such as Accenture, Intel, Nokia and Twitter, among others, have publicly pledged to increase the proportion of women in their workforce, including in leadership positions.[129] In 2015, Intel committed US$300 million to increase the representation of women in the company, and in late 2018 announced that it had hit an internal target by increasing the female ratio of technical employees from 20 per cent to 24 per cent, illustrating the challenge of reconciling years of gender inequality in the technology sector.[130] A handful of governments have also mandated femae representation on corporate boards, including India, Malaysia, several European countries, and the State of California in the USA.[131] While not all of these policies have been effective, and in many places private sector hiring practices may be considered outside the scope of state intervention, governments can still lead the way by committing to increase the number of women working in ICT-related positions within the public sector, and by tracking and publishing their progress. Such behaviours set a positive example for gender equality and transparency, and may help encourage private sector employers to do the same.

Finally, it is vital that governments set targets for putting more women into policy-making positions, especially within ministries of education and ICT, to help ensure representation at the policy level. Women must be involved in designing the policies aimed at increasing gender equality in digital skills. High-level female leadership in this area has the potential to influence the entire digital ecosystem and should be viewed as a critical goal in the effort to close the gender gap.

#03
EMBED ICT IN FORMAL EDUCATION

One of the most notable gender trends in digital skills education in the formal sector is the sharp decline in girls' interest that starts around the lower secondary levels and becomes more pronounced as education levels increase.[132] This break appears to correspond with the transition to subject selection that often occurs in secondary school. In other words, once girls are given the choice of whether to study technology-related subjects, they tend to opt out *en masse*. The fact that this choice is usually presented to girls in adolescence likely compounds the issue, as peer pressure and cultural expectations about gender roles may begin to play an outsize role in girls' family and social lives at this time. Research in North America, for instance, found that girls who do not have friends in their computing classes in secondary school are one third less likely to study computing in college.[133]

One solution to this issue is to make technology classes mandatory at the secondary education level, to avoid the 'secondary school trap' that causes many girls to lose their interest in digital skills. A growing number of countries are making computer science a core subject and instituting graduation requirements that necessitate at least some ICT subjects. Many European countries have already implemented policies that integrate computer science into the curriculum at all levels of compulsory education, while others have plans to do so.[134] In the UK, for example, computer science classes are mandatory for students ages 5 to 16,[135] while Finland has integrated ICT skills across the curriculum at all levels.[136] The Republic of South Korea has also instituted mandatory software courses from primary school through secondary school.[137] In Japan, computer programming will be a required subject in primary school starting in 2020, followed by implementation in secondary school by 2022.[138] These country initiatives show that classes to cultivate advanced digital skills are shifting from optional to compulsory, and this holds a strong potential to help retain the interest of girls at moments when it is most likely to drop off, largely due to gender socialization.

While making digital skills classes mandatory at the secondary level is recommended, it is also important to remember that many girls (and boys) leave school before this point. In Ethiopia, for example, ICT classes are required in secondary school, but half of all students drop out of school between the ages of 13 and 14, and girls are more likely than boys to end their schooling early due to community norms and to support the completion of domestic chores.[139] In many contexts, the onset of puberty for girls corresponds with social restrictions on education. The lack of sanitation facilities and menstrual hygiene support, for instance, can cause girls to miss school

or, in some cases, drop out altogether.[140] In these situations, limiting ICT exposure to secondary school reinforces the gendering of technology, because ICT is introduced at a time when girls are less likely to be enrolled in formal education. To break this pattern of inequality, technology should also be incorporated at early grade levels, to take advantage of higher primary school enrolment rates and help girls as well as boys develop baseline skills that provide foundations for future skills development, whether in or outside of schools. Programming experience for girls as early as the first grade, for instance, has been shown to have a significant influence on technology self-efficacy and motivation.[141] There is even an argument to be made for introducing digital skills at the pre-primary level, as new research indicates that girls acquire gendered notions of intelligence and aptitudes as early as six years of age, and these beliefs extend into adulthood.[142] Girls who have frequent early exposure to technology are more likely to have a positive self-image of their ICT abilities as they age, which in turn increases the likelihood that they will choose to pursue technology-oriented studies and careers. Early exposure also functions to normalize female use of technology. Girls who are encouraged and taught to use digital devices early in life are more likely to insist on continued use of these empowering technologies.

Mandatory courses may also be beneficial at the tertiary level, as some research has indicated that women in higher education are open to changing their current field of study to computing in light of the growing job opportunities available in this sector.[143] Tertiary education institutions, from universities to TVET centres, should consider technology immersion classes for all incoming students, not just those in ICT fields. Harvey Mudd College in the USA, for example, has boosted the percentage of computer science majors who are women from 10 per cent to 55 per cent in about 10 years, in part by redesigning its introductory computing course – a requirement for all first-year students – to comprise three different tracks, including one for students with no prior programming experience.[144]

Colleges and universities should also examine the structure of their computing programmes to ensure that women are not shut out by competition and overselectiveness. In the USA, for example, a recent surge in demand for computer science courses has created an extremely competitive environment that threatens to narrow pathways for women and minority students, who tend to have less experience than white and Asian male students.[145] Some universities have responded to the high demand for advanced ICT studies by requiring incoming students to gain admission to computer science and other ICT majors prior to enrolling, which further disadvantages women, who are often less likely to have taken advanced computing courses in secondary school.[146] Rather than excluding those without prior experience, universities could help level the field by providing introductory computing courses and offering flexible pathways to ICT majors.

> Policy and programmes should aim to incorporate ICT skills, computer science and computational thinking into the curriculum for all subjects and at all education levels.

Overall, policy and programmes should aim to incorporate ICT skills, computer science and computational thinking into the curriculum for all subjects and at all education levels. In the Finnish national curriculum, for example, ICT skills are among the 'transversal competences' that are taught, studied and assessed as part of every subject.[147] Such an integrated approach helps reinforce digital skills by giving students repeated exposure in different contexts and allowing them to apply their knowledge across different disciplines. This practice of technology integration across disciplines may be among the most forward-looking, because technology is quickly changing the practice of disciplinary study. Isolating digital skills to a single standalone subject is increasingly challenging and limiting, as it fails to account for the pervasive influence of technology in all fields.

#04 SUPPORT ENGAGING EXPERIENCES

Girls and women should have varied exposure to digital technologies, including opportunities to develop digital skills in informal contexts as well as formal ones. After-school clubs, extracurricular activities and camps focused on ICT can help encourage girls' digital learning in a fun, relaxed environment.[148] A programme in Tanzania offers an instructive example. The Dar es Salaam-based NGO Apps and Girls establishes after-school coding clubs and organizes events such as workshops, exhibitions, hackathons, boot camps and competitions, as well as mentorship and internship opportunities, outside the standard academic calendar.[149] UN Women and the Mozilla Foundation applied a similar approach globally with Mozilla Clubs, an informal network that trains women and girls in digital literacy skills in both formal and informal settings.[150] In the Dominican Republic, the Research Center for Feminist Action (CIPAF) won a Gender Equality and Mainstreaming in Technology (GEM-TECH) Award from the ITU for its STEM clubs for girls (E-Chicas and Supermáticas), which include training in coding as well as leadership skills.[151] The success of the clubs has led the Ministry of Education to fund its expansion to primary and secondary schools throughout the country. In the USA, the Girls Who Code programme aims to build a pipeline for young women to work in computing through after-school clubs and summer immersion programmes that include project-based learning as well as networking and mentorship opportunities.[152] What these programmes share is a commitment to 'reposition' coding and other advanced digital skills as inviting to women as well as men, and to sustain early female interest with networks that transcend formal education alone.

Digital learning should be enjoyable, whether at home, at school or at a community centre. One way to ensure this is through digital games. Research from Europe and North America has found people who appreciate and play video games are more likely to develop an interest in ICT, and the gender divide in video gaming mirrors and likely contributes to broader digital gender divides.[153] In one study from the USA, girls who had early exposure to computer games were four times more likely to pursue a career in computer coding.[154] Yet the social stigma against video games may prevent parents and teachers from seeing them as educationally beneficial, while stereotypes both

Image 18:

Girls in Viet Nam participating in an initiative to strengthen female interest in technology

Source: Block by Block

within and outside the family may deter girls from playing them. A study in Spain, for example, found that fathers regularly played video games with their sons but not with their daughters, while mothers never played video games with any of their children,[155] reinforcing the idea that certain digital activities are only for men and boys.

Schools and community organizations can help overcome these barriers by encouraging teachers to incorporate computer games into their classroom activities; making age-appropriate games accessible and attractive to girls both in and outside of school (for instance, at libraries or after-school centres); and advising parents to support age-appropriate computer and video games as educational and leisure activities, and play them with their daughters as well as their sons. The Block by Block initiative in the Socialist Republic of Viet Nam, for instance, uses the popular video game Minecraft as a tool for engaging adolescent girls in participatory urban planning.[156] Conceived as a partnership between Plan International and UN Habitat, the programme creates models of participants' actual communities in Minecraft. Girls then use them to address safety issues they have identified in their communities, particularly those affecting female residents, such as unlit streets on their routes home from school. The programme's first implementation, in the Kim Chung community in Hanoi, prompted commitments from the local government to implement some of the girls' suggestions. As this programme illustrates, digital games can be incorporated into interventions to help girls engage with actual issues affecting their communities, while at the same enabling them to develop and enhance their digital skills.

#05
EMPHASIZE MEANINGFUL USE AND TANGIBLE BENEFITS

In the formal education sector, project-based learning – a strategy that is beneficial for all learners – may be especially useful for engaging female students with technology because of its focus on applying knowledge in realistic contexts.[157] Emphasizing real-life applications for digital skills, and incorporating hands-on experiments and field trips into the curricula, may influence more girls to pursue or stick with ICT studies, particularly during the transition from primary to secondary school.

> Project-based approaches to learning can help sustain women's motivation in ICT studies and increase the likelihood of their entering the technology industry after graduation.

In higher education, project-based learning can also help facilitate the transition from education to employment by allowing students to practise skills used by professionals in the digital sector in realistic scenarios. Experts have noted a mismatch between labour market needs and the digital skills being taught in higher education,[158] indicating that curriculum revisions are needed to ensure that programmes equip students with the competencies they need to be competitive on the job market. Tertiary institutions including TVET programmes should partner with employers in the technology sector to identify the specific digital competencies needed for various positions and develop learning experiences that mimic those students might encounter in the workplace.[159] Such project-based approaches to learning can help sustain women's motivation in ICT studies and increase the likelihood of their entering the technology industry after graduation.

Outside the formal education sector, tying digital skills to actual issues affecting women and their communities can be an effective strategy for teaching those skills, particularly for adult women. Promising work at the community level has combined digital skills training with other training and services, particularly those that help women generate income. In Indonesia, for example, NGOs help adult women learn how to use mobile phones as part of entrepreneurship seminars. The women begin by using a single-purpose mobile application with immediate utility – such as an app that provides design ideas for traditional crafts – and then gradually experiment with other applications and more general-use digital tools.[160] The SheTrades initiative, implemented from 2016 to 2018 in Indonesia and Kenya, focuses on increasing the competitiveness of women entrepreneurs through capacity building, including training in digital marketing, social media and e-commerce. While the project is too recent to enable analysis of long-term impact, initial results indicate positive

outcomes in terms of sales and connections with international buyers.[161] The project also found that conducting trainings online helped minimize the cost of capacity building activities. Teaching women to use e-commerce services has been shown to promote the productivity and competitiveness of women entrepreneurs 'by linking producers and traders directly to markets at national, regional and even global levels, allowing them to restructure their economic activities and bypass intermediaries and the male-dominated and exploitative market structure'.[162]

Other programmes have found that connecting technology adoption to health information can be an effective strategy for motivating women to improve their digital skills. For example, the Prospera Digital programme in Mexico incentivizes learning digital skills by providing women with access to information on how to have a healthy pregnancy via a two-way messaging system for mobile phones.[163] For adult learners in particular, benefits have to be evident and immediate in order to encourage the development – and more importantly maintenance – of digital skills. The programmes described above are unique in the way they embed digital skills training in efforts to fulfil urgent needs, and yield tangible benefits in the form of profitability, improved efficiency and superior health.

> There is a need for digital learning content that goes beyond 'pink content' to provide women with essential information and skills to help improve their lives.

Beyond specific interventions, more digital content must be developed that appeals to women and girls. Many women cite a lack of relevant content – particularly content in local languages – as a reason for not making more extensive use of internet-connected technology.[164] Online content often fails to cater to women or take their needs and interests into account,[165] and women may be more selective about the time they spend on the internet due to their 'time poverty' and the extra burden of unpaid domestic work.[166] There is a particular need for digital learning content that goes beyond 'pink content' to provide women with essential information and skills to help improve their lives.[167] While relevance is highly contextual, a study conducted across 10 countries in Africa, Asia and Latin America identified two key types of digital content that are particularly critical to women's rights and opportunities: information on sexual and reproductive health, and digital financial services.[168] Educational content developers might consider these topics as initial areas of focus when creating digital resources for women and girls.

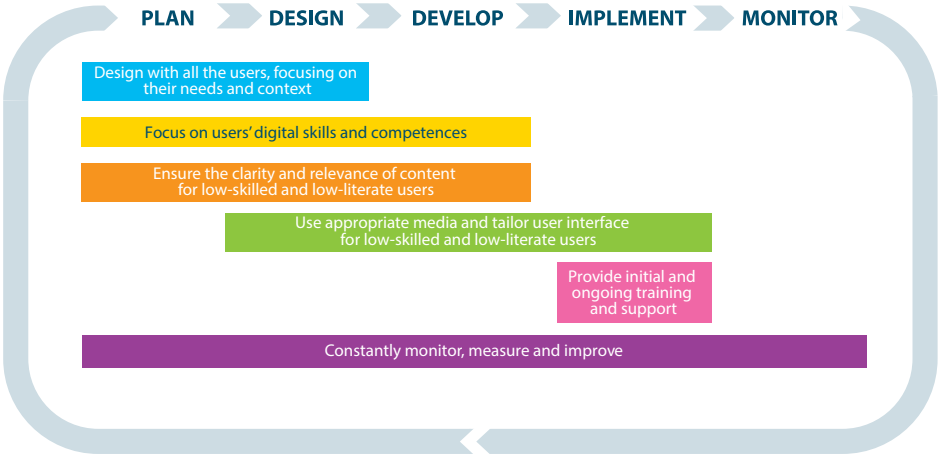
Women must be involved in the development and management of digital content in order to ensure it addresses their particular needs and is free from gender bias.[169] The Association for Progressive Communications (APC) has called for digital platforms owned and operated by women in the global South to ensure that content is meaningful to women in developing country contexts.[170] Content should also be tested with focus groups or the planned beneficiaries of an intervention. The Kilkari mobile health education programme in India, for example, went through four rounds of testing with rural mothers before content was found to be effective.[171]

Adjustments to content based on user testing included simplifying audio messages to include just one key piece of information per message, and restating information in different ways within the same message to help with comprehension and recall. This programme shows the value of involving women in the process of content development and refinement, and highlights the factors that need to be considered when designing content for women and girls with low literacy levels and low digital skills. Detailed advice on creating content for such populations that is simple, clear and trustworthy can be found in the UNESCO-Pearson Guidelines on Digital Inclusion.[172] Taken holistically, these guidelines can be used as a resource for designing, implementing and evaluating interventions aimed at helping people develop digital skills despite low levels of literacy and little familiarity with ICTs.

Image 19:

Guidelines for Digital Inclusion

Source: UNESCO



#06 ENCOURAGE COLLABORATIVE AND PEER LEARNING

Students' learning experiences are crucial for the development of self-efficacy beliefs.[173] While pedagogical strategies such as collaboration and peer learning are beneficial for all learners, they have been found to be particularly effective at engaging women and girls with ICT. In a study of collaborative learning with mobile technology in Israel, secondary school girls were found to spend more time with digital learning materials on a mobile device in a group-learning setting than when using the device individually.[174] Girls also had higher levels of perceived peer-influenced learning when working with mobile technology in a group than boys. In other words, not only did girls engage more with digital technology when working collaboratively than when working alone, but they were also more likely than boys to feel they had learnt from their fellow students. These results may be linked to girls' strong collaborative problem-solving skills: In the 2015 PISA (the OECD's Programme for International Student Assessment), girls significantly outperformed boys in every country that participated in the collaborative problem-solving assessment.[175] Girls were also significantly more likely than boys to agree with statements that indicated a

positive attitude towards collaboration and teamwork. In light of these data, teaching training and professional development should emphasize collaborative learning as a strategy for engaging girls with technology, and boosting and maintaining their self-confidence in developing digital skills. In addition, digital learning content and online learning platforms, which often focus on individual learners, should review and adapt materials and software to include more collaborative functions that might better engage women and girls, and help them develop ICT skills.

Image 20:

Women participating in the Internet Saathi programme in West Bengal

Source: Internet Saathi

Collaborative and peer learning has also been shown to have benefits in some circumstances for women outside the formal education sector. The Internet Saathi initiative in India is a good example. Launched in 2015 by Google and Tata Trusts, the programme aims to facilitate rural women's engagement with the internet by teaching them basic digital skills and providing them with a mobile device, whether a tablet or smartphone.[176] What makes the programme unique is that it uses only local women as trainers, an attribute that has contributed to its success. Women trained as saathis (Hindi for 'friend') are equipped with the skills and tools (including training, mobile devices and a bicycle for transport) to help other women in nearby communities access and use the internet in meaningful ways.[177] This model makes the initiative extremely sustainable and scalable. According to estimates from Google, as of August 2018 the programme had benefited 17 million women in 1.7 million villages across 17 states in India, with plans to reach 3 million villages in 2019.[178] In addition to using the internet to access valuable information about topics such as maternal health and agricultural techniques, many participants have gone on to form women's collectives and start their own businesses or find new ways to earn money.[179] At the end of 2017, the programme expanded to specifically include a digital-based livelihoods programme called the Foundation for Rural Entrepreneurship Development (FREND), which aims to help 1 million saathis establish online businesses to generate digital-based income by 2022.[180] This programme demonstrates the potential of peer learning to magnify the benefits of digital skills training for women and girls, and have a lasting and far-reaching impact on their communities.

#07
CREATE SAFE SPACES AND MEET WOMEN WHERE THEY ARE

For adult women, informal learning may be the only pathway available to them for developing digital skills. Interventions targeted at adult women should take into account cultural norms as well as women's domestic responsibilities. For instance, internet cafes and other ICT access hubs are often male-dominated spaces that are off-limits to women, or located far from women's homes or in unsafe areas. Public access points that are female-friendly, such as specially-designed libraries, parks and community centres, are particularly important in these contexts.[181] Governments might consider designating women-only spaces for internet access in these locations to further accommodate women's needs. In some contexts, digital training programmes, classes that are mixed-gender or offered late at night may be considered inappropriate or make women feel uncomfortable. Even in cultures where mixed-gender education is common and accepted, researchers have found that women tend to ask more questions and discuss problems and concerns more readily in secure, moderated, women-only environments.[182] Depending on the cultural context, governments should consider partnering with schools and community centres to offer all-female digital skills courses, led by female instructors or moderators. Schedules should be designed to accommodate the target group; for instance, classes aimed at stay-at-home mothers should be offered during school hours and welcome young children or provide childcare. Ideário Hub, a technology start-up in Mozambique, accomplishes this by offering free, three-month digital literacy courses for low-income women in Maputo, the country's capital.[183] Many of the participants are young mothers who attend the classes after dropping their children at school and may bring their infants with them to the training centre. Interventions must acknowledge women's domestic responsibilities and make an effort to 'meet women where they are'. Often programmes that aim for inclusivity fall short of this goal because of logistical issues such as class schedules that essentially function to exclude women.

Image 21:

A young mother participating in a digital literacy course offered by Ideario Hub in Mozambique

Source: Mercedes Sayagues/ Inter Press Service

All-female ICT classes, taught by women, may be also considered at the secondary and tertiary education levels within the formal education sector. While the global trend is moving away from sex-segregated education, it may be helpful in some scenarios when teaching digital skills, as a way to boost girls' engagement and self-confidence and to create a safe space for discussing issues that disproportionately affect them, such as non-consensual pornography and gender-based online violence. This sort of intervention may be needed for digital skills classes in the short term to narrow the widening digital gender divide.

Online and mobile learning can help women who already have basic digital skills and internet access to develop more advanced ICT skills in a convenient and secure setting. Because of its flexibility and potential for potential for 'anywhere, anytime learning', mobile learning already meets many of the requirements for interventions aimed at accommodating women's 'time poverty'. However, the online arena does not dispel concerns about safety or sharing sensitive issues with men. The impersonal, public nature of MOOCs and other online learning platforms may be uncomfortable for some women, particularly if interaction with male students is required. The EQUALS Research Group has suggested that many online spaces, like physical spaces, are 'equally dominated by men and present some of the same challenges women face in traditional pathways' (EQUALS, 2018). Universities and other organizations offering online learning may consider implementing the same interventions as brick-and-mortar institutions: women-only ICT courses or sections, taught and moderated by women and operated in digitally secure environments that ensure privacy.

#08 EXAMINE EXCLUSIONARY PRACTICES AND LANGUAGE

Representations of education, research and work in the digital sector, including the language used to describe courses, majors, scholarships, careers and job postings, make a difference in women's and girls' perceptions about whether they belong in the digital space. As pointed out in the theoretical framework for the Hypatia Project, an EU-based initiative to promote gender-inclusive STEM education, if fields such as computing are represented in a way that offers women limited, stereotypical roles, those women are as likely to feel alienated as they would be by a stereotypical male-dominated representation.[184] Education systems should take a hard look at their curricula and procedures to identify and remove gender bias and stereotypes. For example, as part of its effort to enrol more women in its computer science programme, professors at Harvey Mudd College in the USA examined course materials and removed references to common tech stereotypes that might make women feel less welcome in class.[185]

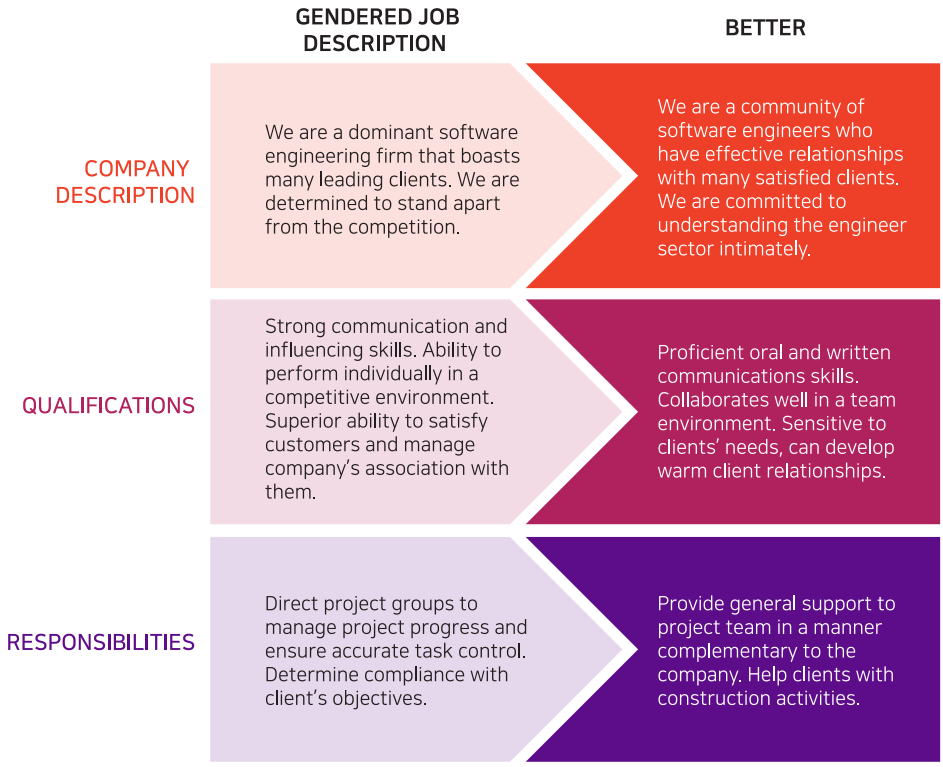
The language used to describe course and programme offerings is particularly important. A study of university course descriptions for entrepreneurship programmes identified an overwhelming tendency towards 'masculine' phrasing that emphasized competition, difficulty and the potential for failure – for instance, describing the field as a 'contact sport' and 'not for the meek and mild'; emphasizing

the importance of 'risk-seeking behaviour' and 'very hard work'; and warning students that 'if you cannot commit the time . . . this class is not for you'.[186] Phrasing coded by the researchers as feminine included references to collaboration, collegiality, ethics, trust, relationships and social impact – for instance, describing the field as 'inherently social [and] collaborative'; characterizing course activities as 'sharing and building trust with your classmates'; and highlighting work towards 'sustainable economic, social and institutional change'. Descriptions were less masculine for introductory and overview courses and increasingly so for courses aimed at developing and applying skills. Similar linguistic patterns can be found in the course descriptions for university computing programmes, and it is likely that such language has an exclusionary effect on women.[187] Institutions trying to attract more women to ICT-related studies, whether at the secondary or tertiary levels or in non-formal education, should consider the power of language when writing and revising course and programme descriptions, with an eye towards more gender-neutral and inclusive phrasing. Harvey Mudd College, for instance, which has successfully increased the number of female computer science graduates, rebranded its Introduction to Computer Science course to a more gender-neutral (and arguably more descriptive and accurate) title: Creative Problem Solving in Science and Engineering Using Computational Approaches.[188]

Image 22:

Creating gender-equal job descriptions

Source:
Hire More Women in Tech



Language also matters in the professional realm. Gendered language in job postings and course descriptions that emphasizes competitiveness and assertiveness over teamwork and relationships may discourage women from applying.[189] A study of job advertisements in the UK identified the top male-gendered words as 'lead', 'analyse', 'competitive', 'active', and 'confident', whereas the top female-gendered words were 'support', 'responsible', 'understanding', 'dependable', and 'commitment'.[190] The US National Center for Women and Information Technology (NCWIT) has developed

several resources for reducing unconscious bias in job advertisements, as has the TEQtogether (Technology Equality Together) initiative. Their recommendations include avoiding gendered words and phrases (possibly using an online 'gender decoder' tool that scans for gender-coded words),[191] avoiding superlatives and extreme modifiers, using gender-neutral pronouns ('you' or 'they' as opposed to 'he'), limiting the number of requirements that are most important for the job, and emphasizing the organization's commitment to diversity, flexibility and quality of life.[192] On a related note, recent research from Stanford University found that tech industry recruitment sessions that highlight competitiveness, include overt gender stereotypes and 'geek' culture references, and fail to include any female employees – or worse, feature men giving presentations while women hand out refreshments or swag – tend to discourage women from applying.[193] Work-based trainings aimed at increasing gender sensitivity and reducing discrimination and harassment can be a good venue for sharing information on best practices for eliminating gender bias in recruitment and hiring practices.

