UNU

The United Nations University (UNU) is a global think tank and postgraduate teaching organisation headquartered in Japan. The mission of UNU is to contribute, through collaborative research and education, to efforts to resolve the pressing global problems of human survival, development and welfare that are the concern of the United Nations, its Peoples and Member States. In carrying out this mission, UNU works with leading universities and research institutes in UN Member States, functioning as a bridge between the international academic community and the United Nations system.

UNU-CS

The United Nations University Institute on Computing and Society (UNU-CS) is a research institute at the intersections of information and communication technologies and international development (ICTD), addressing the key challenges faced by developing societies through high-impact innovations in computing and communication technologies.

EQUALS

EQUALS is a global partnership of corporate leaders, governments, non-profit organisations, communities, and individuals around the world working together to bridge gender digital inequalities. EQUALS was founded in 2016 by five partners: the International Telecommunications Union, UN Women, the International Trade Centre, GSMA, and UNU. The Partnership works to reverse the increasing gender digital divide, and to close the gap by 2030 – supporting UN Sustainable Development Goal 5 by empowering women through their use of information and communication technologies.

An action plan of data gathering, knowledge sharing, and advocacy strengthening drives the EQUALS network partnership. To achieve our goals, partners focus on three core issues: Access, Skills and Leadership. By promoting awareness, building political commitment, leveraging resources and knowledge, harnessing the capacities of partners, and supporting real action, EQUALS seeks to achieve gender digital equality and, through this, to improve the livelihoods of millions around the world.

THE EQUALS RESEARCH GROUP

The EQUALS Research Group – led by the UNU-CS – supports the work of the three EQUALS Coalitions. Composed of over 30 multidisciplinary experts in information gathering and analysis, the group focuses on:

- generating knowledge about the existence, causes, and remedies for gender digital inequalities
- motivating key stakeholder groups — including private sector companies, government departments, regulatory agencies, and academia — to collect and share gender-relevant data

INDIVIDUAL AUTHORS

Fifty-three researchers, from more than 20 member organisations and associates of the EQUALS Partnership, have contributed to this inaugural report of the EQUALS Research Group.

EDITORS

- ARABA SEY is a Principal Research Fellow at UNU-CS and the focal person at UNU-CS responsible for leading the EQUALS Research Group. Her research interests include the use of ICTs in emerging economies, social inclusion, and gender and leadership in the ICT industry.
- NANCY HAFKIN is a renowned expert on information technology, gender, and international development. She is an associate of Women in Global Science and Technology, an international non-profit promoting women’s development of science, technology, and innovation.

EDITORIAL COMMITTEE

- KWASI ANSU KYEREMEH is a retired adjunct professor at the Department of Communication Studies, University of Ghana, Legon, with research interests in girls’ and women’s empowerment and indigenous communication systems.
- ANITA VERNACROFTS is a Senior Lecturer at the University of Washington in the Department of Communication. She serves as the Associate Director for the Communication Leadership graduate program.

CASE STUDY AND CHAPTER AUTHORS

The first part of the report was jointly authored by the EQUALS Research project team at UNU-CS. The Case Studies in Part One, as well as all chapters in Part Two, are contributions by members of the EQUALS Research Group and invited authors, as indicated.

- MONICA BARBOVSCHI Ph.D., is an associated researcher with the Institute of Sociology of the Romanian Academy and a member and former coordinator of the Romanian team in the EU Kids Online network. Her consulting research focuses on internet and gender issues for young people (e.g., with Cetic.br in Sao Paulo and the European Institute for Gender Equality in Vilnius).
- RUHIYA SEWARD is a Senior Program Officer with the Technology and Innovation program at the International Development Innovation program at the International Development Research Centre. She oversees a portfolio of research on digital governance issues in the global South, from digital rights, data analytics and AI, to gender and the feminist internet.
- BEI (JENNY) JU is Senior Research Assistant at UNU-CS focusing on ICTs, migration, and intercultural communication.
- MICHAEL L. BEST is Associate Professor at the Sam Nunn School of International Affairs and the School of Interactive Computing at the Georgia Institute of Technology.
- TINA BEYENE is assistant professor of women, gender, and sexuality studies at California State University, Northridge, concentrating on the colonial genealogy of gender-based violence in contemporary African conflict zones, transnational feminist movements, and applied research on gender, STEM, and development.
- ANA BRANDUSCUC is a researcher who promotes a more inclusive and responsible use of data and technology, through research advocacy, and policy initiatives.
- STEFANIA LAPOLLA CANTONI has a master’s degree in political science from the University of São Paulo (USP). She is an information analyst for the Cetic.br, of the NIC.br.
- MOON CHOI is an Associate Professor at KAIST Graduate School of Science and Technology Policy and founder-director of a research group, Aging and Technology Policy Lab (http://aging.kaist.ac.kr).
Taking Stock: Data and Evidence on Gender Digital Equality

PART ONE

Taking Stock: Data and Evidence on Gender Digital Equality PART ONE

INTERNATIONAL TRADE CENTRE.