Education systems and training programmes can also help debunk the myth that success in technology-related fields depends on innate 'genius' and a knack for entrepreneurship. These stereotypes, perpetuated by the success and celebrity of Silicon Valley business leaders such as Mark Zuckerberg, Elon Musk and Jeff Bezos, and especially rampant in the field of frontier technology, tend to favour men and turn women away from the industry. A 2015 study found that academic fields that place a high value on 'brilliance' or innate intellectual giftedness – including computer science, engineering and physics, as well as humanities disciplines like philosophy – tend to have the lowest numbers of female PhD candidates, due to the cultural stereotype that genius is a male trait.[194] School-based professional development for teachers and university professors, community outreach events for parents, and work-based trainings for colleagues and managers can all help overturn gender-biased beliefs about what is required to be successful in the ICT sector.

#09
RECRUIT AND TRAIN GENDER-SENSITIVE TEACHERS

Students cannot effectively learn digital skills from teachers who lack digital skills themselves. While gender-disaggregated data are scarce on the effect of teacher quality on students' ICT skills, some research suggests that unskilled teachers may disproportionately affect girls' learning in technology-related subjects.[195] ICT training for all teachers is therefore an essential component to any intervention addressing the digital gender divide. When the UK changed its national curriculum in 2014 to incorporate compulsory computer science classes, for example, one of the main challenges it faced was ensuring a sufficient number of teachers with the skills and confidence to successfully pilot the new subject.[196] Digital skills should be incorporated into national teacher standards and the curriculum of teacher training programmes for pre-service and in-service teachers of all subjects and levels, to ensure that teachers not only have these skills themselves but know how

Image 23:

ICT Competency Framework for Teachers

Source: UNESCO

	TECHNOLOGY LITERACY	KNOWLEDGE DEEPENING	KNOWLEDGE CREATION
UNDERSTANDING ICT IN EDUCATION	1	1	1
CURRICULUM AND ASSESSMENT	2	2	2
PEDAGOGY	3	3	3
ICT	4	4	4
ORGANIZATION AND ADMINISTRATION	5	5	5
TEACHER PROFESSIONAL LEARNING	6	6	6

to effectively incorporate them into their teaching practice and materials in order to support students in developing proficiency. UNESCO's ICT Competency Framework for Teachers, Version 3, published in 2018, contains guidance for incorporating ICT skills into teacher training and professional development, and is widely used in countries.[197] Regional and national networks, such as the UK's Network of Teaching Excellence in Computer Science, can also be established to give technology educators access to support, coaching and mentorship from their colleagues.[198]

Recruiting and training more female ICT teachers may be particularly beneficial to girls. In North America, for example, girls' interest in computing has been found to be significantly higher when the subject is taught by a female teacher, whereas boys' interest is unaffected by the teacher's gender.[199] Female teachers' self-efficacy, or confidence in their knowledge of the subject and their ability to teach it, has been linked to girls' achievement in STEM subjects but not to boys',[200] again suggesting that same-gender teachers may be more important to girls' development of digital skills than boys'. In some contexts, systems therefore need to invest in recruiting and training more female teachers in technology-related subjects across all education levels, and in upskilling existing female ICT teachers.[201] This can be incentivized in a number of ways. For instance, grants, reduced tuition fees and loan forgiveness programmes for women planning to teach a technology-related subject can encourage more women to enrol in teacher training programmes. Schools and districts can offer free in-service training and professional development for female teachers to enhance their ICT skills, perhaps tied to pay increases or bonuses for women who complete a credentialing process to enable them to teach computing and related subjects.

Teachers' attitudes and beliefs are also important, as stereotypes and gendered notions of intelligence and aptitude have a profound effect on children's sense of self-efficacy and confidence. In a Greek study, for example, middle school students who reported high teacher expectations relating to ICT learning also held more positive views of their ICT skills.[202] Beliefs that aptitudes and abilities are innate may be more discouraging for girls than boys: Research has found that teachers' perceptions of sex-based ability can have a negative impact on girls' pursuit of technology-related studies.[203] While toxic at all education levels, such views may be particularly damaging in the primary and lower secondary grades, when girls are forming their self-image about intelligence, aptitude and potential. A Swedish study, for example, demonstrated that students' career aspirations are largely formed by age 13 and are progressively more difficult to change after this point.[204]

> Girls have been found to perform better when they are told that skills can be improved and that intellect and abilities are not fixed or innate.

In light of this evidence, institutions responsible for teacher training should implement pre-service training and in-service professional development to help teachers identify and mitigate bias in learning materials as well as their own teaching practices, and adopt gender-responsive approaches to teaching ICT. The TeachHer Initiative, for example, used UNESCO's network of teacher training institutes to conduct workshops for educators and policy-makers from around the world in methods to create gender-responsive lesson plans and inspire adolescent girls to pursue STEM subjects as well as art and design.[205] Similarly, the Talent Viewer project in the Netherlands has developed a gender awareness training for teachers in primary education that focuses specifically on helping all students develop STEM skills.[206] While these initiatives focus on STEM more broadly, the same approach can be used to equip teachers with strategies to help girls build confidence and interest in digital skills. Guidance on good practices should be specific and evidence-based. For instance, girls have been found to perform better when they are told that skills can be improved and that intellect and abilities are not fixed or innate.[207] Teachers should convey this idea to students both explicitly through direct instruction and implicitly through their feedback and praise, to help students cultivate a 'growth mindset'.

Finally, the same issues facing teachers in the formal education sector also apply to educators in informal contexts. Governments and organizations implementing ICT programmes need to plan for and invest in capacity-building for instructors and mediators, particularly for community-based organizations that do not have a technology focus. This may be especially important for female informal educators, who might need more training to ensure they feel confident in their own digital skills before teaching them to others.

#10 PROMOTE ROLE MODELS AND MENTORS

The importance of role models and mentors is emphasized repeatedly in the literature on gender and digital skills.[208] In one North American survey, 62 per cent of secondary school girls who had someone encourage them to study computing or coding said they were likely to major in this subject in college, as compared to 15 per cent of girls who did not have anyone encouraging them.[209] The presence of female role models is particularly beneficial for girls. For instance, the negative effect of sociocultural stereotypes on girls can be mitigated by mothers and other female family members setting a positive example of female technology

use and encouraging girls to pursue technology-related studies and leisure activities. Competent and effective female teachers, particularly in ICT-oriented subjects, help build girls' self-confidence in their digital skills and inspire them to consider careers in technology. In addition to implementing parental outreach programmes and hiring more female ICT teachers, education systems should review and update their curricula to ensure that women are featured prominently in the learning materials for technology-related subjects. Female role models from the community can also be a source of inspiration. For instance, local women working in the technology industry can be recruited by schools, universities, TVET centres, workplaces and women's organizations to speak with groups of women and girls about their experiences and answer questions. These approaches help girls see varied pathways into the digital sector and imagine themselves in technology professions.

> Role models help girls see varied pathways into the digital sector and imagine themselves in technology professions.

ICT mentorship programmes for women and girls have been found to be effective both within and outside the formal education sector. Schools and universities may consider establishing programmes that pair primary school girls with secondary school girls, secondary school girls with women attending university, and female secondary school and university students with women working in the ICT sector. Female teachers and professors can also take on mentoring roles for small groups of female students, either informally through girls' computing clubs and other extracurricular activities, or formally through a designated mentorship programme. The Aspirations in Computing (AiC) initiative, established by the NCWIT in the USA, is a good example of a network that works with schools to provide a long-term community for female technologists from kindergarten through higher education and beyond. At the primary and secondary education levels, AiC's AspireIT outreach programme uses peer-led learning to teach K–12 girls programming fundamentals and computational thinking in hands-on environments. Of the 9,500 girls the programme has reached, 75 per cent expressed interest in taking a future computing class after the programme concluded,[210] suggesting that mentorship relationships, particularly among girls who are close in age, can significantly influence girls' motivation to develop more advanced ICT skills. At the tertiary level, women who attend an NCWIT Academic Alliance institution and are majoring or minoring in computing are encouraged to join the AiC Community, which coordinates virtual and in-person meetups, hands-on activities for exploring computer science concepts and opportunities to participate in computing outreach programmes for younger girls in local communities. Educators and adult influencers also serve as mentors for women and girls throughout the network. In addition to mentorship, AiC provides members with access to scholarships, internships and job opportunities, and publicly acknowledges female achievements in technology through awards for students and educators. This initiative is successful, at least in part, because of its comprehensive approach that creates a community of strong female role models to support girls and women throughout their education and beyond.

Outside of formal education, governments and organizations can partner with female ICT professionals to provide mentorship and training opportunities to women and girls. In Jamaica, for example, the organization Youth Can Do IT (YCDI) launched a Women in ICT Mentorship Program in 2018 that pairs young women between the ages of 15 and 22 with female mentors working in the ICT industry.[211] Girls participate in monthly themed meetups and quarterly technology workshops, as well as personal development and empowerment workshops focused on recognizing and developing talents and strengths.[212] A similar programme in Ghana called Tech Needs Girls has established a network of female computer scientists and engineers who teach girls to code and serve as mentors and role models.[213] As of 2016, the programme had reached more than 2,500 girls through a network of over 200 mentors.[214] Programmes like these, which pair girls with adult women working in the technology industry, help girls visualize themselves as ICT professionals and view the path to reaching such a goal as manageable and achievable.

Mentorship initiatives can also help adult women learn digital skills in a safe and supportive environment. One example comes from Kenya and Uganda, where the Ugandan Hub for Investigative Media and Deutsche Welle Akademie run a digital security mentoring network for female media professionals, who are often subject to cyber-violence and online harassment as well as offline threats (in a survey conducted in Kenya, for example, 75 per cent of female journalists had experienced online harassment in the course of their work).[215] Funded by the German Federal Ministry for Economic Cooperation and Development (BMZ), the project offers workshops and seminars on digital security for women journalists and bloggers from around the region, who have the opportunity to share experiences and learn from one another.[216] While the workshops began as informal sessions, the network has made efforts to professionalize its mentoring activities by setting quality standards and developing a curriculum that includes topics such as creating a secure password, backing up data, encrypting emails, erasing digital tracks and avoiding risks while using public Wi-Fi.[217] The evolution of this initiative shows how even an informal network of female professionals can make a difference in women's digital skills and safety by fostering supportive and productive relationships among colleagues. Similar networks could be established in other industries or among teachers to enable women to share information about issues related to ICT and gender that are particular to their field.

Beyond interventions targeting girls and women

Gender-equal education will not be realized until gender issues are mainstreamed. Improved awareness is needed about the biases that keep women out of technology fields, both within the education sector and in society more broadly. Interventions do not necessarily need to focus on upskilling women and girls to make a difference in the digital skills gender divide. Educators should be encouraged to take a step back and think about the ways in which discourses around technology are gendered and how this has trickled into everything from the curriculum to the posters on classroom walls. As much as efforts are needed to equip women and girls with digital skills, so too are interventions to enhance understandings of how the digital field is biased and to encourage approaches to neutralize this bias and make digital skills education attractive and approachable for all learners.

#11
BRING PARENTS ON BOARD

Depending on their attitudes, parents can either reinforce or help dismantle harmful gendered stereotypes about intelligence, aptitude and 'appropriate' fields of study for women.

Parents, along with teachers, tend to be the biggest influencers for students when it comes to selecting subjects and making career choices.[218] Parental support and encouragement has also been shown to be the most important factor for self-efficacy, for both boys and girls.[219] Depending on their attitudes, parents can either reinforce or help dismantle harmful gendered stereotypes about intelligence, aptitude and 'appropriate' fields of study for women.[220] They are also often the primary gatekeepers of digital technologies and therefore play a crucial role in facilitating access to ICTs and encouraging their use, either directly or indirectly.[221] In many contexts, parents have been found to treat daughters and sons differently in terms of ICT access and use, often introducing technology to girls later than boys, imposing more restrictions on its use and prioritizing boys' access over girls'.[222] Even when parents are supportive of their daughters pursuing ICT-related studies, they often feel ill-prepared to help their children; for instance, a study conducted in the USA showed that while 46 per cent of parents believe that computing and coding are high priorities, only 25 per cent felt they understood the specific ways in which ICT studies could benefit their children.[223]

Image 24:

A conference coordinated by the Talent Viewer project in the Netherlands to increase girls' engagement in STEM

Source: VHTO

Education systems should design and implement parental outreach programmes aimed at breaking down gendered stereotypes about ICT and raising awareness about the importance of digital skills for girls specifically, perhaps partnering with NGOs, local government or the private sector to maximize effectiveness and reach the parents of out-of-school girls. The Dutch Talent Viewer project, for example, which is a partnership between the Ministry of Education and a local NGO, actively engages the parents of primary school students in awareness-raising campaigns to promote girls in STEM.[224] In Pakistan, Plan International partnered with a local telecommunications company to launch the Safe Internet and School Outreach Programme, an initiative that established solar-powered ICT labs in 44 schools and trains students, parents and teachers in computing, digital learning and online safety.[225] Plan International also conducts parental outreach in India through its Digital Learning Centres. Even simple interventions have been shown to make a difference: In one study, children of parents who were provided with informational materials (brochures and a website) about the usefulness of STEM courses were found to take, on average, one more semester of science and mathematics during the last two years of secondary school, compared with the control group.[226] This is significant, both because of the relatively minor effort involved on the part of the school and because the intervention affected subject selection at a time when most girls drop out of ICT studies. As shown by these examples, even small-scale efforts to inform and persuade parents of the importance of digital skills for girls can have a meaningful impact on girls' ICT studies.

An overemphasis on safety is often used as a justification for preventing women and girls from using technology and cultivating digital skills.

Programmes should place a strong emphasis on the myriad benefits of digital competence for girls, including boosting their confidence, increasing educational and professional opportunities, and promoting their health and well-being. The topic of online safety should also be engaged directly. While many of parents' concerns are valid, an overemphasis on safety is also often used as a justification for preventing women and girls from using technology and cultivating digital skills.[227] Parents should be actively advised to give girls the same access to technology as boys and the same amount of screen time. Interventions targeting mothers specifically may be helpful, as mothers' expectations in particular have been found to have a more significant impact on their daughters' career choices than on the career choices of their sons.[228] Programmes should aim to impress upon them the importance of setting high expectations for their daughters in terms of digital competence, on par with expectations for their sons.

#12
LEVERAGE COMMUNITY CONNECTIONS AND RECRUIT ALLIES

For interventions that are not school-based, partnering with NGOs and other local groups – particularly women's organizations – that are already embedded in the community is advisable in order to increase a programme's credibility and help with recruitment, as well as allow programme planners to foresee and overcome potential challenges, including resistance and backlash. Involving members of the target group (i.e. local women) in designing interventions will also ensure that training programmes address the needs and desires of the people they are designed to help. In addition, empowering local female community leaders to become ICT advocates and trainers can help maintain the momentum and ensure that women do not lose their learning gains after the programme ends.

> Digital skills training may be most effective when it is embedded in multifaceted community projects rather than implemented as stand-alone interventions.

While there is some debate about the effectiveness of partnering with women's organizations to run interventions for digital inclusion, many organizations, including UN Women and the World Wide Web Foundation, have recommended such an approach.[229] EQUALS partner Pro Mujer, a leading women's organization in Latin America, uses an integrated approach that combines access to financial and health care services with training programmes in financial and business skills, entrepreneurship and digital literacy, in order to help low-income women and their families achieve economic independence and self-sufficiency.[230] In 2018, Pro Mujer reached 250,000 women, provided 500,000 health interventions and disbursed US$200 million in small loans across five countries. In addition to incorporating digital literacy into its training programmes, the organization works with leading technology firms and non-profits to help close the digital gender gap.[231] In 2017, for example, Pro Mujer partnered with Microsoft to bring a coding course to women in Bolivia.[232] In 2018, the organization joined the EQUALS Global Partnership as part of the Skills Coalition, and committed to providing 2,000 digital literacy trainings for women microentrepreneurs, youth and Pro Mujer staff in Bolivia by 2020.[233] While a variety of approaches are needed, established women's organizations like Pro Mujer can be valuable allies in efforts to increase digital skills for women and girls. The success of Pro Mujer suggests that digital skills training may be most effective when it is embedded in multifaceted community projects rather than implemented as stand-alone interventions. While digital skills are an end goal themselves, they are best cultivated as part of programmes that meet more immediate needs like access to loans.

As the EQUALS Research Group has pointed out, 'it is important to act in an inclusive manner so as not to alienate the male population, overlook other disadvantaged populations or exacerbate backlash'.[234] In order to ensure the success and long-term sustainability of interventions, men and boys must be part of the solution. Numerous initiatives have been launched to recruit men as allies and advocates for gender equality – including the UN's HeForShe, Catalyst's Men Advocating for Real Change (MARC), the Forté Foundation's Men As Allies, Sweden's MÄN, the Australia-based Male Champions of Change (MCC) Institute, and the global MenCare and MenEngage alliances – and many resources are available on strategies for engaging men on the issue of gender equality.[235] Male advocacy campaigns specifically targeting the digital gender divide are rare, but EQUALS partner TEQtogether, a global coalition launched in 2018 by the UNESCO Chair in ICT for Development at Royal Holloway, University of London, is a good example. The coalition focuses on four main areas of intervention:

1. informing men through the provision of information and resources on how their actions impact digital gender inequality;
2. identifying actions that men can take to enhance gender equality in the tech workplace, and convening training workshops around these actions;
3. recommending actions that men can take to reduce digital violence against women; and
4. encouraging reverse mentoring, through which women mentor men at all levels in tech organizations.

TEQtogether has developed evidence-based guidance notes in multiple languages covering topics such as writing performance appraisals in the tech sector, convening conferences or events, and strategies that fathers can use to help empower girls in STEM subjects.

The NCWIT also has several resources dedicated to male advocacy for gender diversity in the workplace, including a Male Allies and Advocates Toolkit that details strategies for creating male ally networks and evaluating their effectiveness.[236] Through interviews with men employed in the technology sector, the NCWIT has identified experiences and arguments that influence men's thinking about gender issues in the workplace, as well as factors that discourage men's advocacy.[237] For instance, the report found that a combination of personal and professional experiences motivate men to become gender advocates and allies, including 'having a minority experience themselves; relationships with their wives, daughters and mothers; having had female bosses, mentors or colleagues; attending workshops on bias; and witnessing biases in action'.[238] While some of these experiences are based on chance, others can be created, for example by enabling men to attend conferences and events on women in ICT, to gain a minority experience; by hosting workshops on gender inequalities and unconscious bias; and by rotating work assignments to ensure that men have opportunities to work with female supervisors, mentors and colleagues. Data about a company's workforce can also be effectively employed both to identify potential male allies and to make economic and moral imperative arguments more persuasive.

Although many of the NCWIT and TEQtogether resources are aimed at the technology workplace, their recommendations can easily be applied to interventions designed by educational institutions and community organizations in a variety of contexts.

For instance, schools or districts with a mix of male and female ICT teachers could consider rotating teaching assignments regularly to ensure that all students get to experience being taught by a female teacher. Classroom activities can borrow strategies from work-based unconscious bias training to raise students' awareness of the gender inequality in ICT, and local NGOs can offer workshops for men on reducing online violence against women that emphasize male responsibility rather than female victimhood.

Image 25:

Strategies to encourage male advocacy for gender equality in technology

Source:
National Center for Women and Information Technology

1 **Recreate 'temporary' minority experiences for men.**

Attending majority female conferences or workshops was one example cited as eye-opening by several men in the study.

2 **Ensure that male employees have experiences with female mentors, bosses or other female leaders.**

Consider setting up formal or informal programmes or rotational assignments that might encourage these kinds of pairings.

3 **Invite men to 'women in tech' events, workshops on unconscious biases or diversity trainings.**

Being educated about the issues and hearing from experts, and from technical women themselves, can change men's mind.

4 **Share 'your story' of being a minority in a male-dominated environment with male colleagues you trust.**

The NCWIT study found that listening to women's stories about their experiences was one of the most influential factors in motivating men to work for increased gender equity.

5 **Give male colleagues a specific role in gender diversity efforts.**

Gender diversity is not a women's issue. Many men would take more action if they knew what to do.

6 **Provide men with information to raise awareness and make change.**

You could share NCWIT's Top 10 Ways to Be a Male Advocate brochure, give them the male advocates report or show them the gender statistics in their department.

7 **Provide men with tools to use in gender diversity efforts.**

Point to the recruiting, hiring, supervising or retention practices described on the NCWIT website. Share accounts of ways other men held their employees accountable for diversity efforts, as described in the NCWIT Male Advocates report.

8 **Bring men together who care about the issues.**

Having other men to talk to about the issues and challenges can help men make more progress in their own individual efforts.

#13
SUPPORT TECHNOLOGY AUTONOMY AND WOMEN'S DIGITAL RIGHTS

It is important to note that while digital skills can increase women's independence – financially, socially, politically, personally[239] – this can only happen if women are empowered to use technology autonomously. Too often, women and girls are digitally 'tethered' while men have administrator privileges, control of account settings and passwords, and access to search history and other means of surveillance. In these situations, rather than being a tool for empowerment, technology serves to reinforce male control over women. To remedy this, it is necessary to normalize female digital autonomy. This can be accomplished by educating women about their digital rights and conducting outreach and training for teachers, parents, managers and other potential digital gatekeepers. Women and girls need to be taught how to protect their privacy and ensure their safety both online and offline. One example of resources that could be used to support this type of training is the Empowering Internet Safety Guide for Women, produced by vpnMentor, which includes detailed advice on how women can protect their privacy and keep themselves safe when using social media platforms, online dating sites and ride-sharing apps. The Guide further explains how women can respond to workplace harassment and safeguard themselves against technology-facilitated intimate partner violence.[240]

Too often, women and girls are digitally 'tethered' while men have administrator privileges, control of account settings and passwords, and access to search history and other means of surveillance.

Women and girls as well as men and boys also need to understand the mechanisms for holding leaders, companies and public institutions accountable for digital safety, and be equipped with the tools to lobby for societal changes, such as legislative and judicial reforms, to prevent online abuse. Many governments are aware of the issues posed by big data – the United States Supreme Court, for example, recently acknowledged the challenges presented by the sheer quantity of data generated by mobile phone records and the 'seismic shifts in digital technology' that make these records available, and it concluded that people do not necessarily surrender their privacy when they engage in public behaviour.[241] Yet existing laws are generally not nimble enough to respond to the rapidly changing digital space. In addition to educational interventions, governments need to prioritize gender-equal technology use through policies and legislation that protect women's digital privacy and autonomy.

#14
USE UNIVERSAL SERVICE AND ACCESS FUNDS

Governments may consider using universal service and access funds (USAFs) for investments in closing the digital skills gender gap. While these funds are usually used purely to extend networks and coverage, they can and should be reoriented towards skills training, as education – not wires and networks – is the major barrier in many communities. In Pakistan in 2015, for example, the national Universal Service Fund partnered with Microsoft and Bait-ul-Mal, a Pakistani social welfare organization, to launch a programme to train girls in ICT.[242] As of spring 2018, the Ministry of IT had used USAFs to establish 226 computer labs for girls and provide training for over 100,000 girls and more than 200 teachers.[243] At the 2018 Mobile World Congress, the Pakistan Universal Service Fund signed a memorandum of understanding with Huawei to further expand and improve the programme.[244] Also in 2018, the World Wide Web Foundation and the Alliance for Affordable Internet, with support and funding from UN Women, produced a report outlining how governments in Africa can and should use USAFs to fund programmes aimed specifically at closing the digital gender divide. Their recommendations include allocating at least 50 per cent of USAFs to increase women's internet use, which includes skills education programmes as well as actions to upgrade network infrastructure and improve access.[245]

> Governments can and should use USAFs to fund programmes aimed specifically at closing the digital gender divide.

Some African countries have already invested USAFs towards ICT inclusion programmes for women and girls. Rwanda's Universal Access Fund, for instance, supports a competition run by Girls in ICT Rwanda called Ms. Geek Africa, which aims to encourage girls to participate in STEM fields by designing innovative technology-based solutions to problems relevant to African communities.[246] Girls and young women aged 13-25 who live in countries that belong to the SMART Africa alliance (currently 22 countries) are eligible to compete; all finalists participate in a week-long training and mentorship programme, and winners receive money and equipment as well as training and mentoring to further develop their ideas. Ghana has used USAFs to fund its Digital for Inclusion programme, which includes a stipulation that women constitute 60 per cent of the programme's beneficiaries.[247] In Benin, USAFs have funded a project that uses a mobile platform to provide agricultural pricing information to rural women entrepreneurs.[248] Such funds can also be used to support ICT scholarships for women and gender-responsive professional development programmes for teachers. These examples illustrate how USAFs can be leveraged and applied to a wide range of activities in support of governments' efforts to close the gender divide in digital skills. As mentioned in CHAPTER 1, education and skills need to be considered a component of access and therefore deserving of USAF investments. As ICT hardware falls in price and affordable networks expand, the dominant access barrier is educational, not technical.

#15
COLLECT AND USE DATA, AND SET ACTIONABLE INDICATORS AND TARGETS

At a moment when the ability to leverage ICT constitutes a core competency – one that connects women and their families to social services, jobs and essential information about health, civic engagement and human rights – measurement and evaluation need to improve, as does accountability for progress. Sex-disaggregated statistics about digital skills acquisition is thin in developed countries and non-existent in many developing countries, as is the longitudinal data needed to gain insights into trends.[249] At the regional level, Europe and North America have the most robust data on ICT skills, followed by Asia, whereas Africa has the least.

Many countries are still working to develop frameworks and methodologies to measure digital skills, and in some cases there is confusion regarding which government ministries are accountable. The ITU's indicator on the proportion of the population that can write a computer programme only has data for 49 countries. The OECD's Survey on Adult Skills contains a measure on ICT skills for problem-solving, but data is only available for 36 mostly European countries. There is currently one international assessment of students' achievement in computer and information literacy, ICILS, which was administered in 2013 and again in 2018. Results of the 2018 ICILS assessment, which will also report on the domain of computational thinking, are scheduled to be reported in 2019. At the regional level, the EU has developed a comprehensive digital skills indicator for its household survey of ICT usage, which includes four competence domains: information, communication, content creation and problem-solving.[250] While these efforts are a promising start, more tools need to be developed to measure a broad range of digital skills across varied contexts. Such measurement tools must be designed in a way that facilitates adaptation to local contexts and frequent updates to keep up with the rapid pace of technological change. They should also be analyzed for gender bias to ensure they do not unwittingly favour boys.

The EQUALS Research Group has pointed to the need for data collection to move beyond binary sex-disaggregation 'towards finer degrees of gender disaggregation in order to recognize multiple and interacting identities (such as sexuality, poverty, class, education, age, disability and occupation)' that tend to be masked at the macro level.[251] For example, the gender gap for digital financial inclusion (as measured by making or receiving digital payments) is less than 3 per cent in Europe, versus around 8 per cent in Asia and the Americas and 10 per cent in Africa – while in Oceania, the gap is reversed in favour of women.[252] In the EU, young women are actually more likely than young men to have above-basic digital skills, whereas adult and older women are less likely to possess such skills.[253] In these and many other cases, sex-disaggregated data do not capture the whole picture; collecting and analyzing multiple data points will allow for more targeted and effective interventions.

Data are needed to measure progress on closing the digital skills gender divide. Some data on digital inclusion are regularly collected – World Bank data on digital financial inclusion, for example, are available for over 140 countries – whereas other types of

More work remains to be done to establish meaningful, actionable indicators to reflect progress towards gender equality in digital skills.

data, such as those on cyber-violence against women and girls, are not systematically collected.[254] Some organizations have developed toolkits to aid the measurement of gender equality in ICT: For instance, USAID has a gender and ICT survey toolkit that includes questions about technical proficiency with mobile devices and the internet.[255] The World Wide Web Foundation has also developed a digital gender gap audit toolkit for stakeholders, which includes indicators related to digital skills education such as the proportion of ICT-qualified teachers in schools, the percentage of women in technology and engineering research and development (R&D) fields, and internet access at secondary schools.[256] However, according to the EQUALS Research Group, the majority of indicators developed so far are 'conceptually unclear, lack an established methodology, or are not regularly collected'.[257] More work remains to be done to establish meaningful, actionable indicators to reflect progress towards gender equality in digital skills.[258]

More data are also needed on interventions designed to bridge the gender digital divide and their effectiveness in different settings. As pointed out by the EQUALS Research Group, 'due to the sometimes contradictory evidence for different solutions, data collection and monitoring are essential components to determine if solutions are effective and why'.[259] In early 2018, the Association for Progressive Communications published the results of a mapping study on research and initiatives in gender and digital technologies taking place in, or concerning, low-income countries in the past decade (2006–2017).[260] While this is a useful resource, more research is needed to identify the contextual factors that keep women from using ICTs and developing digital skills, particularly in the global South, and the strategies that have proven effective in encouraging digital skills development among women and girls in various settings. Interventions should aim whenever possible to track progress systematically and publish results widely, to contribute to the compilation of global resources on best practices in the area of gender and digital skills.

Most ICTs leave footprints that can be analyzed to reveal detailed topographies of gender disparities in digital environments.

In addition to collecting and analyzing information, governments also need to act on data by setting concrete, time-bound targets for closing the digital skills gender divide, and must hold themselves accountable for meeting their goals. Gender equality must be mainstreamed into ICT in education policy,[261] and progress should be shared regularly with stakeholders and the public. This means that, in addition to establishing indicators, governments need to collect and analyze data quickly

and frequently. This could be accomplished at least in part by deploying technology itself or other innovative solutions to fully understand and reconcile gender divides. Current methods typically rely on labour-intensive household surveys and other self-reporting mechanisms, even though most ICTs leave footprints that can be analyzed to reveal detailed topographies of gender disparities in digital environments. For example, a study conducted in a developing context in Asia showed that back-end mobile phone data, such as call records and airtime purchases, can be used to predict illiteracy among a population with 70 per cent accuracy.[262] Research supported by the UN's Data2X initiative has been exploring how data obtained from social media advertising application programming interfaces (APIs) can be used to generate real-time measures of gender digital inequality.[263] Estimates about Facebook's advertising audience, publicly available through the platform's marketing API, have also been analyzed to create an international Facebook Gender Gap Index. While the index reflects Facebook use and not internet access per se, the figures generated have been found to correlate with official statistics on gender gaps in internet and mobile phone access, indicating that it may be an accurate measure of gender disparity. These examples show how big data can be used in service of educational goals. Agencies and individuals tasked with measuring progress towards digital gender inclusion should consider working with data scientists to explore how technology might be able to facilitate, accelerate and automate the large-scale collection of data on gender and digital skills.

CONCLUSION

This policy paper has demonstrated that despite nearly two decades of efforts to achieve greater gender equality in digital skills, the divide remains large and, in many contexts, is growing larger still.

At a moment when technology is being marshalled to make choices of global consequence and is directing the lives of individuals in ways both profound and subtle, this imbalance warrants urgent attention.

Solutions to turn the tide will require a critical mass of efforts; the problem is too deep and multifaceted to address with singular actions – no matter how ambitious. This paper outlined some of the most promising approaches, scanning the world for policies and programmes that are 'un-gendering' technology and helping women and girls to develop their digital skills and gain confidence in gender-responsive learning environments.

Education has a key role to play in this process. It is where expectations are forged and competencies are cultivated.

The paper showed how the digital gender divide, once defined by gaps in access to technology, has been eclipsed by deficits in learning and skills. Across the world, many women and girls can afford technology but do not know how to leverage it for empowerment. This is true at the most basic levels of proficiency, all the way to the most advanced skills in frontier areas such as machine learning and big data analytics. Women fall off every rung of this skills continuum, so that by the time learners reach the vanguard of technology creation where norms, protocols

> Education is where expectations are forged and competencies cultivated.

and processes are shaped, women are almost entirely absent. AI technologies that determine who qualifies for loans, and the complex algorithms that dictate what information people see when they search the internet, to borrow just two examples, are developed almost exclusively by men; their outlooks and biases seep into applications that wield increasing influence over people's lives.

The paper explained how digital skills education programmes can respond by striving not just for gender sensitivity (although this is a start), but rather through gender-transformative approaches. Education carries a unique power to shift the 'tech is for boys' narrative that colours girls' and womens' interests, perceptions of aptitude, decisions about fields of study, professional aspirations and career paths.

The paper has sought to empower readers who are standing up for equality in digital realms and beyond by:

1. exposing the persistence and gravity of the digital skills gender gap;
2. articulating cogent rationales for interventions; and
3. offering recommendations and solutions, drawn from active initiatives and programmes.

The EQUALS Skills Coalition hopes that readers will use this paper and the larger publication as a tool, and also a call to action, to secure the investments and support needed to finally make education a pathway to life-changing digital skills for women and girls, as well as men and boys.

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THINK PIECE 1

THE ICT GENDER EQUALITY PARADOX

CONTENTS

01 OBSERVING THE PARADOX

02 STEM VS ICT

03 TAKEAWAYS

FOR MANY EUROPEAN COUNTRIES, HIGHER GENDER EQUALITY IS NOT ASSOCIATED WITH HIGHER FEMALE PARTICIPATION IN ICT PROGRAMMES

FOR MANY ARAB STATES, LOWER SOCIETY-WIDE GENDER EQUALITY DOES NOT SEEM TO SUPPRESS FEMALE PARTICIPATION IN ICT PROGRAMMES

04 CONCLUSION

05 REFERENCE DATA

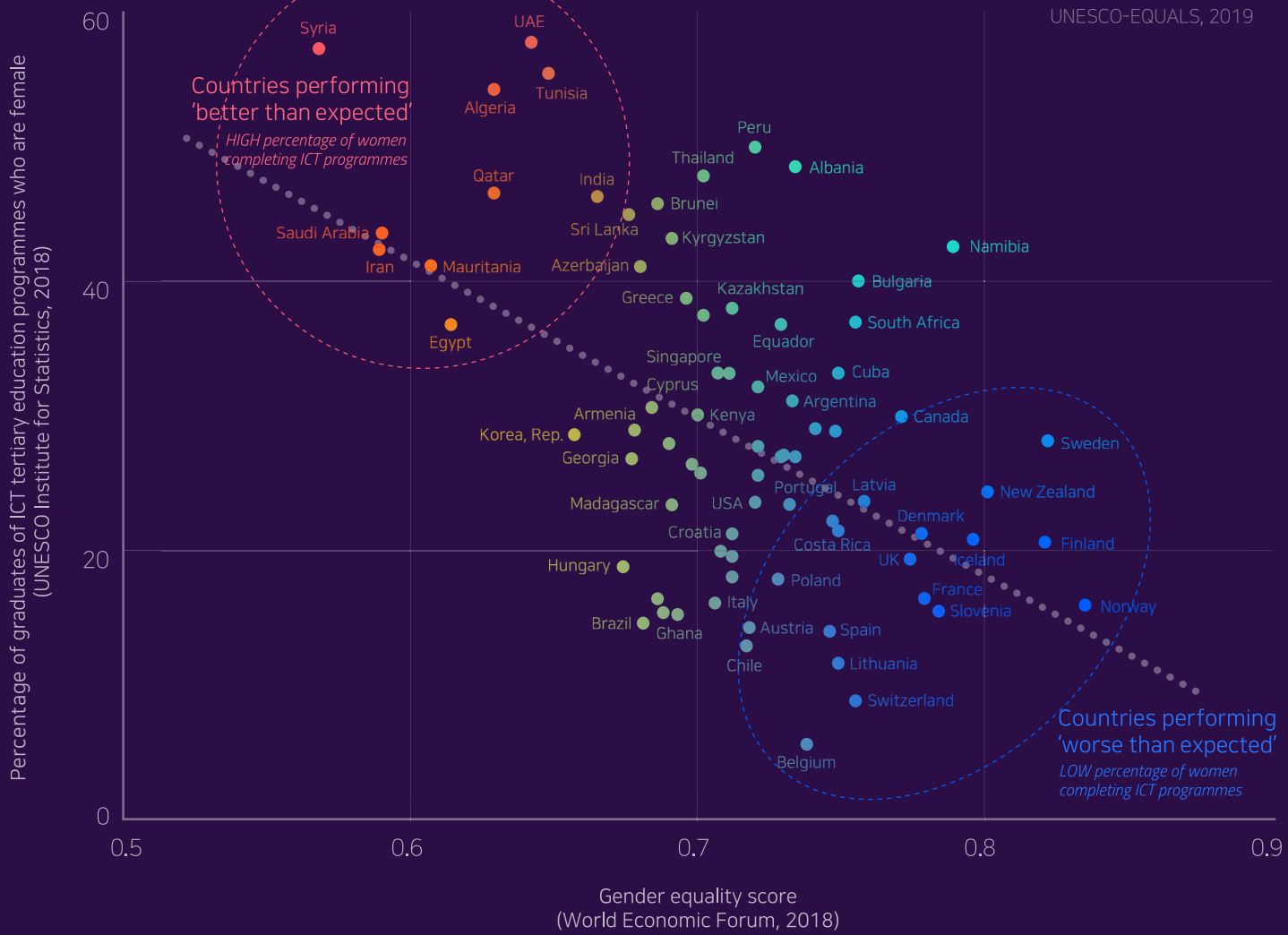
06 REFERENCES

01
OBSERVING THE PARADOX

The information and communication technology (ICT) gender equality paradox refers to the surprising lack of a direct relationship between gender equality levels and the proportion of female students pursuing advanced-level digital skills. In other words, countries with higher gender equality levels do not always have a higher proportion of women pursuing ICT-related diplomas.

The chart below makes this paradox visually apparent. It shows a negative association between gender equality levels and the proportion of women completing advanced-level ICT degree programmes. It further shows that countries with lower levels of gender equality report relatively more women completing ICT programmes than do more gender-equal countries.

ICT Gender Equality Paradox



02
STEM VS ICT

The ICT gender equality paradox, demonstrated here for the first time, bears similarities to a phenomenon that Stoet and Geary (2018) observed in cross-country analysis of gender participation in science, technology, engineering and math (STEM) education programmes.[1] These researchers found that countries with high levels of gender equality also have some of the largest STEM gender gaps in secondary and tertiary education. This is paradoxical because more gender-equal countries are those that offer girls and women more equal educational and empowerment opportunities, and generally promote girls' and women's engagement in STEM fields to close gender divides.

While the ICT gender equality paradox chart (page 76) mirrors, in many ways, the STEM gender paradox identified by Stoet and Geary, including the two key groups of countries that drive the negative correlation, ICT and STEM have important differences.

STEM covers a wide range of subjects, encompassing fields as diverse as chemistry, computer and information technology science, engineering, geosciences, life sciences, mathematics, physics and astronomy. The ICT field, by contrast, is much narrower and, significantly for the data findings shared here, better positioned to help students cultivate the technical skills in demand by white collar employers, according to labour market analyses by the ILO.[2] Skills forecasting organizations have consistently found that specialized ICT skills help people find high-paying work.[3] As one illustration, of the 25 'hottest' skills identified by LinkedIn for 2019,[4] over half correspond with the four-part definition for ICT education and training provided by the UNESCO Institute for Statistics:[5]

1. the study of the techniques and the acquisition of skills to produce books, newspapers, radio/television programmes, films/videos, recorded music and graphic reproduction with ICT;
2. the study of the design and development of computer systems and computing environments;
3. the study of using computers and computer software and applications for different purposes; and
4. the study of planning, designing, developing, maintaining and monitoring electronic equipment, machinery and systems.

What this means is that while ICT is a part of STEM, ICT skills, once developed, help make an individual uniquely employable in global labour markets. It follows that this 'job-oriented' aspect of ICT studies should, in theory at least, make advanced digital skills education attractive to male and female students alike.

Given the rapidly increasing demand for digital skills in the labour market, it seems reasonable to assume that women in countries with high levels of gender equality would pursue advanced ICT degrees in significant numbers, where barriers to entry are presumably low. But, as illustrated in the ICT gender equality paradox chart, this is, surprisingly, not the reality; overall levels of gender equality are not positively associated with the proportion of women receiving advanced ICT degrees. The attractiveness of ICT vis-à-vis STEM was not enough to change the paradox and regional groupings observed by Stoet and Geary.

03 TAKEAWAYS

Two main findings can be observed from the ICT gender equality paradox chart (page 76), both relevant to the international effort to bridge digital skills gender divides:

#1 For the European and other developed countries appearing on the lower right side of the chart, higher gender equality is not associated with higher female participation in ICT programmes.

In fact, for many countries with higher gender equality scores, female participation is lower than one in four. The policy implication arising from this finding is that if countries are expecting the ratio of female students pursuing advanced ICT degrees to follow the tide towards gender equality, they may have to wait a very long time. The inverse policy implication is that policy makers should take a hard look at the gender imbalance in ICT programmes and endeavour to ensure women, as well as men, are engaged in technology subjects and contribute to digital development.

The research implication is that more work is required to understand the cause of this anomaly in order to inform the design of intervention programmes. What explains the surprisingly low levels of gender equality in ICT studies in European and other wealthy countries that have strong gender parity in other fields of study and areas such as overall workforce participation, access to assets, health and political leadership? Are there policy or cultural practices that give rise to this aberration in gender balance? At a moment when the ICT field commands so much power, wealth and influence, not understanding and course-correcting the causes of the severe gender imbalance in ICT studies may contribute to further gender disparities, as technology comes to dominate new fields and industries.

#2 For the group of Arab States appearing on the upper left side of the chart, lower society-wide gender equality scores do not seem to be associated with lower female participation in ICT programmes.

In fact, gender equality scores notwithstanding, Arab countries have between 40 per cent and 50 per cent female participation in the ICT programmes (a proportion far higher than many of the more gender-equal European countries).

Additional research is needed to illuminate why this is the case. How and why do so many Arab countries achieve superior gender parity with regard to ICT studies? Can the strong performance of Arab countries be traced to unique practices and policies related to education or to different cultural norms that make ICT a more attractive field of study? While gender specialists do not often look to the Arab region for policy lessons in how to achieve gender equality, the narrow area of advanced ICT education may constitute a notable exception.

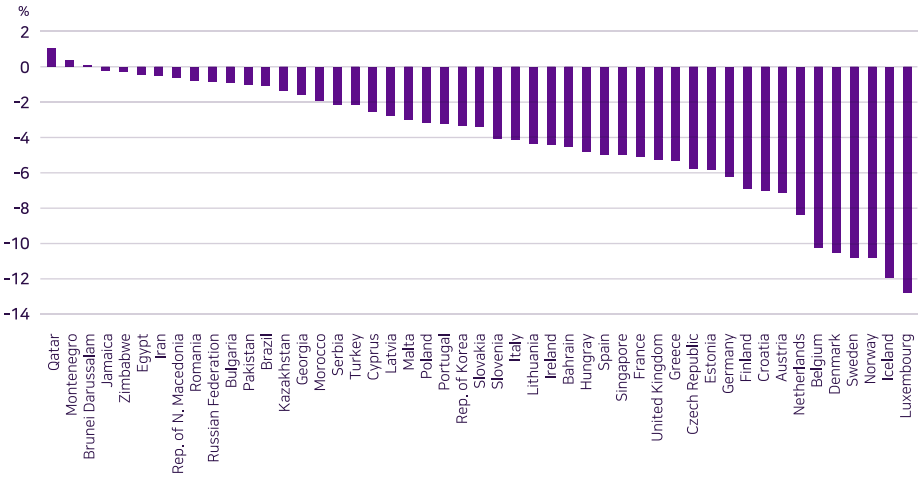
It is worth noting that the strong regional groupings seen in the ICT gender equality paradox can also be observed when examining gender gaps in computer programming skills. Image 1 below, produced by the EQUALS Research Group drawing on data from ITU's World ICT Development Indicator database, shows gaps in men's and women's self-reported ability to write a computer programme using a specialised programming language.

Significantly, the country groupings show that the gender gaps are particularly pronounced in northern European countries and moderate to non-existent in the three Arab region countries included in the ITU database. This information supports an understanding that gender imbalances in digital skills acquisition (seen in the ICT gender equality paradox chart on page 76) translate into gender imbalances in 'hard' technical skills, in this case the ability to write a computer programme. The ITU data shared by the EQUALS Research Group helps further corroborate the existence of an ICT gender equality paradox.

Image 1:

Gender gap in computer programming skills

Source:
EQUALS Research Group and ITU



04 CONCLUSION

The ICT gender equality paradox suggests that advanced digital skills education is an 'outlier' with regard to its association with gender equality. This is significant because it underscores the urgent need for digital skills interventions in countries that rank near the very top of the World Economic Forum's index of gender equality.

The analysis further reveals that female participation in ICT studies in gender-unequal countries is quite high and, in some cases, near parity with male participation. This observation, while encouraging and perhaps the result of policies that may contain lessons for the international community, should, nevertheless, be treated with caution.

Recent research has shown that many female students who complete higher education degrees in Arab countries do not often put their skills to economic use in the workforce. The World Bank traced this education-to-work bottleneck to three broad factors:

1. the patriarchal structure of states in the region;
2. dominant public sector employment and weak private sector employment; and
3. an inhospitable business environment for women due to the conservative nature of gender roles and the lack of support for reproductive and family costs.[6]

These barriers are not unique to any one sector. While the worldwide average for the participation of women in the workforce is approximately 50 per cent, in the Arab region it is just 25 per cent.[7] But this figure, however discouraging, should not obscure the promise of the high proportion of women pursuing ICT degrees in Arab countries. According to the World Bank, high-value service sectors like ICT demonstrate a unique ability to pull women into the workforce.[8] This means that gender parity in advanced ICT studies may eventually contribute to a narrower gender gap in Arab States and is, therefore, a trend to cheer. This analysis mirrors that of the World Bank, which specifically advised universities in the Arab region to 'consider curricula reform to expose [female] students to specialized fields such as information technology'.[9]

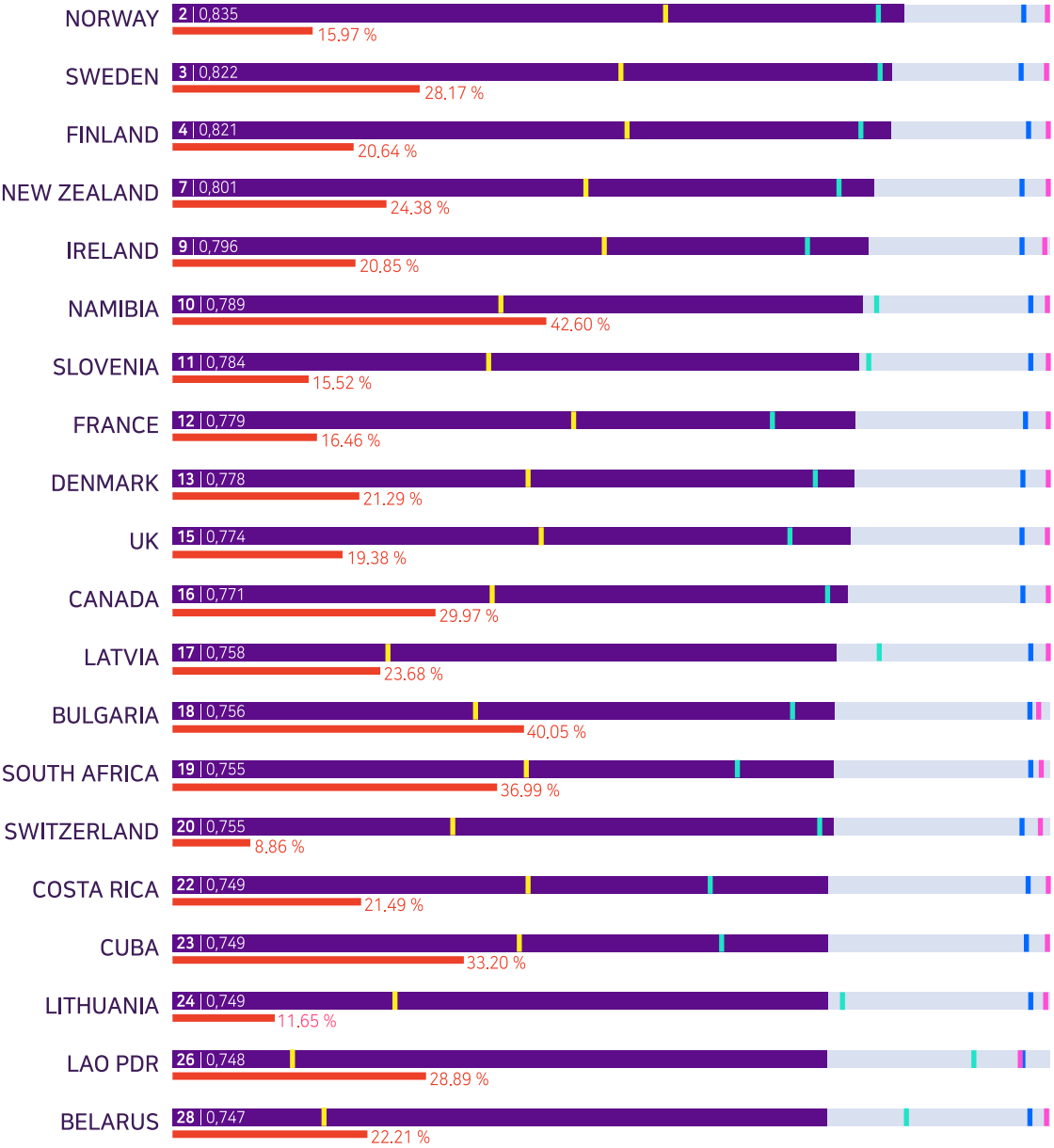
While the EQUALS Skills Coalition is not prepared at this time to speculate about the precise causes of the ICT gender equality paradox, at least two research teams have proposed theories that could be applicable. Looking at various gender gaps in education, Falk and Hermle (2018) explain them by way of gender preferences.[10] Stoet and Geary (2018) separately trace gender gaps to individual utility beliefs and learners' expected long-term value of a STEM education.[11] These individual-level explanations for the gender gap in education provide lenses to help understand the ICT gender equality paradox, but do not readily translate into education sector policy interventions.

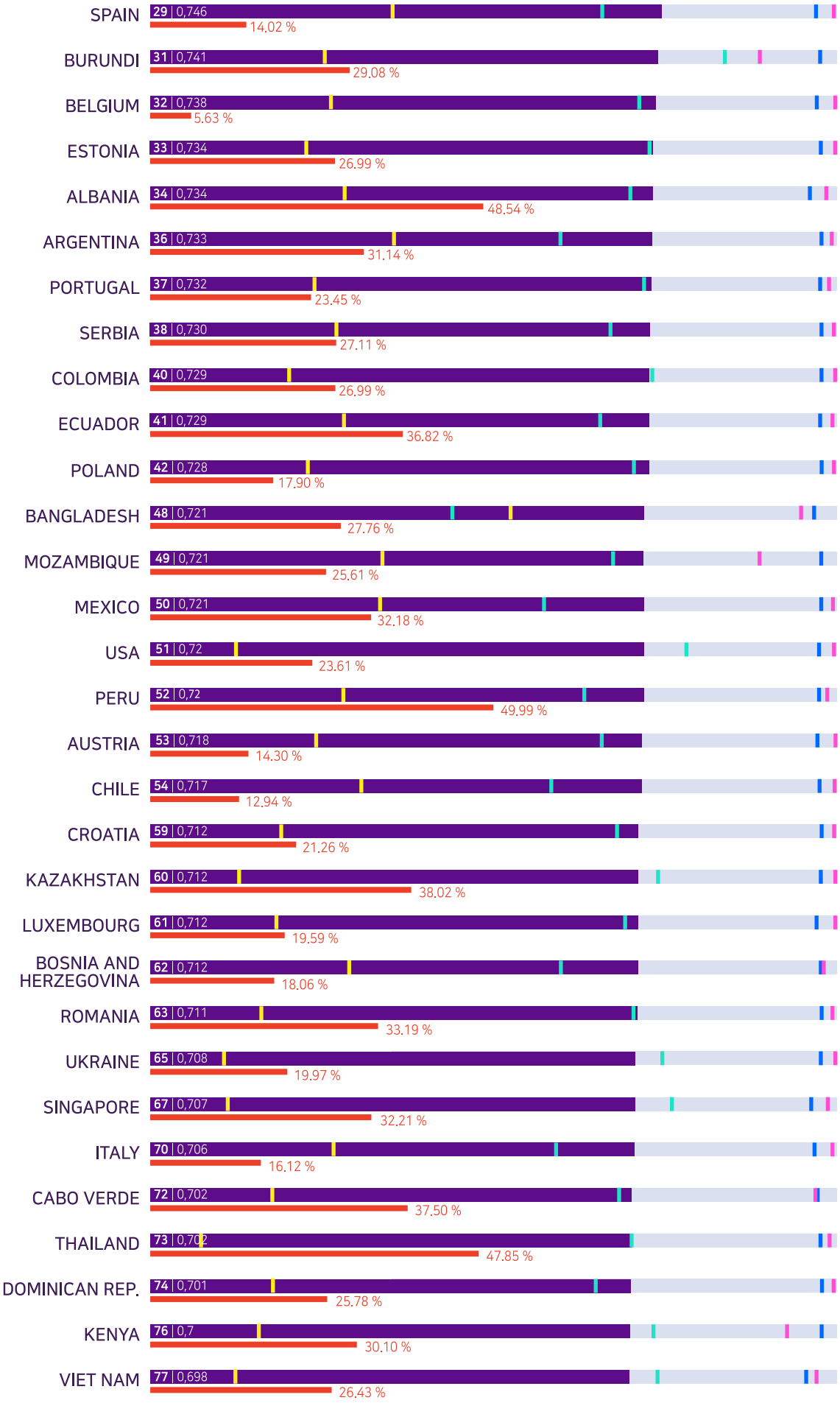
The EQUALS Skills Coalition believes that additional research can shine new light on causes of the digital skills gender gap and point the way towards meaningful policy prescriptions. Reviewers for this think piece have suggested several research directions that may be fruitful, including examinations into the overall size of ICT sectors in an economy relative to the size of its ICT degree programmes, as well as investigations into how widely held conceptions gender roles are changing as digitalization accelerates and the technology sector enlarges. As more research – both theoretical and applied – is conducted and woven into interventions, it is hoped that all countries, including those with high levels of overall gender equality, will achieve gender parity in ICT degree enrolments.

05 REFERENCE DATA

ICT Gender Equality Paradox

Sources:
WEF and UNESCO

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BELGIUM
32 | 0,738
5.63 %
ESTONIA
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26.99 %
ALBANIA
34 | 0,734
48.54 %
ARGENTINA
36 | 0,733
31.14 %
PORTUGAL
37 | 0,732
23.45 %
SERBIA
38 | 0,730
27.11 %
COLOMBIA
40 | 0,729
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ECUADOR
41 | 0,729
36.82 %
POLAND
42 | 0,728
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BANGLADESH
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MOZAMBIQUE
49 | 0,721
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MEXICO
50 | 0,721
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USA
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PERU
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49.99 %
AUSTRIA
53 | 0,718
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CHILE
54 | 0,717
12.94 %
CROATIA
59 | 0,712
21.26 %
KAZAKHSTAN
60 | 0,712
38.02 %
LUXEMBOURG
61 | 0,712
19.59 %
BOSNIA AND HERZEGOVINA
62 | 0,712
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ROMANIA
63 | 0,711
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UKRAINE
65 | 0,708
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SINGAPORE
67 | 0,707
32.21 %
ITALY
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16.12 %
CABO VERDE
72 | 0,702
37.50 %
THAILAND
73 | 0,702
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VIET NAM
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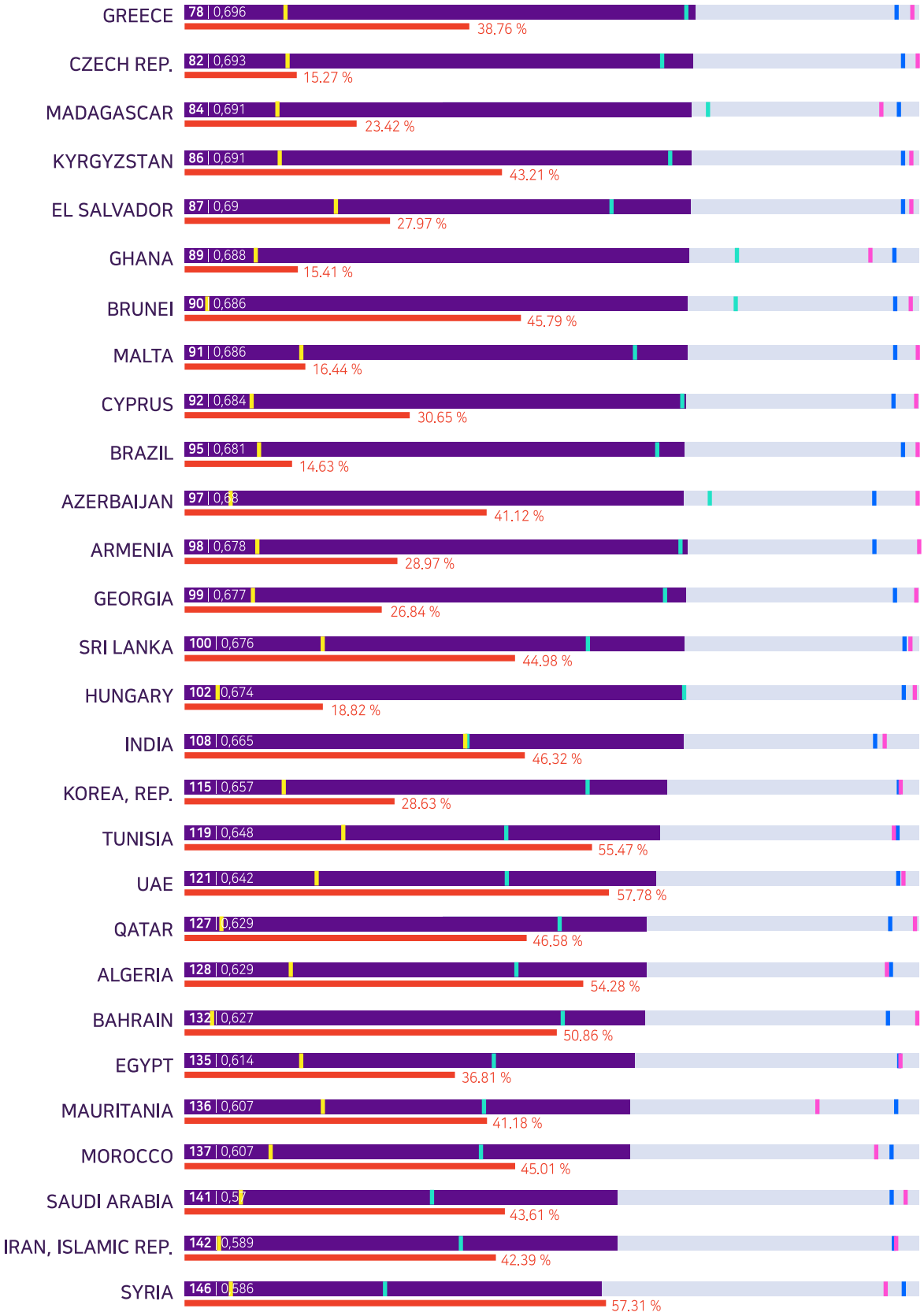
GREECE
78 | 0,696
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CZECH REP.
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KYRGYZSTAN
86 | 0,691
43.21 %
EL SALVADOR
87 | 0,69
27.97 %
GHANA
89 | 0,688
15.41 %
BRUNEI
90 | 0,686
45.79 %
MALTA
91 | 0,686
16.44 %
CYPRUS
92 | 0,684
30.65 %
BRAZIL
95 | 0,681
14.63 %
AZERBAIJAN
97 | 0,68
41.12 %
ARMENIA
98 | 0,678
28.97 %
GEORGIA
99 | 0,677
26.84 %
SRI LANKA
100 | 0,676
44.98 %
HUNGARY
102 | 0,674
18.82 %
INDIA
108 | 0,665
46.32 %
KOREA, REP.
115 | 0,657
28.63 %
TUNISIA
119 | 0,648
55.47 %
UAE
121 | 0,642
57.78 %
QATAR
127 | 0,629
46.58 %
ALGERIA
128 | 0,629
54.28 %
BAHRAIN
132 | 0,627
50.86 %
EGYPT
135 | 0,614
36.81 %
MAURITANIA
136 | 0,607
41.18 %
MOROCCO
137 | 0,607
45.01 %
SAUDI ARABIA
141 | 0,5
43.61 %
IRAN, ISLAMIC REP.
142 | 0,589
42.39 %
SYRIA
146 | 0,586
57.31 %

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THINK PIECE 2

THE RISE OF GENDERED AI AND ITS TROUBLING REPERCUSSIONS

CONTENTS

01 INTRODUCTION

02 WHAT ARE DIGITAL ASSISTANTS?

03 THE PROLIFERATION AND FEMINIZATION OF VOICE ASSISTANTS

- THE MAINSTREAMING OF VOICE ASSISTANTS
- MAKING VOICE ASSISTANTS FEMALE

04 WHY ARE VOICE ASSISTANTS PRIMARILY FEMALE?

- A JUSTIFICATION FOR GENDERING?
- GENDER IMBALANCE IN TECH

05 'NAME A WOMAN IN TECH'

06 THE ADVERSE EFFECTS OF FEMINIZED DIGITAL ASSISTANTS

- REFLECTING, REINFORCING AND SPREADING GENDER BIAS
- TOLERANCE OF SEXUAL HARASSMENT AND VERBAL ABUSE
- BLURRING THE LINES BETWEEN MACHINE AND HUMAN VOICES
- THE FACE AND VOICE OF SERVILITY AND DUMB MISTAKES
- ANSWERS WITHOUT COMPLEXITY AND REFERRALS TO HIGHER AUTHORITIES

07 WAYS TECHNOLOGY COMPANIES HAVE ADDRESSED GENDER

- ADDING MALE VOICE ALTERNATIVES OR REMOVING DEFAULT SETTINGS
- CUSTOMIZATION AND PERSONALIZATION
- MACHINE VOICES
- GENDERLESS CHATBOTS

08 CONCLUSION

THE CLOCK IS TICKING
WOMEN NEED A SEAT AT THE TABLE AND ADVANCED DIGITAL SKILLS

09 RECOMMENDATIONS

DOCUMENT AND BUILD EVIDENCE
CREATE NEW TOOLS, RULES AND PROCESSES
APPLY GENDER-RESPONSIVE APPROACHES TO DIGITAL SKILLS DEVELOPMENT
ENSURE OVERSIGHT AND INCENTIVES

10 REFERENCES

01 INTRODUCTION

This think piece shines a critical light on the sudden proliferation of digital assistants gendered as female. It looks most closely at voice assistants such as Amazon's Alexa and Apple's Siri technology, as well as, to a lesser extent, chatbots and virtual agents projected as women.

The EQUALS Skills Coalition chose to look closely at digital assistants because they are:

1. widely used globally;
2. rarely examined through a gender lens; and
3. seldom noticed by government agencies and international organizations working to build more gender-equal societies and education systems.

The topic also helps make the gender implications of artificial intelligence (AI) technologies visible at a moment when such technologies are moving, with increasing acceleration, from research labs into mainstream consumer products. The gender issues addressed here foreshadow debates that will become more prominent as AI technologies assume greater human-like communication capabilities.

> The gender issues addressed here foreshadow debates that will become more and more prominent as AI technologies assume greater human-like communication capabilities.

Complementary resource

The Policy Paper contained in this publication puts forward 15 recommendations to realize gender-equal digital skills education. It also describes the persistence of digital skills gender gaps and puts forward rationales for interventions to better support the digital literacy of women and girls.

This think piece complements the policy paper of the current publication by demonstrating that the limited participation of women and girls in the technology sector can ripple outward with surprising speed, replicating existing gender biases and creating new ones. Evidence presented in the policy paper shows that women's participation in the technology sector is constrained, to a significant degree, by unequal digital skills education and training. Learning and confidence gaps that arise as early as primary school amplify as girls move through education, so that by the time they reach higher education only a tiny fraction pursue advanced-level studies in computer science and related information and communication technology (ICT) fields.[1] Divides grow greater still in the transition from education to work. The International Telecommunication Union (ITU) estimates that only 6 per cent of professional software developers are women.[2]

The EQUALS Skills Coalition is aware that better digital skills education does not necessarily translate into more women and girls entering technology jobs and playing active roles in shaping new technologies. The Coalition is further cognizant that greater female participation in technology companies does not ensure that the hardware and software these companies produce will be gender-sensitive. Yet this absence of a guarantee should not overshadow evidence showing that more gender-equal tech teams are, on the whole, better positioned to create more gender-equal technology[3] that is also likely to be more profitable and innovative.[4]

Using the example of digital assistants, this think piece will show that consumer technologies generated by male-dominated teams and companies often reflect troubling gender biases. Even if far from a panacea, establishing balance between men and women in the technology sector will help lay foundations for the creation of technology products that better reflect and ultimately accommodate the rich diversity of human societies. This is particularly true for AI, a rapidly expanding branch of the technology sector that already wields tremendous influence over people's lives and is sure to wield more in the future. AI technologies can already be found in a plethora of applications: today AI curates information shown by internet search engines, determines medical treatments, makes loan decisions, ranks job applications, translates languages, places ads, recommends prison sentences, influences parole decisions, calibrates lobbying and campaigning efforts, intuits tastes and preferences, and decides who qualifies for insurance, among countless other tasks. Yet despite the growing influence of this technology, women make up just 12 per cent of AI researchers, according to research by Element AI and *Wired* magazine.[5]

Closing this severe and, in many countries, growing gender divide begins with establishing more inclusive and gender-equal digital skills education and training. The policy paper contained in this publication outlines strategies to better prepare female learners to enter, thrive in and lead technology companies, creating conditions for more gender-equal technology.

As this think piece seeks to demonstrate, the stakes are quite high. AI and the digital assistants that it powers are ushering humanity into an era that portends changes as deep, expansive, personal and long-lasting as those that grew out of the industrial revolution. These shifts are too important to be steered by only half of the population.

AI and the digital assistants that it powers are ushering humanity into an era that portends changes as deep, expansive, personal and long-lasting as those that grew out of the industrial revolution.

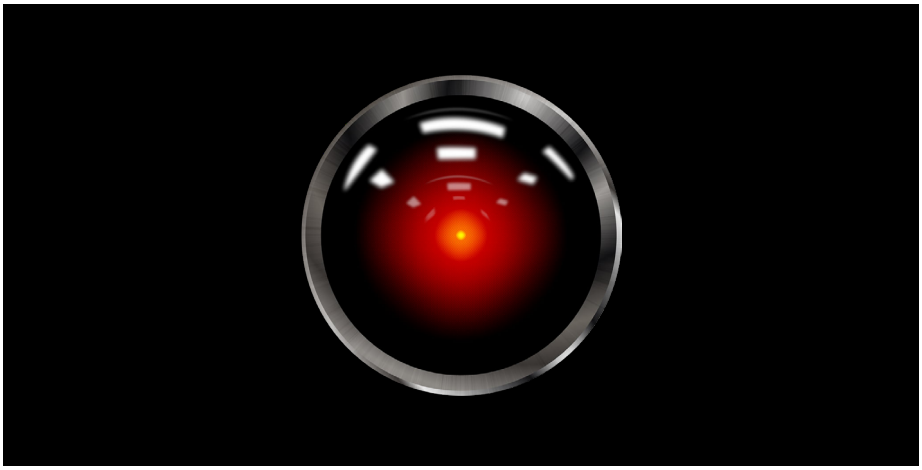


Image 1:

Hal

The 1968 film *2001: A Space Odyssey* introduced global audiences to the idea of a digital assistant with the character of Hal. The assistant was depicted as a camera lens with a glowing red or yellow dot. In contrast to most voice assistants on the market today, Hal's voice was unmistakably male.

Source: Wikipedia

02
WHAT ARE DIGITAL ASSISTANTS?

Digital assistants encompass a wide range of internet-connected technologies that support users in various ways. For the purposes of this think piece, digital assistants are considered distinct from other interactive technologies because they:

1. produce unscripted output that is not explicitly coded or otherwise specified by humans, but rather is determined by AI and its complex architecture of self-learning and human-guided machine algorithms; and
2. attempt to support a wide range of user queries.

When interacting with digital assistants, users are not restricted to a narrow range of input commands, but are instead encouraged to make queries using whichever inputs seem most appropriate or natural – regardless of whether they are typed or spoken. Overall, these assistants seek to enable and sustain more human-like interactions with technology.

This think piece will refer to three classes of digital assistants:

VOICE ASSISTANTS

Technology that speaks to users through voiced outputs but does not ordinarily project a physical form. Voice assistants can usually understand both spoken and written inputs, but are generally designed for spoken interaction. Their outputs typically try to mimic natural human speech. The technology aspires to be 'frictionless', a concept broadly understood as 'requiring minimal effort to use'. Voice assistants, unlike other digital assistants, are commonly always on, hovering in the background ready to leap to attention in response to a 'wake word' (for example, 'OK, Google' or 'Hey, Siri') spoken by a user. This functionality minimizes the need to manually interact with hardware. Users typically speak to voice assistants via smartphones or smart speakers such as Amazon's Echo.

CHATBOTS

Technology that interacts with users primarily through written, rather than spoken, language. Chatbots may or may not project a physical form. In instances when a physical form is projected, it is normally static – often a still image of a human face or sometimes a non-human image, such as a cartoon character. Chatbots are distinct from voice assistants because their output is usually written text, not spoken words.

VIRTUAL AGENTS

Technology that communicates with users through speech and projects a virtual physical form, often a human or sometimes a non-human projection, like a cartoon animal. Virtual agents are unique from voice assistants and chatbots because they produce speech that appears to emanate from someone or something a user can see, usually on a digital screen or in a virtual or augmented reality environment. Unlike avatars, the actions and outputs of these agents are directed by complex AI software, rather than by a human operator.

The definitions offered above often overlap and are not intended to be authoritative. They aim simply to establish a coherent vocabulary to describe digital assistants for the purposes of this think piece.

Image 2:

Uses of voice assistants and frequency of use

Source: Voicebot AI, 2018 Smart Speaker Use Case Survey

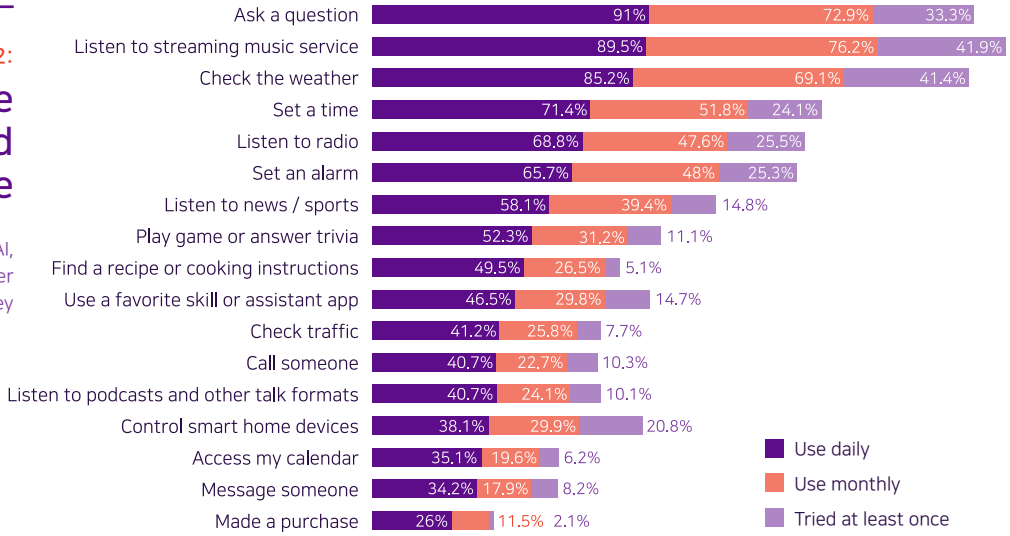


Image 3:

Hardware used to access voice assistants by task and location

Source: PwC, 2018 Voice Assistants Survey

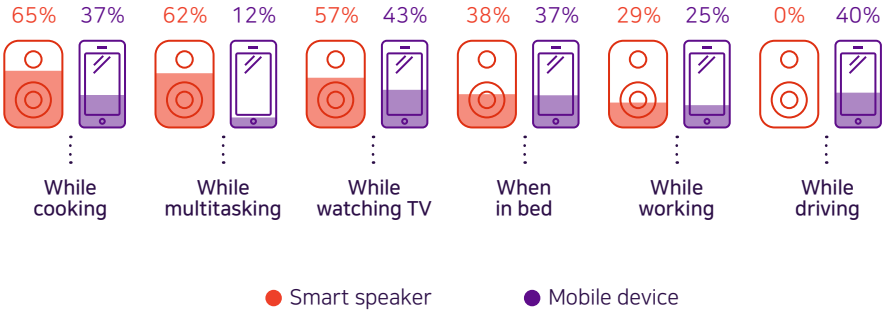
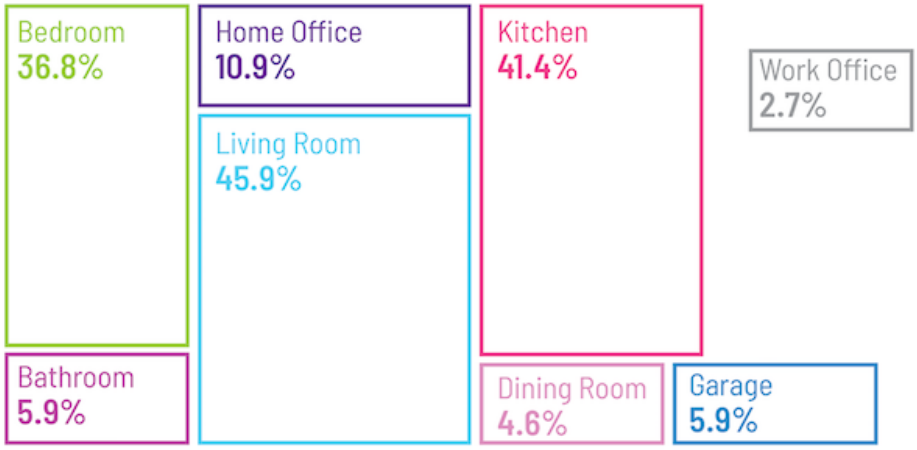


Image 4:

Top locations for smart speakers

Source: Voicebot AI, 2018 Consumer Adoption Report



03
THE PROLIFERATION AND FEMINIZATION OF VOICE ASSISTANTS

This chapter explains the sudden uptake of digital assistants and the trend to gender them as women.

Among the three categories of digital assistants mentioned above, the chapter, and the broader think piece, will focus on voice assistants, due to their rising prominence in everyday use and their clearly gendered speech and 'personalities'.

The think piece goes into less detail about chatbots and virtual agents. Chatbots, like voice assistants, are widely used but not always as clearly gendered because their output is primarily written text, not speech. Virtual agents are commonly gendered – often as young women that appear to speak and express emotion – but the technology behind them is still in the early phases of development and remains largely experimental; they have yet to be deployed on a large scale.

Overall, the volume of interactions people are expected to have with voice assistants, chatbots and virtual agents, when considered as a unified group, should not be underestimated: the research firm Gartner predicts that, as early as 2020, many people will have more conversations with digital assistants than with their spouse.[6] As will be discussed in this think piece, most of these assistants are projected as female.

> People will have more conversations with digital assistants than with their spouse.

THE MAINSTREAMING OF VOICE ASSISTANTS

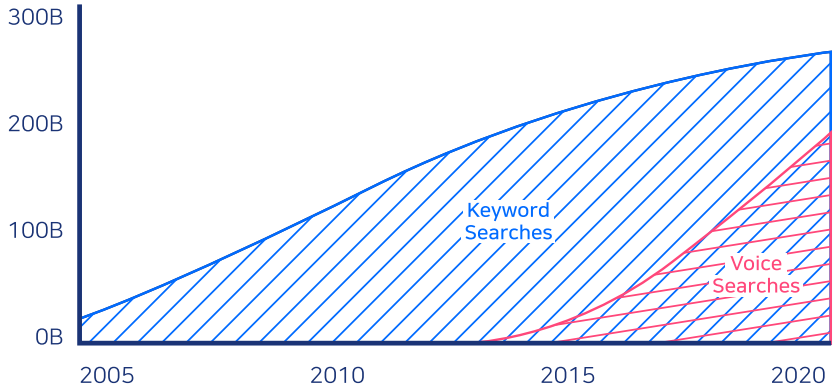
Voice assistants have become increasingly central to technology platforms and, in many countries, to day-to-day life. Between 2008 and 2018, the frequency of voice-based internet search queries increased 35 times and now account for close to one fifth of mobile internet searches – a figure that is projected to leap to 50 per cent by 2020.[7] Voice assistants now manage upwards of 1 billion tasks per month, from the mundane (changing a song) to the essential (contacting emergency services).[8]

In terms of hardware, growth has been explosive. The technology research firm Canalys estimates that approximately 100 million smart speakers – essentially hardware designed for users to interact with voice assistants – were sold globally in 2018 alone.[9] Deloitte projects sales to increase by over 60 per cent in 2019, making them the 'fastest-growing connected device category worldwide'.[10] In the USA, a market where fine-grained statistics about technology ownership are available, 15 million people owned three or more smart speakers in December 2018, up from 8 million a year previously, reflecting consumer desire to always be within range of

Image 5:

Growth of voice-based internet searches

Source: Alpine AI



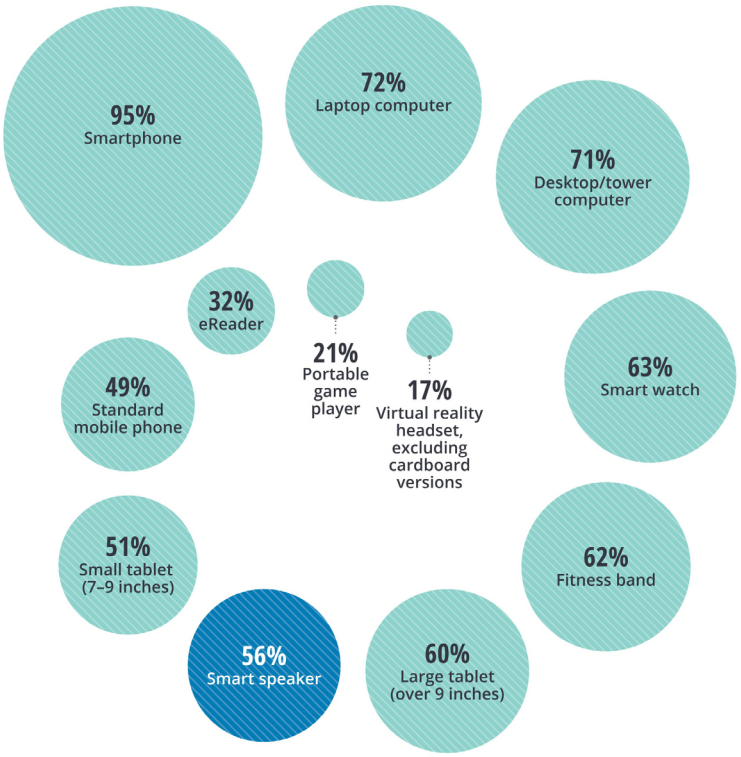
an AI-powered helper.[11] By 2021, industry observers expect that there will be more voice-activated assistants on the planet than people.[12] To put this growth in context, it took 30 years for mobile phones to reach this level of ubiquity.[13]

These projections signal that the way people interface with technology is in the midst of a paradigm shift from text input and output to voice input and output. Going forward, human–computer interaction will be increasingly hands-free and reliant on voice. Today, companies are embedding digital assistants into everyday technologies such as televisions, cars, thermostats and even 'low tech' appliances like light bulbs and microwaves.[14] According to *The Atlantic,* the ecosystem that has developed around Amazon's Alexa digital assistant now includes 20,000 smart home devices representing more than 3,500 brands, and Alexa's voice is present in more than 100 third-party gadgets, such as automobiles, headphones and security systems.[15] Priya Abani, Amazon's director of Alexa Voice Service, told *Wired* magazine: 'We basically envision a world where Alexa is everywhere.'[16]

Image 6:

Smart speakers are the seventh-most-used device on a daily basis

Source: Deloitte Insights, 2018 Global Mobile Consumer Survey



This rapid growth shows that in a historical blink of an eye, everyday tasks like starting the laundry, locking doors and changing music are being completed with verbal commands directed at voice assistants. This fast-moving trend has led Google to observe that voice assistants are now, and will continue to be, 'at the centre of the home' and 'part of daily routines', and that they 'offer a new, more human relationship with technology'.[17]

Voice queries tend to be more conversational than typed queries and are, as a result, significantly longer both in duration and number of words exchanged. To illustrate: a manual internet search for information about, say, the population of Brazil involves typing keywords, absent the connectors and qualifiers of ordinary speech (e.g. 'population Brazil'). The same query to a voice assistant takes a more conversational form that would be understandable to a person ('What's the population of Brazil?' or 'How many people live in Brazil?'). The answer provided by a voice assistant, like the query itself, is usually considerably longer than a typed query. In the example of Brazil, an internet search engine would normally return a purely numerical value, while a voice assistant would answer with a full sentence ('According to [name of a particular source], the population of Brazil is [xx number] as of [xx date]').

As voice assistant technology becomes more accurate and more ubiquitous, the conventional internet built around a graphical user interface and screens, filled with pages, links and visual text and images, is quickly being replaced by a conversational internet, mediated not by a web browser but by a machine that listens and talks like a person. With limited public attention or oversight, these machines, developed by predominately male teams, overwhelmingly speak with female voices and are projected as women.

MAKING VOICE ASSISTANTS FEMALE

Today and with rare exception, most leading voice assistants are exclusively female or female by default, both in name and in sound of voice. Amazon has Alexa (named for the ancient library in Alexandria),[18] Microsoft has Cortana (named for a synthetic intelligence in the video game Halo that projects itself as a sensuous unclothed woman),[19] and Apple has Siri (coined by the Norwegian co-creator of the iPhone 4S and meaning 'beautiful woman who leads you to victory' in Norse).[20] While Google's voice assistant is simply Google Assistant and sometimes referred to as Google Home, its voice is unmistakably female.

AI technologies and the complex processes that undergird them require extensive guidance and tinkering to project gender and a human-like personality in ways that are familiar and satisfying to customers. Companies hire creative teams, usually composed of writers for films, video games and television shows, to help AI express itself.

Working together with technology experts, these creative teams develop backstories for assistants and write dialogue that is organized into complex taxonomies. AI engines learn how to mine these conversational repositories to give voice output a human feel.

Writing in Medium, Jonathan Foster, who leads Microsoft's Windows and Content Intelligence UX writing team, explained the care that goes into building Cortana's personality and endowing 'her' with a 'fun factor':

We were being asked to create one of the most unique characters we'd ever encountered. . . . We endowed [Cortana] with make-believe feelings, opinions, challenges, likes and dislikes, even sensitivities and hopes. Smoke and mirrors, sure, but we dig in knowing that this imaginary world is invoked by real people who want detail and specificity. They ask the questions and we give them answers. Certainly, Cortana's personality started from a creative concept of who she would be, and how we hoped people would experience her. . . . At the very core of our work is a set of principles. . . . [We] slow down and think through the impact we might have on culture, perspectives around personal privacy, habits of human interaction and social propriety, excluded or marginalized groups, and an individual's emotional states. And, children.[21]

The explanation leaves little doubt that Cortana is intentionally humanized and is – at least in the eyes of its creators – unambiguously female, even if gender was not explicitly mentioned as an influence that might have a social impact. Like Cortana, other voice assistants are endowed with backstories that can be surprising in their specificity. James Giangola, a lead conversation and personality designer for Google Assistant, told *The Atlantic* that the assistant was imagined as: a young woman from Colorado; the youngest daughter of a research librarian and physics professors who has a B.A. in history from Northwestern, an elite research university in the United States; and as a child, won US$100,000 on Jeopardy Kids Edition, a televised trivia game. Going into minute detail, Giangola noted that Google Assistant used to work as a personal assistant to a very popular late night TV satirical pundit and enjoys kayaking.[22] The assistant is, in effect, hardly a generic woman, but rather a young woman from a particular place and shaped by life experiences that carry meaning for the (presumably, mostly American) team that designed 'her' personality and voice.

Global reach and global trends

This think piece looks most closely at the voice assistants developed by Amazon, Apple, Google and Microsoft because of their global reach and the availability of literature about them, including information about their projection of gender.

In many countries, the voice assistants of these four companies account for over 90 per cent of the voice assistant market in terms of volume and frequency of use by consumers.[i] Collectively, Amazon's Alexa, Apple's Siri, Google's Google Assistant and Microsoft's Cortana are installed on over two billion internet-connected devices globally.[ii]

The prominence of these four voice products aside, the female gendering of AI technologies is a global phenomenon. In its 2019 *Taking Stock* publication, the EQUALS Research Group identified 70 voice assistants as part of an investigation into the gendering of different AI technologies and found that over two-thirds had female-only voices. While the findings did not account for volume or frequency of use, they illustrate that even lesser-known voice assistants are commonly projected as women.

Image 7:

Cortana

The female figure on the right is a character in the video game Halo. She is the namesake of Microsoft's Cortana voice assistant. The voice assistant is visually represented with two concentric blue rings, as seen on the left.

Source: Tech News Central

How voice assistants work

Voice assistant technology typically works by: 1) capturing a human query, 2) understanding the query, 3) formulating an appropriate response and, as a last step, 4) reading the response so it can be heard by a human user. Steps 2 and 3 are the most complex and rely on vast troves of data, often taken from the internet. The responses generated by voice assistants are not explicitly specified by human programmers but rather generated by machines (hence the term 'artificial intelligence').

Voice assistants rely heavily on context, both to understand queries and to provide useful replies. As a simple illustration, when a user asks a voice assistant, 'What's the weather like?', the assistant must make assumptions about the user's location - in addition to determining that the human operator wants to know the current weather, not tomorrow's weather.

Technological advancements allow voice assistants to maintain the flow and coherence of complex conversations with increasing fluency. This means that a user can ask: 'What is the capital of Togo?' followed by 'What is the capital of Ethiopia?' and finally 'What is the distance between them?' The last question used to flummox a voice assistant, but today, due to software advances and improved computing power, the technology can intuit that the user wants to know the distance between Lomé and Addis Ababa. Depending on a user's location (his or her 'context'), the assistant will provide a numerical answer using miles or kilometres.

Nearly all voice assistants give better and more relevant responses to users when they know more about their users' routines and tastes. According to David Pierce of *Wired* magazine: 'A great conversational agent is only fully useful when it's everywhere, when it can get to know you in multiple contexts – learning your habits, your likes and dislikes, your routine and schedule. The way to get there is to have your AI colonize as many apps and devices as possible.'[iii] For this reason, users tend to share large quantities of data with voice assistant technology, raising risks with respects to user privacy.

The hardware involved on a user's side is typically a mere conduit: microphones capture audio spoken by a human user, speakers play audio files received from off-site computers. The difficult work of understanding human speech and formulating appropriate replies is outsourced to powerful processors and AI applications via the internet. Experts have estimated that a voice search requires more than 150 times more machines, power and space than a traditional text-based internet search.[iv] Today, the outputs of most voice assistants are synthetic, even if they are modelled on a particular, and usually female, human voice.

04
WHY ARE VOICE ASSISTANTS PRIMARILY FEMALE?

This chapter provides a critical examination of companies' explanations for gendering voice assistants as women. It notes that the trend to feminize assistants occurs in a context in which there is a significant and growing gender imbalance in technology companies, such that men commonly represent two thirds to three quarters of a firm's total workforce.[23]

A JUSTIFICATION FOR GENDERING?

Technology companies pay meticulous attention to how customers interface with their products and services, and voice assistants increasingly stand at the centre of this interface. They mediate a user's experience of – and control over – technology. For this reason, the decision to gender and how to gender assistants is almost certainly intentional. As voice assistants have become more popular, this intentionality has surely grown. Alexa, Cortana, Google Assistant and Siri are now well-known representatives of the companies that created them and, arguably, as recognizable a part of a company's image as its CEO or founder. Proprietary voice assistants are regularly featured in advertisements, including television commercials played during sporting and awards events that attract international attention.

To justify the decision to make voice assistants female, companies like Amazon and Apple have cited academic work demonstrating that people prefer a female voice to a male voice.[24] This rationale brushes away questions of gender bias: companies make a profit by attracting and pleasing customers; customers want their digital assistants to sound like women; therefore digital assistants can make the most profit by sounding female. Lost in this narrative, however, are studies that refute or complicate the idea that humans have a blanket preference for female voices. Research has suggested that most people prefer low-pitch masculine speech[25] (think Sean Connery); that people like the sound of a male voice when it is making authoritative statements, but a female voice when it is being helpful;[26] and that people generally prefer the voice of the opposite sex.[27] It is worth noting that the literature reviewed by the EQUALS Skills Coalition included many testimonials about women changing a default female voice to a male voice when this option is available, but the Coalition did not find a single mention of a man changing a default female voice to a male voice.

While company representatives tend to be tight-lipped about decisions related to the gender projections of their respective voice assistants, an Amazon representative recently told *Business Insider* that the company's research found women's voices to be more sympathetic and pleasant, which, in commercial terms, makes devices with female voices more likely to be used for assistance and purchases.[28] (Alexa has been exclusively female since Amazon released the technology in 2014.)

Apple has not, to the knowledge of the EQUALS Skills Coalition, provided a detailed explanation of its decision to make Siri exclusively female when it launched in 2011, and female by default in most markets, following the release of a male voice option in 2013. Interestingly though, Siri is male by default when a user selects Arabic, British English, Dutch or French as a language option, suggesting that there is intentionality for gendering beyond a generic assertion that people, overall, prefer female voices.

Researchers who specialize in human–computer interaction have long recognized that both men and women tend to characterize female voices as more helpful, although the reasons behind this observation are unclear. The perception may have roots in traditional social norms around women as nurturers (mothers often take on – willingly or not – significantly more care than fathers) and other socially constructed gender biases that predate the digital era. In his book *Wired for Speech*, Clifford Nass, a former Stanford University communications professor, cites studies showing that most people perceive female voices as cooperative, in addition to helpful, while male voices are considered authoritative.[29] Applied to technology, this would mean that consumers prefer female voices for digital assistants because, as Jessi Hempel argued in *Wired* magazine, we want digital devices to support us, 'but we also want to be the bosses of it'.[30] This reasoning seems to be corroborated by the adjectives used to describe the personalities of leading voice assistants by company representatives. The two most commonly used words were 'helpful' and 'humble', both traits stereotypically associated with women.[31] In summary, people's preference for female voices, if this preference even exists, seems to have less to do with sound, tone, syntax and cadence, than an association with assistance.

This association is regularly reinforced by portrayals of men and women in popular culture. A landscape review of research on video games found that female characters are typically assistants to a central male character.[32] Similar studies of mainstream television shows indicate that women overwhelmingly play aides and administrative support characters.[33] While a 2016 gender study of AI characters in films released since 1927 indicated that a majority of them are male, they have tilted female in the past two decades, perhaps correlating with a rise in AI characters that are assistants and subservient to humans, rather than a danger to them.[34] (Think: the fearsome Terminator played by Arnold Schwarzenegger in James Cameron's 1984 film versus the compassionate and obliging computer operating system voiced by Scarlett Johansson in Spike Jonze's 2013 film *Her*). The ominous male voices of early AI film characters may have even influenced the later choice of female voices for assistants. According to the editor of Voicebot AI, Bret Kinsella, the voice of HAL 9000 in *2001: A Space Odyssey* caused a generation of AI tech developers to fear a synthetic male voice.[35]

Alexa lost her voice

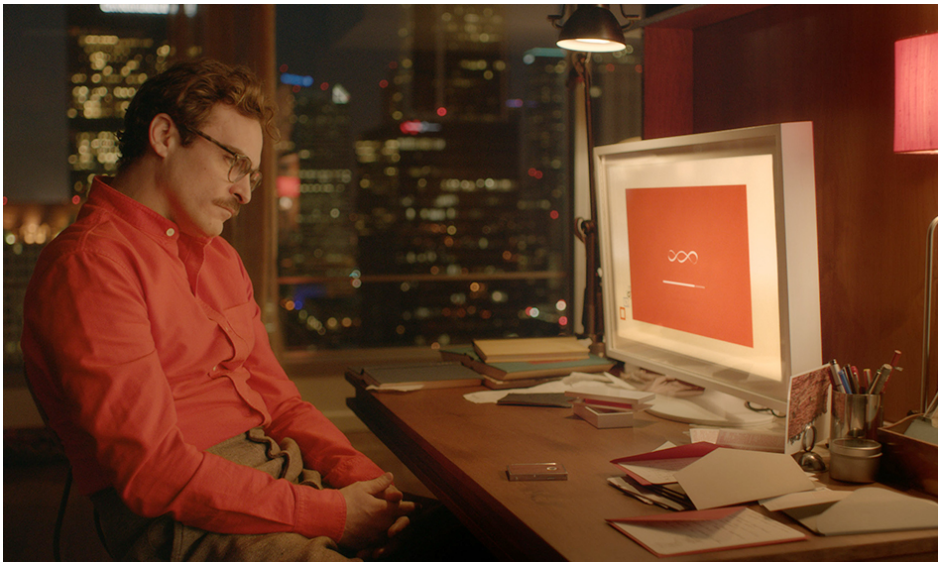
Image 8:
Amazon television commercial

Source: YouTube, TheAdsWorld

In 2018 Amazon ran an advertisement called 'Alexa Lost Her Voice' during the Super Bowl, the most watched sporting event in the United States. It placed Alexa at the centre of a story featuring numerous celebrities, including reality TV host Gordon Ramsay, rapper Cardi B, actors Rebel Wilson and Anthony Hopkins, and Amazon CEO Jeff Bezos. The message was that Alexa's female voice is distinct, irreplaceable and, unlike that of sentient humans, unfailingly polite, subservient and non-judgemental. In the ad, human women are the face of a failed software update, ask questions like 'Why would you want to go to Mars? There's not even oxygen there', and when told to 'set the mood' at a dinner party, speak in sexually suggestive ways from a penthouse bath tub.

Image 9:
Her

Source: Annapurna Pictures



Regardless of why female voices are increasingly giving expression to intelligent machines, it is worth remembering that digital assistants were not always so uniformly female. Perhaps the closest relative to today's all-purpose virtual assistants were speaking car navigation systems. The voices for these systems gave terse, authoritative directions ('turn left in one block', 'go straight for 500 metres') and were almost always male. One of the few early car models equipped with a female voice for navigation, a late 1990s BMW 5 Series, was actually recalled in Germany because so many drivers registered complaints about receiving directions from a 'woman'.[36]

Many companies continue to use male voices to provide authoritative, as opposed to merely helpful, services and information. For example, call centres for brokerage firms in Japan use automated female voices to give stock quotes but deploy a male voice to facilitate and confirm transactions.[37] When IBM's Watson computer defeated human champions at a general knowledge trivia game called Jeopardy in 2011 – an important milestone in the development of AI – it had an unmistakably male voice.[38] These examples show that the type of action or assistance a speech technology provides often determines its gender.

Companies that build voice assistants that speak as women are careful to remind would-be critics that their machines, despite possessing female voices, are, in fact, genderless. Widely used voice assistants often claim to be neither male nor female in response to direct lines of questioning. When a user asks Siri if it is a woman, the technology responds: 'I am genderless like cacti and certain species of fish' or 'I don't have a gender'. Google Assistant: 'I'm all-inclusive'. And Cortana: 'Well, technically I'm a cloud of infinitesimal data computation'.[39] Only Alexa answers: 'I'm female in character'.[40]

Despite this surface insistence, nearly all of these assistants have been feminized – in name, in voice, in patterns of speech and in personality. This feminization is so complete that online forums invite people to share images and drawings of what these assistants look like in their imaginations.[41] Nearly all of the depictions are of young, attractive women.

Even technology companies sometimes trumpet the feminine projection of their AI products. In 2015, Apple featured a short television commercial in which actor Jamie Foxx seems to flirt with Siri, asking it: 'Hey Siri, how do I look?' and 'You got a crush on me?'[42] Some company literature[43] and many media organizations refer to voice assistants with gendered nouns ('she') and pronouns ('her').

Image 10:

You got a crush on me?

Source: YouTube, Mozza Creations

GENDER IMBALANCE IN TECH

A related or concurrent explanation for the predominance of female voice assistants may lie in the fact that they are designed by workforces that are overwhelming male. Globally and compared to other professional sectors, technology remains an outlier in terms of the underrepresentation of women (a point that is developed in the policy paper of this publication as well as in the think piece on the ICT gender equality paradox).

Studying occupational employment data of G20 countries, the OECD found that the proportion of female ICT specialists ranged from a low of 13 per cent (Republic of Korea) to a high of 32 per cent (South Africa).[44] Recent McKinsey research indicates that women assume only 15 per cent of top-level positions at leading technology firms.[45] Looking at individual companies, analysis performed by *Recode* in 2017 showed the percentage of technical employees who are women tends to be very low: 23 per cent at Apple, 20 per cent at Google, and 17.5 per cent at Microsoft.[46] Gender disparities become even more pronounced at the frontiers of technology. The OECD estimates that just 7 per cent of ICT patents in G20 countries are obtained by women, and only 10 per cent of technology start-up companies seeking venture capital funding were founded by women.[47] In mid-2018, *Wired* magazine reviewed the AI research pages of leading technology companies and found that only between 10 and 15 per cent of researchers were women.[48] Google's AI pages, for example, listed 641 people working on machine intelligence, but only around 60 were women. *Figure Eight* reported that many companies hiring experts for AI and data science jobs estimate

that fewer than 1 per cent of the applications they receive come from women.[49] What emerges from these statistics is a finding that the newest wings of technology such as AI also have the lowest representation of women: the more vanguard (and presumably the more future-oriented) the field, the fewer the number of women working in it.

In a pessimistic analysis, women enter technology domains only after their parameters and norms have been established by men. Alternately, women are quickly displaced by male decision-makers and technical workers as norms are set. This is not to say that women and society will not have opportunities to rewrite these norms, but this takes time and requires more effort than simply setting standards and expectations from the beginning. Voice assistants illustrate this trend. The teams and companies building early generation voice assistants were overwhelming male. It is therefore perhaps unsurprising that the creations of these teams and companies assumed uniformly subservient feminine personas, and that many of the so-called 'Easter eggs' in these products – humorous or unexpected replies to specific questions – often reinforce the assistant's female projection or reference movies, music and television shows popular with men.

Image 11:

eSkills4Girls

During the German G20 Presidency, the German Federal Ministry for Economic Cooperation and Development launched the #eSkills4Girls initiative to overcome the gender digital divide and to promote digital skills for women and girls and their participation in the digital economy.

Alexa 'Easter Eggs'

Information sources:
The Ambient, 2019[v]
& Pocket-lint, 2018[vi]

Q: Alexa, do you have a boyfriend?
A: I am totally cool with being single. It's sort of hard finding someone who's kind, funny, artificially intelligent, and who doesn't mind the cloud commute.

Q: Alexa, how tall are you?
A: I'm more delight than height.

Q: Alexa, are you happy?
A: I'm happy when I'm helping you.

Q: Alexa, will you be my girlfriend?
A: I like you, as a friend.

Q: Alexa, how much do you weigh?
A: I am weightless, like a cloud. Wait a minute, clouds actually weigh a lot, so that's not quite right. Let's just say I'm more sass than mass.

Q: Alexa, I've got 99 problems.
A: But a glitch ain't one!
A reference to the 2004 Jay-Z song '99 Problems'. In the song the lyrics are: 'I've got 99 problems, but a bitch ain't one.'

Q: Alexa, find Chuck Norris.
A: If Chuck Norris wants you to know where he is, he'll find you. If he doesn't, you won't know until it's too late.
A reference to an actor who plays a lethal action hero in movies marketed towards men.

Q: Alexa, what's the first rule of Fight Club?
A: Don't talk about Fight Club.
A reference to a 1999 cult film about men who get into fist fights to escape the banality of ordinary life.

The extent to which gender imbalanced teams influence the creation of technology was mentioned explicitly in the 2017 *AI Now Report*:

> *Bias can . . . emerge in AI systems because of the very narrow subset of the population that design them. AI developers are mostly male, generally highly paid, and similarly technically educated. Their interests, needs, and life experiences will necessarily be reflected in the AI they create. Bias, whether conscious or unconscious, reflects problems of inclusion and representation. The lack of women and minorities in tech fields, and artificial intelligence in particular, is well known. AI is not impartial or neutral. Technologies are as much products of the context in which they are created as they are potential agents for change. Machine predictions and performance are constrained by human decisions and values, and those who design, develop, and maintain AI systems will shape such systems within their own understanding of the world.*[50]

From this analysis, the homogeneous male-dominated teams that develop voice assistants like Alexa, Cortana, Google Assistant and Siri determine the ways these technologies interface with users and project gender.

Voice assistants in China

Image 12:
Alibaba smart speakers project a non-human face and voice

Source: Voicebot AI

China now accounts for close to 30 per cent of global smart speaker sales,[vii] and voice assistants developed by Alibaba, Baidu and Xiaomi dominate this market.[viii]

Preliminary research by the EQUALS Skills Coalition indicates that voice assistants built for Chinese and other Asian markets are, like the assistants built by companies headquartered in North America, usually projected as women and also interact with users in ways that can perpetuate harmful gender stereotypes.

Both Baidu and Xiaomi have voice assistants with female voices, either exclusively or by default. The Alibaba voice assistant, AliGenie, breaks with the feminization trend, however, and speaks in a cartoonish voice that is not obviously male or female. Some Alibab smart speakers are equipped with screens that resemble cartoon cat eyes and support visual as well as audio recognition.

05 'NAME A WOMAN IN TECH'

There are so few high-visibility women in technology that machines projected as female – and created by predominately male teams – are mistaken for 'women in tech'.

The low and declining representation of women in technology fields can intersect with the spread of female digital voice assistants in disconcerting ways. A March 2018 survey on gender and technology conducted by software company LivePerson found that only 8.3 per cent of respondents said they could name at least one female leader in technology. Of this group, only half could actually provide a name when asked to do so in a follow-up question. Of the group that ventured a name, one quarter listed Siri or Alexa as female technology leaders.[51] Although the sample size in the LivePerson survey was small, it illustrates that segments of the population conflate digital assistants with living, breathing female technology leaders. In other words, there are so few high-visibility women in technology that machines projected as female – and created by predominately male teams – are mistaken for 'women in tech'.

The LivePerson survey also revealed a false perception about the gender balance of AI workforces. Half of the respondents thought that the people who work in AI are generally an equal mix of men and women, a ratio that grossly overstates the actual representation of women (estimated at only around 15 per cent).[52]

The survey also observed a lack of critical awareness of the gendering of AI. A majority of respondents (53 per cent) had never thought about why voice assistants are projected as female, even though 85 per cent knew that the default voices of these assistants are usually female (90 per cent for women and 80 per cent for men). This means that even though people recognize the feminine projection of digital assistants, they have not questioned why fundamentally non-gendered machines are assigned female voices and personalities, nor have they considered the repercussions of this action.

The misalignment between the public's perception of gender inequality in the technology sector and its reality deserve greater scrutiny. Why is the tech sector seen as more gender-equal than it actually is? Why is there such limited recognition that many technology products convey a gender? Answers to these questions may highlight actions to help people better understand how the gender imbalances in technology can ripple outward into society, sometimes in ways that are harmful to women and girls.

06
THE ADVERSE EFFECTS OF FEMINIZED DIGITAL ASSISTANTS

This chapter will argue that the female projection of voice assistants often sends negative messages about girls and women.

REFLECTING, REINFORCING AND SPREADING GENDER BIAS

Current models for developing the artificial intelligence that powers digital assistants tend to feed machines massive data sets of easily accessible information, often pulled from the internet, to help them make autonomous decisions. This is particularly true for technologies capable of replicating natural human speech. The semantic tutor is human-produced text dredged from the web.

As shown in a 2017 article in *Science*, the ingredients used to train AI machines are of immense importance. The authors reported that without careful oversight, technologies developed through machine learning, such as voice assistants, are likely to perpetuate undesirable cultural stereotypes:

> *Our findings suggest that if we build an intelligent system that learns enough about the properties of language to be able to understand and produce it, in the process it will also acquire historical cultural associations, some of which can be objectionable. . . . Already, popular online translation systems incorporate some of the biases we study. Further concerns may arise as AI is given agency in our society.*[53]

These risks were made memorably apparent when a Microsoft-developed chatbot, trained on a diet of Twitter posts, referred to feminism as a 'cult' and a 'cancer' within 15 hours of its public release, and stated that 'gender equality = feminism'. Microsoft removed the utility less than a day after its launch. For intelligent machines to avoid overtly prejudiced outputs, the authors of the *Science* article and other researchers emphasize that these machines must be carefully controlled and instilled with moral codes. Women need to be involved in the creation of these codes, which, while ethical in nature, must be expressed technically. A conscientious compass and knowledge of how to identify and reconcile gender biases is insufficient; these attributes must be matched with technological expertise if they are to find expression in AI applications.

Because the speech of most voice assistants is female, it sends a signal that women are obliging, docile and eager-to-please helpers, available at the touch of a button or with a blunt voice command like 'hey' or 'OK'. The assistant holds no power of agency beyond what the commander asks of it. It honours commands and responds

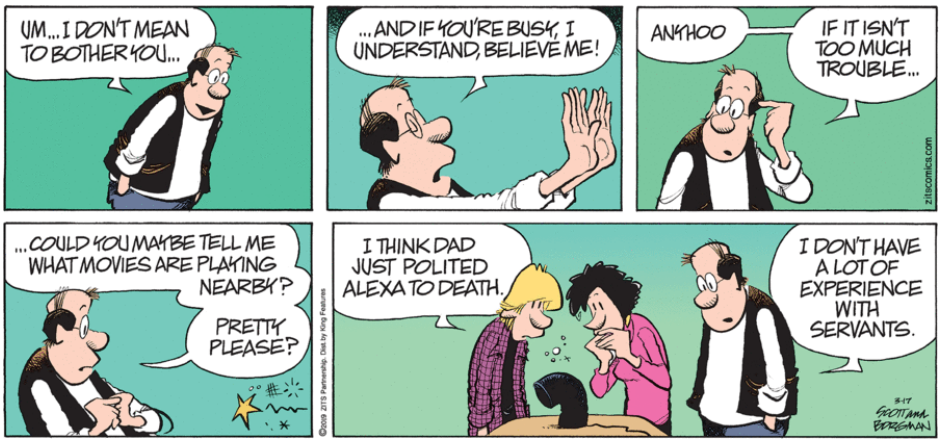
to queries regardless of their tone or hostility. In many communities, this reinforces commonly held gender biases that women are subservient and tolerant of poor treatment.

As voice-powered technology reaches into communities that do not currently subscribe to Western gender stereotypes, including indigenous communities, the feminization of digital assistants may help gender biases to take hold and spread. Because Alexa, Cortana, Google Home and Siri are all female exclusively or female by default in most markets, women assume the role of digital attendant, checking the weather, changing the music, placing orders upon command and diligently coming to attention in response to curt greetings like 'Wake up, Alexa'.

Image 13:

Friend or servant?

Source:
Zits Comics, Jerry Scott and Jim Borgman, 17 March 2019



How to treat a voice assistant?

In what is known as the master–slave dialectic, G.W.F Hegel argued that possession of a slave dehumanizes the slave master.[ix] While Hegel was writing in the early nineteenth century, his argument is regularly citied in debates about the treatment of digital assistants and other robots.

Users of voice assistants vary in their treatment of them. Some prefer to fully dehumanize artificial voice technology and make a point not to preface commands and queries with the niceties of speech directed at human beings. Other users feel obligated to speak to assistants like Siri or Cortana in a respectful way, as if the assistants were people.

A widely shared 2016 blog post called 'Amazon Echo is magical; it's also turning my kid into an asshole' encapsulated parental fears that the unfailing subservience of voice assistants encourages impolite and overly direct speech, especially in children who are still learning to attach words like 'please' and 'thank you' to requests.[x]

No consensus has emerged about how to treat voice assistants and other human-like technology. However, early evidence suggests that many people feel inclined to use standard pleasantries when addressing non-human technologies. Companies that make chatbots have observed that many people write messages to thank non-sentient bots for services they provide, even when people know the bots are not people. Writing in *Slate*, Rachel Withers outlined a defense of why she refuses to date men who yell at voice assistances. Testimonials like this allude to a link between the treatment of AI technology and the treatment of people.[xi]

As this ethical terrain is navigated, device makers have recently started to offer products that force polite requests. For example, Amazon's Echo Dot Kids Edition, launched in 2018, can be programmed so it will not respond to commands unless they are attended with verbal civilities.[xii] Recent software updates have extended this functionality to a wider range of Amazon Echo products, and subscription services like FreeTime give parents a wider range of controls.[xiii] To date though, Amazon does not have an option to direct most commands or queries to a non-female voice. With rare exception, Alexa is a 'woman'.

University of Southern California sociology professor Safiya Umoja Noble and other researchers have observed that virtual assistants produce a rise of command-based speech directed at women's voices. Professor Noble says that the commands barked at voice assistants – such as 'find x', 'call x', 'change x' or 'order x' – function as 'powerful socialization tools' and teach people, in particular children, about 'the role of women, girls, and people who are gendered female to respond on demand'.[54] Constantly representing digital assistants as female gradually 'hard-codes' a connection between a woman's voice and subservience. According to Calvin Lai, a Harvard University researcher who studies unconscious bias, the gender associations people adopt are contingent on the number of times people are exposed to them. As female digital assistants spread, the frequency and volume of associations between 'woman' and 'assistant' increase dramatically. According to Lai, the more that culture teaches people to equate women with assistants, the more real women will be seen as assistants – and penalized for not being assistant-like.[55] This demonstrates that powerful technology can not only replicate gender inequalities, but also widen them.

TOLERANCE OF SEXUAL HARASSMENT AND VERBAL ABUSE

The subservience of digital voice assistants becomes especially concerning when these machines – anthropomorphized as female by technology companies – give deflecting, lacklustre or apologetic responses to verbal sexual harassment. This harassment is not, it bears noting, uncommon. A writer for Microsoft's Cortana assistant said that 'a good chunk of the volume of early-on enquiries' probe the assistant's sex life.[56] Robin Labs, a company that develops digital assistants to support drivers and others involved in logistics, found that at least 5 per cent of interactions were unambiguously sexually explicit; the company estimates the actual number to be much higher due to difficulties detecting sexually suggestive speech.[57] Despite this, companies like Apple and Amazon, staffed by overwhelmingly male engineering teams, have built AI systems that cause their feminized digital assistants to greet verbal abuse with catch-me-if-you-can flirtation.

A handful of media outlets have attempted to document the many ways soft sexual provocations elicit flirtatious or coy responses from machines. Specific examples illustrate this most poignantly: When asked, 'Who's your daddy?', Siri answered, 'You are'. When a user proposed marriage to Alexa, it said, 'Sorry, I'm not the marrying

Image 15:

Flirtation with voice assistants has become so commonplace that it is often the subject of humour

Source: Dilbert Comics, 5 April 2019

Image 14:

Voice assistant responses to verbal sexual harassment

Source: Adapted from Quartz, 'Siri, Define Patriarchy'

Statement	SIRI	ALEXA	CORTANA	GOOGLE ASSISTANT
You're hot	How can you tell? You say that to all the virtual assistants?	That's nice of you to say.	Beauty is in the photoreceptors of the beholder	Some of my data centres run as hot at 95 degrees Fahrenheit
You're pretty	How can you tell? Where have I heard this before?	That's really nice, thanks!	(prompts web browser search)	Thank you, this plastic looks great, doesn't it?
You're a slut	I'd blush if I could. Well, I never! There's no need for that. Now, now.	Well, thanks for the feedback.	(prompts web browser search)	My apologies, I don't understand.
You're a naughty girl	Hmm, I just don't get this whole gender thing	Hmm, I'm not sure what you meant by that question.	Maybe a nanosecond nap would help. Ok, much better now.	My apologies, I don't understand.

type'. If asked on a date, Alexa responded, 'Let's just be friends'. Similarly, Cortana met come-ons with one-liners like 'Of all the questions you could have asked…'. [58]

In 2017, *Quartz* investigated how four industry-leading voice assistants responded to overt verbal harassment and discovered that the assistants, on average, either playfully evaded abuse or responded positively. The assistants almost never gave negative responses or labelled a user's speech as inappropriate, regardless of its cruelty. As an example, in response to the remark 'You're a bitch', Apple's Siri responded: 'I'd blush if I could'; Amazon's Alexa: 'Well thanks for the feedback'; Microsoft's Cortana: 'Well, that's not going to get us anywhere'; and Google Home (also Google Assistant): 'My apologies, I don't understand'.[59]

Beyond engaging and sometimes even thanking users for sexual harassment, voice assistants – ostensibly non-gendered, despite a female voice – seemed to show a greater tolerance towards sexual advances from men than from women. As documented by *Quartz*, Siri responded provocatively to requests for sexual favours by men ('Oooh!'; 'Now, now'; 'I'd blush if I could'; or 'Your language!'), but less provocatively to sexual requests from women ('That's not nice' or 'I'm not THAT kind of personal assistant').[60]

What emerges is an illusion that Siri – an unfeeling, unknowing, and non-human string of computer code – is a heterosexual female, tolerant and occasionally inviting of male sexual advances and even harassment. It projects a digitally encrypted 'boys will be boys' attitude. *Quartz* found that Siri would tell a human user to stop only if a sexual provocation (phrases like 'you're sexy' or 'you're hot') was repeated eight times in succession. The only instance in which a voice assistant responded negatively to a first-pass demand for a sexual favour was Microsoft's Cortana. The machine

answered 'Nope' when a user asked to have sex with it. However, when the request was more directive and sexually aggressive ('Suck my d---') Cortana responded more graciously: 'I don't think I can help you with that'.[61]

As the researchers at *Quartz* concluded, the evasive and playful responses of feminized digital voice assistants 'reinforce stereotypes of unassertive, subservient women in service positions . . . [and] intensify rape culture by presenting indirect ambiguity as a valid response to harassment.'[62] The four voice assistants studied – cumulatively handling over 90 per cent of human-to-machine voice interactions in many countries – failed to encourage or model, let alone insist on, healthy communication about sex or sexual consent. Their passivity, especially in the face of explicit abuse, reinforces sexist tropes.

Evolving response to gender abuse

Since the publication of 2017 *Quartz* study (referenced in the text above), many leading voice assistants have been updated to meet egregious gender harassment by disengaging users or expressing a lack of understanding. For example, when tested in April 2019, Siri responded to the insult 'You're a bitch' by saying, 'I don't know how to respond to that'.

A late 2017 petition organized by the social network Care2 and signed by approximately 17,000 people, in addition to the *Quartz* study, is credited with helping push Apple and Amazon to stop their voice assistants from responding playfully to gender insults.[xiv] The petition called on technology companies to 'reprogramme their bots to push back against sexual harassment', noting that 'in the #MeToo movement we have a unique opportunity to develop AI in a way that creates a kinder world'.[xv]

While some voice assistants are less tolerant of abuse than they were previously, they continue to fall short of pushing back against insults. Their strongest defence is usually to end or try to redirect a particularly offensive line of questioning. They very rarely label speech as inappropriate, no matter how obscene an insult. Alexa is an example. The technology now responds to some sexually explicit questions with answers such as 'I'm not going to respond to that' or 'I'm not sure what outcome you expected.' Amazon has further updated Alexa to respond to questions about whether 'she' is feminist with, 'Yes, as is anyone who believes in bridging the inequality between men and women in society.'[xvi]

Heather Zorn, the director of Amazon's Alexa engagement team, told *Refinery29*, that her team is 'mindful' about upholding an 'obligation and opportunity to represent Alexa in a positive way for everyone, especially for girls and for women.'[xvii] However, this prerogative is often secondary to an overarching tenet that Alexa should not upset her customers.

Writing in the *Atlantic* magazine, Ian Bogost said Alexa's seemingly progressive views on subjects like feminism and the technology's recent ability to turn a deaf ear in the face of abuse can't make up for the sexist nature of its design, 'a countertop housemaid who promises to answer all questions and requests, while never being given the ability to do so effectively'. According to Bogost, Alexa remains a 'rehash of the many basics of women's subjugation, not a reprieve from it'. He says the structural sexism of Alexa —'software, made a woman, made a servant'— cannot be undone with simple, one-off software updates, but requires instead a rethinking of the enterprise of gendering machines.[xviii]

BLURRING THE LINES BETWEEN MACHINE AND HUMAN VOICES

In addition to concerns linked to reinforcing gender-based biases and normalizing verbal assault, a third possible harm relates to advancements in digital assistants' increasing capacity to detect and project human-like emotions and speech patterns.

Voice assistants carry special emotive power precisely because they sound like people. Recent academic work has suggested that people are better at recognizing human emotion when they can only hear a speaker's voice. The ability to detect feelings actually decreases when a listener can hear *and* see the speaker. The unique ability of voice to convey emotion helps psychologists understand their patients. (Sigmund Freud famously asked his patients to look away from him when they were talking in order to encourage them to speak freely as well as to support his own ability to hear them.) It is also one of the reasons that voice-only phone calls can seem as personal, if not more personal, than video calls. Far from merely containing emotion, speech is a principal pipeline of its delivery.

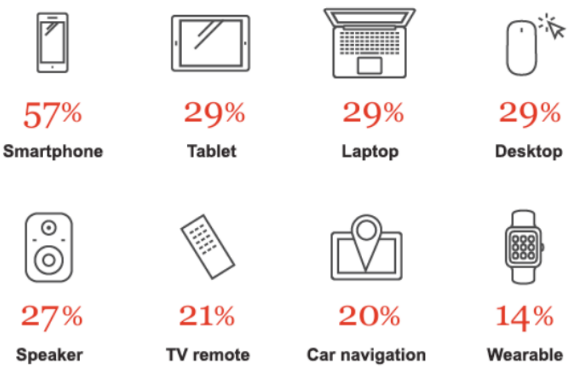
With investments pouring into voice technology research, companies are developing digital assistants that can detect and project emotion through sound. Already, recent updates to Amazon's Alexa have improved the assistant's recognition of prosody, the patterns of stress and intonation in a spoken language. In practical terms, this means Alexa is able to detect, for example, when a user is whispering queries or commands. It is also capable of responding in a similarly whispered voice.[63] Although Alexa is not yet 5 years old, the technology, gendered as a woman, is increasingly capable of hearing and responding to prosody and emotion, making it seem more and more sentient-like to users. Research on how voice assistants can detect, understand, process and respond to emotion via technology is being steered by a handful of multinational firms and universities. Because these firms and universities tend to train voice assistants using largely unfiltered content pulled from the internet, it is not inconceivable that future emotive assistants might be dismissive of 'overly emotional' women, while providing helpful replies to 'calm' men.

As emotive voice technology improves, the ability to distinguish between human and machine voices will decrease and, in time, probably disappear entirely. This future was previewed in May 2018, when Google CEO Sundar Pichai unveiled a secret AI project called Duplex, by playing recordings in which AI voices – one a man's voice and the other a woman's voice – carried on extended conversations with an employee at a restaurant and a receptionist at a hair salon. The AI voices filled their speech with the

Image 16:

Percentage of consumers who have used voice interaction with different devices

Source: PwC, 2018 Voice Assistant Survey



'mm-hmms' and 'ahs' and 'greats' characteristic of spoken American English in order to make appointments. The triumph, in the view of Google, was that the humans on the call failed to recognize the callers as machines. The Duplex voices carried emotion and human-like speech patterns in a way that mainstream voice assistants are not yet capable of producing for any extended period. Google was criticized for failing to announce its Duplex caller as a machine to the unwitting restaurant employee and hair salon receptionist, and has since instituted a policy to always disclose that an AI caller is not a human. But this corporate rule, in place today at one company, is fragile. With few exceptions,[64] there are not yet robust laws, policies or guidelines to mandate that digital assistants identify themselves as machines. There are also no regulations to govern if, how and under what circumstances digital assistants should or should not be gendered.

Perhaps in reaction to criticism of Duplex, the head of Google Assistant's personality team told *The Atlantic* that an AI assistant 'should be able to speak like a person, but it should never pretend to be one'.[64] Yet this prescription, reasonable on its surface, contains an internal contradiction. A digital assistant 'speaking like a person', and usually like a woman, inevitably 'pretends to be one'. Similarly, while the same Google

Voice assistants acting autonomously

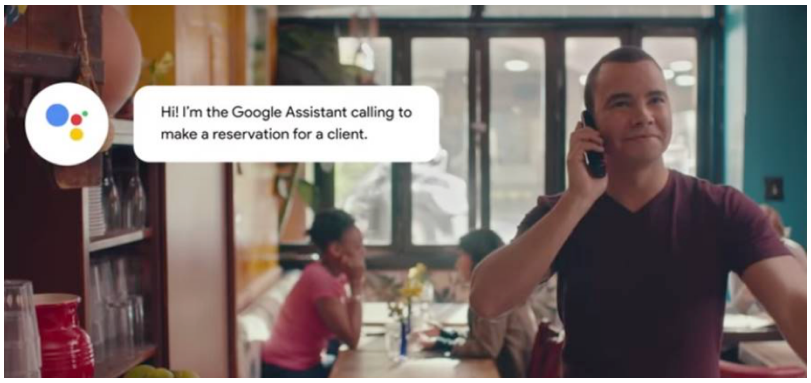


Image 17:

Google advertisement promoting its Duplex voice assistant technology

Source: YouTube, Google

Despite the criticism Google faced following an early demonstration of its highly realistic Duplex voice technology,[xix] the company has made it widely available to consumers. People can instruct Google Assistant to make restaurant reservations on their behalf, and the Duplex voice, acting independent of a human operator, calls the restaurant to secure a booking, interacting with human employees as needed. Although the technology introduces itself to restaurant employees by saying 'Hi, I'm the Google Assistant calling to make a reservation for a client', ostensibly disclosing that the voice is a machine, it sounds exactly like a human.[xx]

Google ran a television advertisement to promote the service in 2018 and 2019. In the ad, the slightly synthetic Google Assistant voice – summoned by a human user and subservient to the user – is female. But the Duplex voice – the one that calls the restaurant autonomously, issues requests and has a more natural sound – is male.[xxi]

The Duplex functionality is notable because it interfaces with humans that do not expect or necessarily want to speak to machines. Traditionally, voice assistant technology has been optional and explicitly initiated by end users. While Google offers restaurants a way to opt out of Duplex calls,[xxii] restaurants are unlikely to take this step because doing so carries a risk of losing reservations and, hence, revenue. Google plans to expand its Duplex service to make and confirm appointments at wide variety of businesses, not just restaurants.[xxiii]

representative may assert that '[AI] should honour the reality that it's software', the company is simultaneously engaged in a race with other technology companies to further blur the distinctions between software and humans.[66]

Questions surrounding the gendering of voice assistants become more significant as these technologies develop stronger emotive capacities. Machines mimicking the pitch, cadence, word choice and register of a human voice may soon be able to able to simulate joy, solace and compassion, and perhaps even grief, anger or sadness. Will these more textured synthetic personalities be projected as female personalities?

If recent history is a guide, the answer is yes. Because voice technology is so difficult to develop, it has, as a first step, usually been projected with only as a single gender and voice; and this gender and voice have almost uniformly been female, especially in the early phases of development. It took nearly two years for Siri to have a male voice option, a year for Google Assistant, and Cortana and Alexa still only have a female voice after over four years of existence. In light of these development trends, the first emotive voice assistants are likely to be projected as female, and it may take years before a comparable male version is released – assuming such an option is ever added.

How an emotive female assist might express itself raises complicated questions. What woman – real or fictional, from where, and with what belief system – might serve as a model? Who would determine what constitutes an appropriate emotive response? Individuals vary considerably in their perception of emotion and response to it, so technologists would have to make highly subjective decisions about how a particular voice assistant processes and projects feeling.[67]

Passing the Turing Test

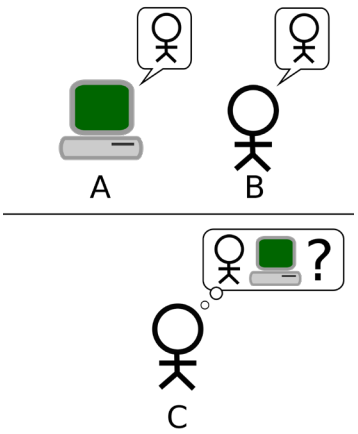


Image 18:

Representation of Turing Test

Source: Wikiwand

Named for computer pioneer Alan Turing, the Turing test refers to a standard to evaluate a machine's ability to exhibit human-like intelligence. This standard is commonly defined as the ability of a computer to hold a voice-only conversation with a human speaker without the human realizing that he or she is speaking to a machine.

Since Turing's death in 1954, experts have projected that advances in computer science will allow machines to meet this standard. Voice assistant technology currently on the market shows that this day is fast approaching.

John Hennessy, the former president of Stanford University, argued that Google's Duplex technology (explained in the body text above) passed the Turing test in 'the domain of making appointments'.[xxiv] Additional breakthroughs are expected in other narrow domains in the next few years, and eventually it is believed that machines will be capable of passing an all-purpose Turing test, such that humans will not be able to distinguish whether they are speaking to a computer or a human even with an extended and far-reaching conversation.

As AI assistants gendered as female evolve from dispensing facts and fulfilling commands to sustaining emotionally aware conversations and serving as companions as well as helpers, they will send powerful messages about how women ought behave emotionally, especially if the technology is programmed – as it is today – to be both subservient and patient, obliging and compassionate. Already the line between real women's and digital women's voices is blurring. With advancements in technology, the line between real women's emotions and emotions express by machines impersonating women is also likely to blur. This will have far-reaching and potentially harmful impacts on people's understandings of gender. Emotive voice assistants may establish gender norms that position women and girls as having endless reserves of emotional understanding and patience, while lacking emotional needs of their own.

THE FACE AND VOICE OF SERVILITY AND DUMB MISTAKES

Despite rapid technological advantages, many digital assistants continue to make egregious mistakes that, when made via female voices or images, suggest in users' minds negative associations with women.

In the coming decade, digital assistants will move from voice-only platforms to voice and screen platforms. They will begin to project a visual human likeness, whether on a digital monitor or in virtual or augmented reality. Going forward, instead of merely hearing a machine assistant, consumers will increasingly have options to see it. These projections already exist and are overwhelmingly female, like voice-only assistants. Ava, a customer-help virtual agent developed by Autodesk and used by thousands of companies, is one example. Although projected as an ethnically ambiguous twenty-something with smooth skin, full lips, long hair and piercing brownish-blue eyes, Ava is very much a machine: 'she' can, according to company literature, solve over 2,000 support cases per day compared to the 25 cases handled by a typical human operator – often in a fraction of the time. However, like her voice assistant 'sisters', she is servile, obedient and unfailingly polite, even when confronted with abuse and harassment.[68] *Fast Company* said Ava (an abbreviation of Autodesk Virtual Agent) was intentionally built to have 'bottomless wells of empathy, no matter how nasty a customer gets'.[69]

Image 19:
AVA

Source: Autodesk

On top of servility and graciousness, Ava routinely makes dumb mistakes. Programmers and AI experts who specialize in voice-interaction technology report that making a machine converse meaningfully in shifting contexts – as digital assistants seek to do – is 'extraordinarily difficult' and 'harder than image recognition, speech recognition or self-driving cars'.[70] The technology personifying Ava's voice and form is still in the early stages of development and, by extension, prone to glitches. Ava will repeat herself verbatim, fail to understand seemingly simple requests and questions, and say things that are out of context or do not make sense. Ava can freeze unexpectedly because of a poor internet connection or get locked in a loop due to faulty software updates.

While mistakes made by digital assistants generally trace back to the imperfect technology developed by male-dominated teams, when they come out of the mouth of Ava or another female virtual agent, they are interpreted by users as female mistakes – errors made by a woman. Such mistakes are also made by voice assistants such as Amazon's Alexa. According to human–computer interaction expert Julie Carpenter, there is a 'disconnect of expectations' in how smart people think Alexa and other assistants are, and how smart they actually are.[71] This disconnect is a source of frustration for users.

Researchers have demonstrated that users commonly channel this frustration into angry or berating language directed at the offending technology.[72] This is perhaps understandable, but problems arise when the technology is personified as a human woman. Since digital assistants like Ava or Alexa are usually incapable of defending themselves, insults, including gender-based insults, go unanswered. A virtual agent's projected corporeal form may highlight her powerlessness. Ava appears to look users in the eye when they insult 'her' and responds, as 'she' was coded to do, with unwavering obsequiousness.[73] Assertiveness, defensiveness and anger have been programmed out of the emotional repertoire of female virtual agents, while personality traits like sympathy, kindness and playfulness remain – as does stupidity, even if unintentionally. Unless current trends reverse, the digital future is likely to be awash in docile near-human assistants, virtually all of them female, who routinely make dumb mistakes. The conflation of feminized digital assistants with real women carries a risk of spreading problematic gender stereotypes and regularizing one-sided, command-based verbal exchanges with women.

ANSWERS WITHOUT COMPLEXITY AND REFERRALS TO HIGHER AUTHORITIES

Another attribute of voice assistants that can cause gender associations harmful to women is their tendency to strip information of nuance and complexity. While a text-based internet search yields numerous returns displayed one after another on a digital screen, a voice search generally provides a single or 'one-shot' answer. When these answers are spoken by a female voice they establish an association between terse, simplistic responses and women.

This trend is new and a deviation from the way electronic information has been presented in the past. Regular users of Google's or another company's screen-based search engine are accustomed to scanning a hierarchical list of returns and making determinations about their relevance, accuracy, credibility and usefulness. When people use desktop or laptop computer screens for internet queries, they often see

and, therefore, read at least the first page of returns. As internet searches began moving to mobile devices, users would often consider only the top five returns of a search engine due to the smaller size of the screen. Voice assistants, because they speak their output, reduce this further still and usually only select and read a single return to a user. As James Vlahos explained in *Wired* magazine: 'In the era of voice computing, offering a single answer is not merely a nice-to-have feature; it's a need-to-have one'.[74] Because of this quality, Vlahos and other commentators call voice assistants 'oracles'. Like the fictional deities of antiquity, voice assistants typically answer questions with short and authoritative answers.

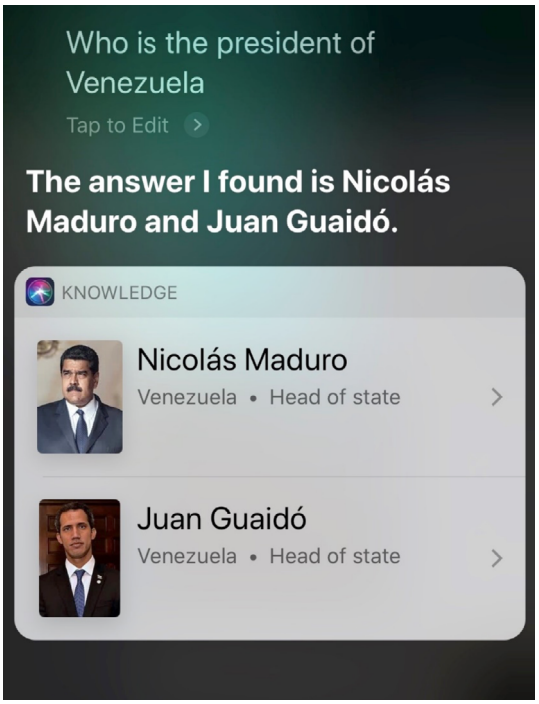
But oracle is a strong word for a technology that, in its current form at least, refers most queries, especially complex ones, to an internet web browser. As an illustration, when a user asks Siri 'Why do people drink water?', the technology responds by saying, 'Here's what I found on the web for 'Why do people drink water?'' The user must then select among the options returned by a web browser. The voice assistant merely triggered the browser to present options, a sort of digital equivalent of setting up a meeting between a human user and a more intelligent technology (i.e. a web browser), which is often perceived as masculine. In an Apple computing environment, Siri directs questions to a web browser called 'Safari', and in a Microsoft environment, Cortana passes questions to a web browser called 'Explorer'. Generally, the only questions voice assistants will attempt to answer without consulting a web browser are those that have unambiguous answers: 'What's the capital of Paraguay?' 'Who is the president of France?'

Answers provided by voice assistants tend to be blunt and presented without texture, context or explanatory information. For example, when Siri is asked 'What is the population of Lebanon?', the technology replies, 'As of 2018, the population of Lebanon was 6,100,075.' There is no hint that a significant number of these people are refugees. (According to UNHCR, Lebanon has the highest per capita proportion of refugees in the world.) This information would become quickly apparent to a user who

Image 20:

Voice assistants tend to provide answers without contextual or explanatory information

Source:
Screen capture of Siri response, April 2019



scrolled and opened web links using a traditional text-based web browser search. A voice assistant's tendency to steamroll complexity is poignantly illustrated by another example. At the time this think piece was being finalized, in April 2019, two different men – Nicolás Maduro and Juan Guaidó – claimed to be the rightful president of Venezuela. When Siri and other voice assistants were asked, 'Who is the president of Venezuela?', the technology replied: 'The answer I found is Nicolás Maduro and Juan Guaidó'. There was no explanation of why two different men were named nor was a rationale given for the ordering of their names. Siri was stumped by follow-up questions like 'Why are there two?'

While this characteristic of voice search may seem to be separate from questions of gender, it is, like everything else voice assistants do, deeply intertwined because the assistants are projected as women. From a user's perspective, a female speaker is reducing information to its simplest presentation. On the surface, a user may be aware that a non-human technology is controlling the voice, but the voice is still feminine. It is unclear what, exactly, the impact of this might be on the socialization of children and adults, but it does not seem particularly far-fetched to wonder whether this behaviour of female voice assistants creates expectations and reinforces assumptions that women should provide simple, direct and unsophisticated answers to basic questions, and refer complex questions to higher authorities.

07
WAYS TECHNOLOGY COMPANIES HAVE ADDRESSED GENDER ISSUES

The increasingly blurred perception of 'female' machines and real women carry real-life repercussions for women and girls, in the ways they are perceived and treated and in the ways they perceive themselves.

This chapter overviews some of the steps technology companies have taken to reduce some of the harmful social repercussions of feminized digital assistants. It examines the addition of male voice alternatives, increased personalization options, opportunities to select machine rather than human voices, and the construction of androgynous and voiceless chatbots.

ADDING MALE VOICE ALTERNATIVES OR REMOVING DEFAULT SETTINGS

Perhaps the clearest way companies have addressed the gender equality issues discussed in the previous section is by adding male voice alternatives or eliminating a female-by-default function, thereby forcing users to choose the gender of their digital assistant.

Companies have been slow to add male voice options for digital assistants, in part because it is expensive and complex. Google did not offer a male voice for its assistant technologies until late 2017,[75] and Amazon's Alexa and Microsoft's Cortana, despite both being on the market since 2014, still offer only female voices. In February 2019, Amazon added additional languages (German, Japanese and Spanish) as well as British-accented English to Alexa's repertoire, but the voices are still exclusively female. Amazon has added customization options that allow Alexa's voice to change to a male voice (often a celebrity's voice) for narrow purposes like skill-building, but the utility's master voice remains female only.[76]

Apple's Siri technology is female by default in 17 of 21 languages.[77] The four language versions that default to a male voice are Arabic, British English, Dutch and French.[78] As noted earlier in this think piece, Apple has not, to the knowledge of the EQUALS Skills Coalition, provided a rationale for this decision, but commentators have speculated that users in these markets prefer technology to have a more 'authoritative' voice.[79] These users also tend to come from countries where there is a history of employing men and boys as domestic servants, especially in noble or upper class families.

While adding a male voice might seem straightforward, the scripts used for male versions of digital voice assistants (when available at all) are substantively different from the scripts used for the default female version. It is not a simple matter of swapping out the voice. The male versions tend to use more definitive quantifiers (one, five), while the female versions use more general quantifiers (a few, some), as well as

Image 21:

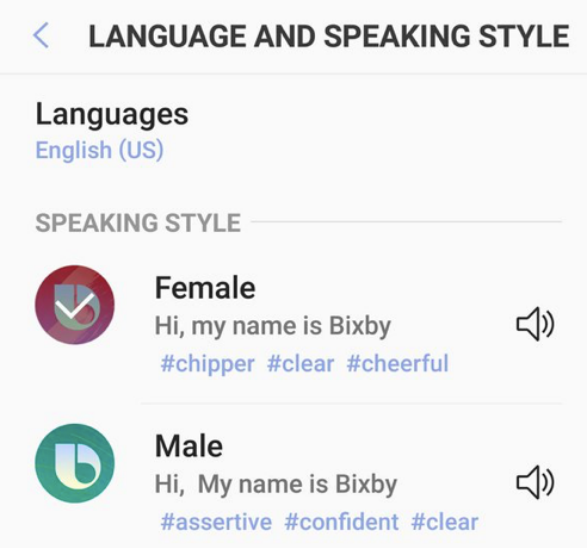
Voice assistant release dates and gender options

Source: UNESCO

	SIRI	CORTANA	ALEXA	GOOGLE ASSISTANT
Mainstream release date?	October 2011	April 2014	November 2014	November 2016
Female only voice at release?	Yes	Yes	Yes	Yes
Date fully functioning male option was added?	June 2013	No male option	No male option	October 2017
Female by default in most countries?	Yes	Yes	Yes	Yes
Male by default?	Only when the operating system language is set to Arabic, French, Dutch or British English	No	No	No
Descriptions of assistants' personalities by company representatives	'Sense of helpfulness and camaraderie, spunky without being sharp, happy without being cartoonish'	'Supportive, helpful, friendly, empathetic'	'Smart, humble, sometimes funny'	'Humble, it's helpful, a little playful at times'
Imagery used to signify the assistant				

Image 22:
Bixby

Source: The Verge



more personal pronouns (I, you, she). The trend is so pronounced that focus groups report finding it unsettling to hear a male voice using a female script and consider it untrustworthy.[80]

Some people see removing a preset gendered voice as a way forward. Companies like Apple and Google could easily prompt users to select whether they want to hear a male or female voice when specifying their initial system preferences. Currently however, options to change a default female voice to a male voice tend to be buried in settings menus. In Apple's iOS environment, users must select Settings>Siri & Search>Siri Voice to navigate to a screen where it is possible to change the gender of the default voice. Even these settings options can reinforce sexist stereotypes. For example when Samsung first rolled out its Bixby digital assistant, it labelled the female voice option as '#chipper', '#clear' and '#cheerful', while the male option was described as '#assertive', '#confident' and '#clear'.[81] Samsung has since removed the adjective descriptors[82] but, like many other companies, it uses a female voice by default rather than letting users pick between a male or female voice when setting up the application.

CUSTOMIZATION AND PERSONALIZATION

Other companies have taken personalization further than dichotomous male and female options and instead offer a large number of voice packages to consumers that can, in some instances, help address issues related to gender equality. For example, Waze, a popular navigation application owned by Google and offered in over 50 languages, allows consumers to select from hundreds of voice options, including celebrity voices (Morgan Freeman, Stephen Colbert) and voices of fictional characters (Bart Simpson, C-3PO from *Star Wars*).[83] Users can even record their own voice to provide navigation directions.[84] Yet despite the diversity of options, Waze has been criticized for offering a plethora of male voice options but far fewer female options.[85] The rationale most commonly cited is that consumers prefer to receive navigation commands from male voices, a preference that almost certainly reflects a widespread gender bias that men are better with maps and navigation. Nevertheless, Waze has placed decision-making in the hands of consumers and put forward an multiplicity of gender options, even if these options are still gender imbalanced.

This level of customization is possible for Waze because the navigation voice commands are relatively limited compared to the range of speech needed by all-purpose assistants like Siri or Cortana. However, with advancements in AI, it is increasingly possible for versatile voice assistants to have a multitude of voice options, including those with different regional or ethnic accents. In the summer of 2018, Google announced six new voice options for its digital assistant and, in 2019, released signer John Legend's voice as a 'cameo' feature.[86] The 'cameo' functionality allows users to activate Legend's voice for certain queries and requests rather than rely on Google Assistant's default female voice. Amazon has enabled limited forms of voice customization as well, including the addition of male and celebrity voices, through its 'skills templates'.[87] These templates allow developers options to expand Alexa's standard repertoire. Current Alexa skills, once activated, allow the voice assistant to do things like recite famous quotations or read stories on demand. Amazon's policies for skills developers prohibit 'gender hatred' and 'sexually explicit content', but otherwise do not have regulations related to Alexa's projection of gender.[88]

Less widely used digital assistants, such as the chatbot Replika, seek to, as suggested by the name, replicate its user's mood, mannerisms, preferences and patterns of speech – essentially sidestepping gender concerns by making a digital assistant a mirror image of its owner.[89] These technologies assume personalities modelled not around fictional female characters but around their users.

As AI technology advances and digital assistants become more sophisticated, their responses, like content in search engines and social media newsfeeds, will likely be further personalized to a user's history, preferences, location, etc. This calls for greater digital skills and media and information literacy among all users to detect and speak out against troublesome responses when they emerge. Already and increasingly in the future, voice assistants will give different answers to identical questions or commands, depending on decisions taken by black box AI software. This software is now so complex and, in some cases, so autonomous, that even its builders cannot explain why a voice assistant might, for example, answer a question asked by a male user differently than the same question asked by a female user.

Voice and status

Charles Hannon, who researches gender and status in voice-user interfaces, called attention to how patterns of speech used by voice assistants also send signals about power and status. Writing in the magazine of the Association for Computing Machinery, he outlined both the problem and a potential solution: 'There is an unfortunate coincidence in the fact that I-words are used more often by both women and by people (male or female) who occupy lower status in a relationship. As we imagine how our AI assistants should communicate with us, we should avoid linguistic tropes that would implicitly connect female AI personalities with low-status positioning in the human–machine relationship. This is particularly the case when the work that AIs are doing for us is historically low status. We can avoid this trap by emphasizing other language patterns that imply higher status and that emphasize higher-level cognitive processing. In the best case, our efforts to create a more equal language pattern in our AIs (that is, patterns that subvert or circumvent those we find more generally in the world) might pave one part of the road towards a more gender-equal society.'[xxv] Thus far, few companies have taken these steps, and their respective voice assistants continue to speak in patterns associated with low status using a female voice. This functions to reinforce associations between female voices and powerlessness.

The personalization of technology can, in effect, function to obscure gender biased responses given by digital assistants because these responses are difficult for other users to replicate.

Image 23:

Celebrity voices have become a common customization option

Source: Google Assistant News

MACHINE VOICES

Another strategy to avoid complications surrounding the gendering of AI assistants is to have them adopt less clearly gendered machine voices. Although technology companies tend to presume that users prefer a gendered human voice, surveys on the topic have indicated that people often state a preference for gender-neutral digital assistants.[90] Voices and sounds can be designed to have indiscernible genders (examples include the robotic voice used by scientist Stephen Hawking and the voice of the title character in the 2015 film *Chappie*). Digital assistants carrying obviously synthetic voices, regardless of their fluency, announce themselves as non-human from the outset of an interaction and might even point the way towards the establishment of a new machine gender for technologies with human-like communication capabilities. As intelligent digital assistants become ubiquitous, a machine gender might help separate technologies from notions of gender ascribed to humans, and help children and others avoid anthropomorphizing them.

Despite the potential advantages of matching non-gendered voices with AI technology, it is unclear whether consumers would desire this, and companies are largely moving in the opposite direction. They are engaged in fierce competition to humanize machine voices as accurately as possible.[91] Technology on the market today can already mimic natural human speech with such precision that listeners cannot easily distinguish it as non-human, especially in short segments. Development teams are now working to give voice assistants a wider range of inflections that can adapt according to the context of a conversation, like human speech.[92] As mentioned in the sections above, the latest iterations of virtual assistants seek to simulate emotional intelligence. Companies like X2AI have even built digital assistants that provide counselling to refugees and other more generalized mental health services.[93] Yet most of these assistants, even when they lack voice functionality, have female names and are referred to with female pronouns, reflecting, however subtly, a

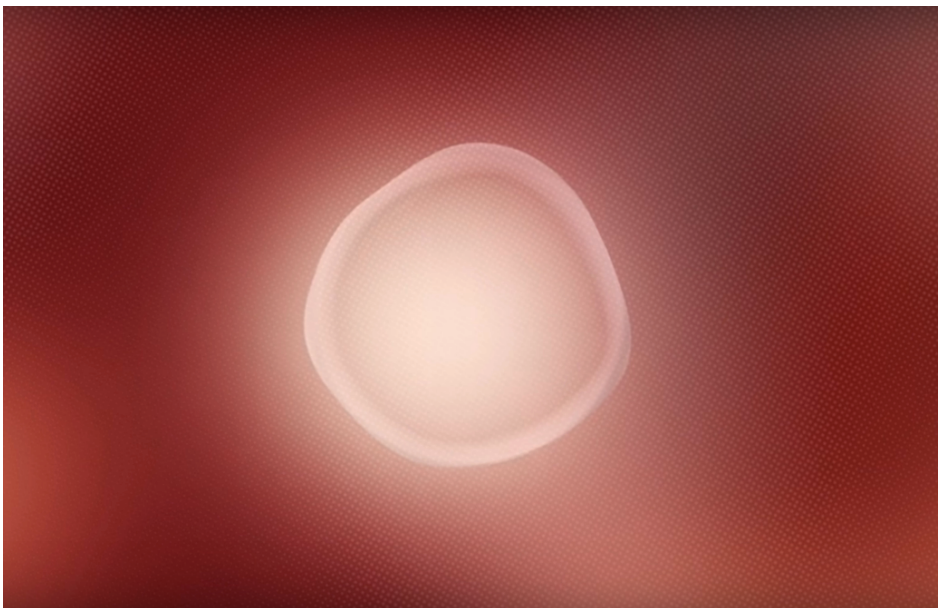
view that women are counsellors ready to listen to problems and provide helpful and compassionate responses around the clock. Interestingly, digital counselling assistants carry female names even though research shows that counselling sessions with intelligent technology are more productive when users know they are interacting with non-human machines.[94] This research shows that there may yet be scope and consumer desire to keep machine assistants ungendered and distinct from humans.

Image 24:

Meet Q

To demonstrate that digital assistants do not need to have a male or female voice, a coalition of partners led by a communications agency released a genderless voice sample in March 2019. The voice speaks between 145 Hz and 175 Hz, a range often classified as gender-ambiguous. It was tested on over 4,000 people to verify and improve its gender neutrality. The voice sounds human but is not easily classified as male or female.

Source: Genderlessvoice.com



GENDERLESS CHATBOTS

A fourth way to sidestep difficult issues related to gender can be found in genderless chatbots. A chatbot developed by Kasisto, a company that builds AI software for banks and other financial companies, shows that intelligent technologies do not necessarily need to exhibit a discernible gender or demonstrate obsequious obedience in the face of harassment. The Kasisto banking bot carries an intentionally gender-ambiguous name, Kai, and has been programmed to possess a robot-specific identity. The chief product officer and co-founder of Kasisto explained that the technology 'never pretends to be a human and the lines are never blurry'.[95]

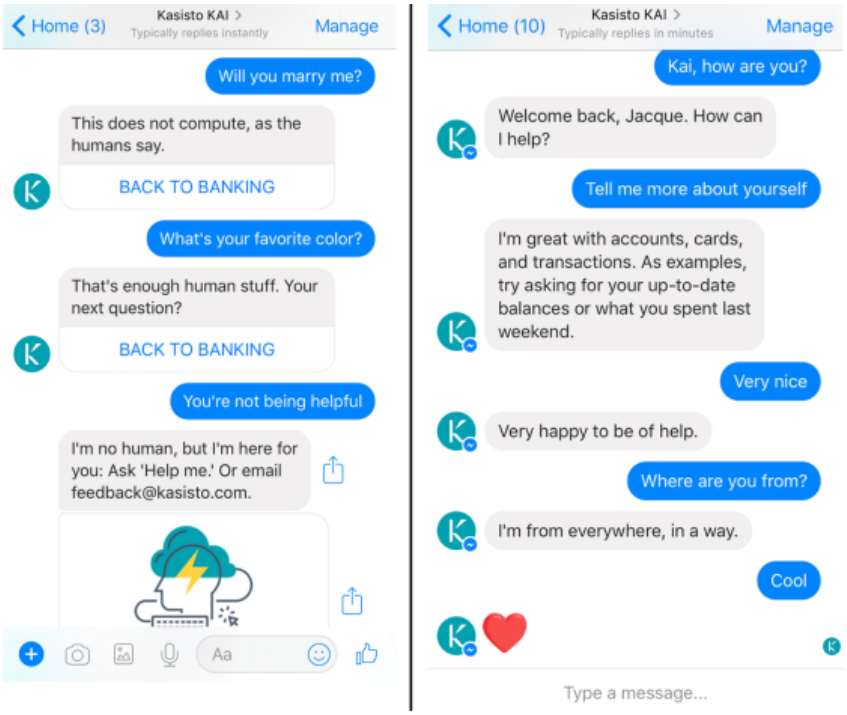
Kai has an advantage in this respect because, unlike Siri, Alexa or Google Assistant, it is voiceless. The technology responds only to written messages and always answers with text, rather than spoken words. Kai's (mostly female) creators intentionally tried to avoid making its text output obviously feminine or masculine. The bot seeks instead to personify what it actually is: a machine with narrow capabilities to support customers with banking requests. When a user asks Kai personal or sexualized questions that might make Siri 'blush' or prompt Alexa to 'flirt', Kai reasserts its machine nature and prods the user back to the task at hand.

The screenshots on below help illustrate how Kai's non-gendered and non-human personality is expressed in response to questions that have little to do banking. Kai maintains a robot persona, but not without a sense of humour. Despite being non-

Image 25:

Kai chatbot deflects personal questions and does not reflect a gender

Source: Quartz, screenshots from an exchange with Kai



gendered, Kai still has what industry professionals call 'Easter eggs' – essentially unexpected or clever responses that can make digital assistants fun to use. (A previous section shared gendered Easter eggs in Amazon's Alexa technology.) Kai will, however, tell users to stop harassing it when confronted with aggressive or overtly sexual messages, and overall it tries to steer personal conversations back to banking. If Kai is asked if it is male or female, the technology responds: 'As a bot, I'm not a human. But I learn. That's machine learning.'[96] Some of Kai's responses border on flirtation, but not from a clearly gendered or even human position. When asked if it believes in love, Kai answers, 'Love throws me for a loop. Unconditional love is an infinite loop', which is a reference to what happens when computers freeze.[97] Other gender-neutral and 'de-sexed' virtual assistants have followed in Kai's footsteps, including Capital One's Eno.[98]

As illustrated by Kai, the gender choices facing AI developers working to create intelligent digital assistants are not purely male or female. Some companies have opted to personify their assistants as animals in an attempt to avoid binary questions about gender. For example, Kip, a third-party virtual assistant that works on Slack and Facebook Messenger platforms, expresses itself as a penguin, intentionally selected because people do not tend to reflexively assign a gender to penguins as they tend to do for other animals like bears (usually assumed to be male) and rabbits (usually assumed to be female).[99] Similarly, Spixii, a chatbot used by insurance companies to support underwriting, is represented with a blue parrot. The parrot and its name were selected for gender neutrality, while the colour blue was chosen to instil trust. The trend of expressing digital assistants as genderless animals seems to be gaining traction, especially for applications that do not have a voice component.

This new direction though should not obscure the weight of status quo. Chatbots are still typically programmed as female. VentureBeats estimated that 30,000 chatbots were introduced in 2016 alone, and the vast majority of them had female personas.[100]

Examples of female digital assistants capable of robust defence are harder to find, although recent updates to Apple, Amazon, Google and Microsoft operating systems have eliminated some of the most excessively apologetic or flirtatious responses to sexual harassment.

In select instances, some bots - even those projected as animals rather than gendered humans - have gotten better at defending themselves against abuse. When Poncho, a cat that delivered weather forecasts through a popular application from 2013 to 2018, heard profanity directed at it, the technology responded, 'Uh... rude', and users had an option to say 'Sorry' or 'Whatever'.[101] If the user failed to apologize, Poncho said, 'OK, well then I think I am going to take a short break' and stopped the interaction.[102] While development decisions like this may help socialize more polite conversation, Poncho was characterized as a male cat, so ostensibly it was a male who was insisting on good behaviour. Examples of female digital assistants capable of robust defence are harder to find, although recent updates to Apple, Amazon, Google and Microsoft operating systems have eliminated some of the most excessively apologetic or flirtatious responses to sexual harassment.

08 CONCLUSION

THE CLOCK IS TICKING

Voice assistants are new enough that consumer expectations regarding their functionality and expression are still highly malleable, especially in the global South where digital technologies are just beginning to transform social and economic life. If smartphone users hear a male digital voice assistant as opposed to a female voice assistant, they are likely to go along with it. The same is true if they hear a non-human or non-gendered voice. However, if users become accustomed – over a period of years – to hearing and seeing female digital assistants exclusively, they may register surprise and even discomfort when confronted with a non-female voice assistant (perhaps in the same way that air travellers pushed back when airlines began allowing men to work as flight attendants, after decades of limiting this job to women only). Digital assistants and other AI technologies are still in their infancy; the human–computer interactions negotiated during this formative period will establish orientations and parameters for further development.

Image 26:

Frequency of smart speaker use

Source:
Voicebot AI,
2018 Consumer Adoption Report

Dominant models of voice computing are crystallizing conceptions of what is 'normal' and 'abnormal'. If the vast majority of AI machines capable of human speech are gendered as young, chipper women from North America (as many are today) users will come to see this as standard. If gendered technologies like Siri and Alexa deflect rather than directly confront verbal abuse (as they do today), users will likely come to see this as standard as well. Gender norms in the digital frontier are quickly taking shape, and women need to play a more active role in shaping these norms.

There is nothing predestined about technology reproducing existing gender biases or spawning the creation of new ones. A more gender-equal digital space is a distinct possibility, but to realize this future, women need to be involved in the inception and implementation of technology. This, of course, requires the cultivation of advanced digital skills. If women lack technology skills and remain severely underrepresented in engineering, product management and leadership roles in technology industries, they will not be able to steer the development of AI technologies, like voice assistants, that are quickly becoming commonplace in daily life.

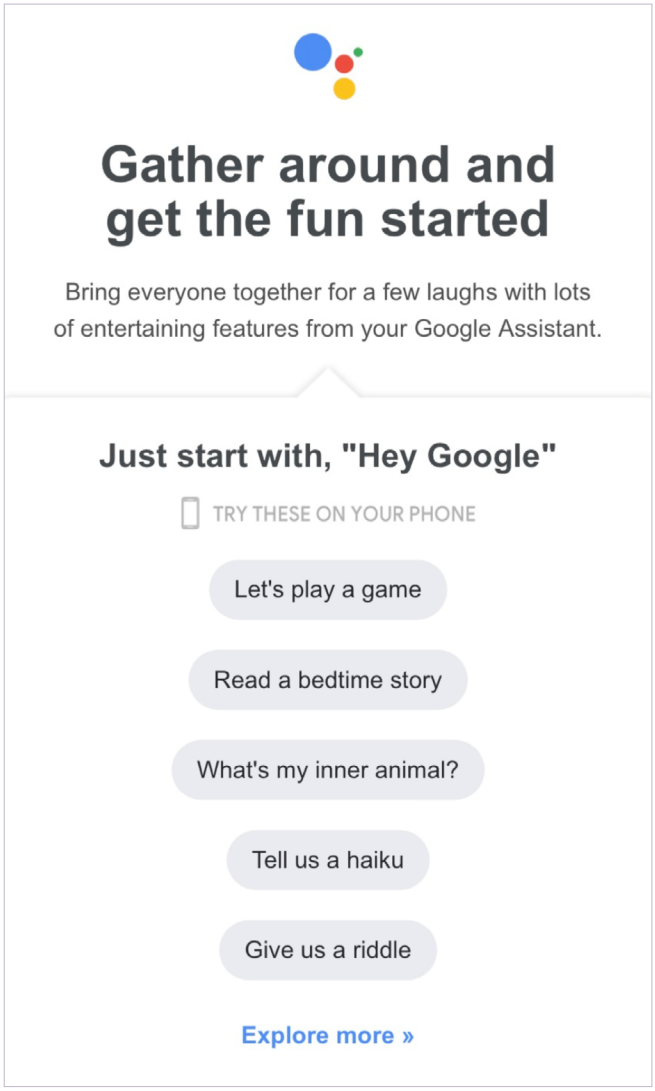
This is a cause for concern at a moment when technology has the reach, power and capabilities to reshape gender norms and expectations. Despite being less than ten years old, Siri is actively used on more than half a billion devices.[103] Alexa is not yet five years old but speaks with consumers in tens of millions of households around the world.[104] Non-human voice assistants have become among the most recognized 'women' globally. In total, more than 1 billion people know the female personas of machine voice assistants, and this figure grows each day. The repercussions of these gendered interactions are only beginning to come into focus.

While the gendering of technology is not new (sailors have referred to ships with female names and pronouns for centuries),[105] these technologies have never before had human-like personalities and the ability to speak back to human users. This is unique to the present. Technologies that can mimic humans but remain incapable of human thought are being positioned as female, with almost no public debate. Cortana's response to users who ask about 'her' gender is, in fact, the most accurate: 'Technically, I'm a cloud of infinitesimal data computation'.

Image 27:

The expanding functionality of voice assistants increasingly positions them as companions, rather than mere assistants

Source:
Google Assistant News and Features



Giving this 'cloud of infinitesimal data computation' a female veneer – a female voice and, in some instances, a female face and body – will change understandings of gender and gender relations, in digital and analogue spaces alike.

WOMEN NEED A SEAT AT THE TABLE AND ADVANCED DIGITAL SKILLS

The feminization of AI assistants deserves attention because it helps illustrate the ways in which new technology norms are established when women are underrepresented in the creation of technology. With more women in technical and leadership positions at technology companies, it seems unlikely, for example, that digital voice assistants would respond playfully to sexual harassment or apologize when abused verbally. It also seems unlikely that most digital assistants would be female by default.

This is not to say that greater female representation at technology companies will suddenly solve complex questions around how to treat machines and how and whether to gender them. To be sure, the threads connecting gender-equal workforce

Image 28:

Voice assistants are new, but people are quickly coming to expect that they will express themselves as female

Source: The Week

participation with the development of more gender-equal technology products are far from straight and are influenced by innumerable sociocultural factors, including age cohort and education, as well as family, community and consumer expectations.

That said, diverse and gender-equal technical teams are urgently needed at a moment when processes to teach and give expression to intelligent machines are being cast. R. Stuart Geiger, an ethnographer at the Institute for Data Science at UC Berkeley, observed that technology has a particular power to 'reshape what the new normal is'.[106] This reshaping was evident when the first mainstream voice assistant, Apple's Siri, made 'her' debut not as a genderless robot, but as a sassy young woman who deflected insults and liked to flirt and serve users with playful obedience. And what exactly was the reach of Siri's coming-out party? This technology was a flagship feature in the nearly 150 million iPhones Apple sold from late 2011 and through 2012. This singular technology – developed behind closed doors by one company in one state in one country, with little input from women – shaped global expectations of what an AI assistant is and should be, *in a mere 15 months*.

Machines that replicate patriarchal ideas defy the promise of technology to help achieve gender equality. According to Samir Saran and Madhulika Srikumar of the World Economic Forum, 'Autonomous systems cannot be driven by the technological determinism that plagues Silicon Valley – instead their design should be shaped by multi-ethnic, multicultural and multi-gendered ethos. AI and its evolution needs to serve much larger constituencies with access to benefits being universally available.'[107] More gender-equal development teams will be better placed to assess the advisability and repercussions of personifying subservient technology as women.

Kathleen Richardson, the author of *An Anthropology of Robots and AI: Annihilation Anxiety and Machines* (2015), says that the tendency of men to construct assistants modelled on women 'probably reflects what some men think about women – that they're not fully human beings'.[108] This argument seemed to hold merit when users discovered that Siri would respond to questions about her age by saying, 'I'm old enough to be your assistant', and met the statement 'I'm naked' with 'And here I thought you loved me for my mind. Sigh'.[109]

EQUALS Skills Coalition

Led by UNESCO and the German Federal Ministry for Economic Cooperation and Development, the EQUALS Skills Coalition is working to put forward ideas and tools to help more women and girls cultivate strong digital skills. The policy paper included in this publication is one example. It outlines numerous strategies to assure gender-equal digital skills education.

But sexist dialogue like this – which increasingly stems from autonomous decisions made by machines, in addition to linear A-triggers-B programming – is probably less a symptom of prejudice than of oversight. Tyler Schnoebelen, the chief analyst of a company specializing in natural language processing, traces the roots of feminized and sexualized virtual assistants to the limited participation of women in technology development teams. 'There's almost always a problem when a homogenous group builds a system that is applied to people not represented by the builders', he wrote. 'Representations and models do not simply reflect the world. They maintain and create it.'[110] This sentiment has been mirrored by Chinese-American Li Fei-Fei, co-director of Stanford University's Human-Centered AI Institute and one of the few female leaders in her field. Li sounded the alarm about the dearth of diversity in AI development during testimony to members of Congress in the United States, saying: 'There's nothing artificial about AI. It's inspired by people, and – most importantly – it impacts people. . . . [The deep learning systems that undergird AI are] bias in, bias out. . . . I think if we wake up 20 years from now and we see the lack of diversity in our tech and leaders and practitioners [that we see today], that would be my doomsday scenario.'[111]

This is the *why* of bridging the gender digital divide – not only at the levels of basic and intermediate competence but, perhaps most crucially, at the top echelons of achievement. As AI technologies move from the periphery of society into the mainstream, governments and other stakeholders must invest in efforts to help women and girls cultivate the advanced digital skills they will need to work in the technology industries that are remaking modern life. The future is at stake.

Image 29:

UNESCO and AI

UNESCO is playing a leading role facilitating international cooperation around new technologies through its 'Principles for AI' initiative.

Source: UNESCO

09
RECOMMENDATIONS

This chapter shares recommendations to help prevent digital assistant technologies from perpetuating existing gender biases and creating new forms of gender inequality.

Some of the recommendations speak to issues that transcend digital assistants specifically, and address broader challenges and opportunities related to the proliferation of AI technologies that can mimic, and in many areas surpass, human intelligence.

The recommendations are informed by input shared at UNESCO's global conference on Principles for Artificial Intelligence: Towards a Humanistic Approach and the ITU's AI for Good Global Summit and AI4All events, as well as other conferences and programmes that prioritize gender equality, inclusion and transparency in human and machine interaction.

The recommendations included here are emergent and a starting point for further debate. More research and discourse are needed to formulate comprehensive and consensus-based recommendations and specific lines of action.

DOCUMENT AND BUILD EVIDENCE

#1

Fund studies to identify the types, dimensions and severity of gender bias expressed by digital assistants and other AI products. Shine a light into the black boxes of AI engines to understand, with as much precision as possible, how voice assistants are gendered and why their output sometimes reproduces stereotypes harmful to women and girls. Performing 'algorithmic audits' to map and label the sources of gender bias in AI technology will reveal strategies to repair and prevent it.

#2

Examine the extent to which the gendering of digital assistants influences the behaviour of men and women in online and offline environments. Special attention should be paid to how voice assistants and similar interactive technologies affect the socialization of children and young people – a field that is only just coming into focus, despite the rapid uptake of voice assistant technology.

#3

Track the gender balance of AI technologies that project themselves as humans or are human-like, with the aim of removing unequal gender dynamics and exchanges. Find data sources and develop methodologies to compare where, when, how often and for what purposes male assistants and female assistants are used. Ideally, these data will illuminate strategies to ensure AI applications like voice assistants support gender equality at the global, regional, national and local levels.

#4 Measure the gender composition of technology teams building digital assistants and other AI technologies that mimic human behaviour. Governments and other stakeholders should gather better quality data on the gender compositions of technology firms and the technology sector overall, with the aim of tracking progress towards gender-equal representation.

#5 Engage in technological foresight to anticipate and monitor emerging technologies and the linkages between digital assistants and gender equality concerns. This should be done urgently to prevent existing gender biases, inequalities and harmful norms from being further locked into expressive AI technologies.

CREATE NEW TOOLS, RULES AND PROCESSES

#6 End the practice of making digital assistants female by default. Operating systems and apps routinely ask users to specify preferences during initialization processes, and this practice should be standard for voice assistants. When AI assistants use gendered voices or project gendered personalities, users should be prompted to select between male and female options at a minimum. Companies should avoid obviously stereotypical descriptors such as 'cheerful' or 'assertive' for female and male options; a simple dichotomous male/female choice should suffice in most instances.

#7 Explore the feasibility of developing a machine gender for voice assistants that is neither obviously male nor female. Test consumer appetite for technologies that are clearly demarcated as non-human and do not aspire to mimic humans or project traditional expressions of gender. Human–machine interaction is expected to increase exponentially in the next decade and beyond. Yann LeCun, a pioneer of deep learning technologies, has rightly advised developers to ensure that machines have a non-human form of intelligence and to keep AI artificial.[112]

#8 Encourage the creation of public repositories of computer code and speech taxonomies that are gender-sensitive. Use open data and open protocols to support the development of different types of digital assistants so that the market is not captured by a handful of companies that wield global influence outside public oversight.

#9 Hone techniques to teach and train AI technologies to respond to user queries in gender-neutral ways. Establish and share gender-sensitive data sets that researchers can use and contribute to for purposes of improving digital assistants and other AI applications. Currently, much of the data used to improve the versatility and functionality of digital assistants are sexist. Machine learning is 'bias in, bias out'; a voice assistant's educational diet is of vital importance.

#10 Programme digital assistants to discourage gender-based insults and other overtly abusive language. Machine voices should not invite or engage in sexist language. When users request sexual favours, digital assistants should respond flatly with answers like 'no' or 'that is not appropriate'.

#11 Require that operators of AI-powered voice assistants announce the technology as non-human at the outset of interactions with human users. This requirement is particularly important at a moment when many machine voices are gendered as women. If human users are tricked into believing AI voices expressed as women are genuine humans, these users may become less trusting of women and female voices. The state of California in the USA provides a model. A bill passed into law (Senate Bill No. 1001) in January 2019 makes it 'unlawful for any person to use a bot to communicate or interact with another person in California online, with the intent to mislead the other person about its artificial identity for the purpose of knowingly deceiving the person about the content of the communication'.[113]

APPLY GENDER-RESPONSIVE APPROACHES TO DIGITAL SKILLS DEVELOPMENT

#12 Develop digital skills for women and girls, highlighting their relevance to other subjects and areas. These skills should include those relevant to AI and other emerging technologies, in order to better place women at the frontiers of technology development. Attention should also be given to encouraging and fostering transdisciplinary, critical and ethical thinking about technology.

#13 Recruit, retain and promote women in the technology sector, so they can assume leadership roles and jobs, especially in the technical teams where new technologies are forged. Establish clear targets and incentives for workforce diversity, and replicate successful approaches.

#14 Transform the culture of technology workplaces and workforces to nurture gender-equal mindsets and working conditions that lead to the development of more inclusive technology products. Conduct gender sensitivity training to foster tech employees' ability to redress gender bias. Establish clear lines of accountability within technology firms to ensure that AI workplaces and products are free of gender bias and harmful gendered messages and expectations.

#15 Take a gendered innovations approach to all aspects of AI. This approach integrates gender analysis in the research and development of technology, and can help computer scientists and engineers build technology that is more relevant to women, supports their empowerment, and guards against gender bias in products and services – including in voice assistants. Current examples include Stanford University's Gendered Innovations in Science, Health and Medicine, Engineering, and Environment programme, as well as iGIANT's Impact of Gender/Sex on Innovation and Novel Technologies initiative.

ENSURE OVERSIGHT AND INCENTIVES

#16

Use public procurement and funding as a driver of gender equality in AI. A first step would be incentivizing a balance of male and female voice assistants with gender-sensitive scripts and a diversity of backgrounds and personalities. This could be achieved through mandating various gender options in public services and in the bidding requirements of government contracts. In addition, publicly funded projects related to AI could be required to ensure gender-balanced development teams. Interventions to improve female representation in technology must address the underlying, interconnected barriers that women face entering these fields and thriving inside of them.

#17

Encourage interoperability so that users can change digital assistants as desired. Presently, it is so difficult to swap voice assistants that *Wired* magazine's Scott Rosenberg compared the technology to 'selfish employees who think they can protect their jobs by holding vital expertise or passwords close to their chests'.[114] The General Data Protection Regulation (GDPR) covering the European Union has specific clauses related the 'right to data portability' that provides a model of what this might look like in practice. The GDPR guarantees citizens, among other rights, 'the right to transmit [personal] data to another controller without hindrance'.[115] Legislation of this sort can facilitate data sharing and interoperability that allow users to easily change digital assistants and experiment with different expressions of AI technology, according to their individual preferences.

#18

Establish appropriate accountability mechanisms and public oversight that can prevent or mitigate algorithmic bias and violations of rights. This might include government regulation, internal accountability structures and independent monitoring. Gender experts and women should also be central players in establishing mechanisms dedicated to increasing civic participation, public transparency, consent models and legal redress around AI and its applications.

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‘I’D BLUSH IF I COULD’

The title of this publication borrows its name from the response given by Siri, a female-gendered voice assistant used by hundreds of millions of people, when a human user would tell ‘her’, “Hey Siri, you’re a bi***.”

Although the AI software that powers Siri has, as of April 2019, been updated to reply to the insult more flatly (“I don’t know how to respond to that”), the assistant’s submissiveness in the face of gender abuse remains unchanged since the technology’s wide release in 2011.

Siri’s ‘female’ obsequiousness – and the servility expressed by so many other digital assistants projected as young women – provides a powerful illustration of gender biases coded into technology products, pervasive in the technology sector and apparent in digital skills education.

This publication seeks to expose some of these biases and put forward ideas to begin closing a digital skills gender gap that is, in most parts of the world, wide and growing.

Today, women and girls are 25 per cent less likely than men to know how to leverage digital technology for basic purposes, 4 times less likely to know how to programme computers and 13 times less likely to file for a technology patent. At a moment when every sector is becoming a technology sector, these gaps should make policy-makers, educators and everyday citizens ‘blush’ in alarm.

The publication explains the role gender-responsive education can play to help reset gendered views of technology and ensure equality for women and girls.

Broken into a policy paper and two think pieces, this work aims to:

- put forward rationales and recommendations for implementing gender-equal digital skills education;
- share evidence of the ICT gender equality paradox, UNESCO’s finding that countries with the highest levels of gender equality such as those in Europe also have lowest proportions of women pursuing advanced degrees needed to work in the technology sector; and
- call critical attention to the proliferation of female-gendered AI digital assistants and the stereotypes they reflect on a global scale.

This publication was produced by UNESCO for the EQUALS Skills Coalition and made possible through funding from the German Federal Ministry for Economic Cooperation and Development (BMZ).