POONAM WATINE is an International Consultant for Market Linkages, Food and Agriculture Organisation (FAO).

SUMAIRA NASEEM is a Senior Research Assistant at UNU-CS with research focus on ICTs and analysing the social, economic, and political impacts of ICT policies and interventions.

RITA KUMAR is a professor of women and gender studies in the Department of the African Development Bank.

SUMAIRA NASEEM is an everyday activist, volunteer, and researcher.

SISA NGABAZA is a Senior Lecturer in Information Systems at the University of the Western Cape, focusing on research and development of the Information Society (Cetic.br) ofbrasilia.

CAROLINA HADAD is a coder, computer scientist, and social innovation specialist at Chicas en Tecnologia.

YANINA PAPARELLA is a programmer, computer scientist, and social innovation specialist at Chicas en Tecnologia.

MARIANA LOPEZ is advocacy manager for the GSMA Connected Women Programme where she ensures the programme’s insights are disseminated effectively and assists with efforts to drive women’s digital and financial inclusion.

NANCY SALEEM is a researcher at the Access to Knowledge for Development Center, American University in Cairo. She works to make sure that everyone, everywhere, can benefit from the opportunities that technology offers: coining the slogan “all of the people – all of the internet – all of the time.”

CAROLINA HADAD is an economist at the OECD’s Directorate for Science, Technology and Innovation, working in innovation and technological change (including Intellectual Property Rights), firm and industry dynamics and performance, global value chains, and jobs and skills.

ELIZABETH A. QUAGLIA, a cryptographer, has conducted security research in industry and academia for over ten years.

POONAM WATINE is an International Consultant for Market Linkages, Food and Agriculture Organisation (FAO).

LUCIA MARCIONI is an economist at the OECD’s Directorate for Science, Technology and Innovation, focusing on the links between technology, labour, and firm dynamics, as well as international trade and productivity.

DORRIF KANDIAO is a visiting research assistant at UNU-CS. He is a Ph.D. candidate in the Human-Computer Interaction Institute at Carnegie Mellon University and a fellow in the IES-funded Program for Interdisciplinary Education Research, where he researches and designs educational technologies for developing contexts, and he is a principal investigator for the Metropolis21 Smart Cities Institute, where he researches the impact of machine learning on civic decision-making.

SUMAIRA NASEEM is a senior research assistant at UNU-CS with research focus on ICTs and analysing the social, economic, and political impacts of ICT policies and interventions.

DON RODNEY JUNIO is a senior research assistant at UNU-CS. Don’s research focuses on meaningful access and use of ICTs and analysing the social, economic, and political impacts of ICT policies and interventions.

HANIF MUKHERJEE is a cryptographer, has conducted security research in industry and academia for over ten years.

POONAM WATINE is an International Consultant for Market Linkages, Food and Agriculture Organisation (FAO).

LUCIA MARCIONI is an economist at the OECD’s Directorate for Science, Technology and Innovation, focusing on the links between technology, labour, and firm dynamics, as well as international trade and productivity.

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Disclaimer
The views expressed in this publication are those of the authors from the EQUALS Research Group. They do not necessarily reflect the opinions or views of the United Nations University or other member organisations in the EQUALS Research Group.
The gender digital divide affects millions of women and girls worldwide, limiting their access to technology and resources, their ability to gain critical skills, and their opportunities for leadership in the tech sector. To close the gap, we need solid research into all three facets of the gender digital divide — access, skills, and leadership. The EQUALS Research Group provides key insights into the problem, so that we can work together for a solution.

Doreen Bogdan-Martin, Director, Telecommunication Development Bureau, ITU

We believe the Internet is for everyone. Yet women and girls continue to face challenges that hinder them from benefiting from the opportunities the Internet provides. The reasons for this are complex, and there is no one conclusive strategy to solve it. And while studies have been conducted, more research is needed. The EQUALS Research Coalition report comes to fill this need for data and analysis by providing us with valuable insights on the challenges women face in gaining meaningful Internet access. These insights will inform our work, and the work of the larger community as well.

Joyce Dogniez, Vice President for Community Development & Engagement, Internet Society

The future health of our global economy depends on the empowerment of women and girls. This report highlights the depth and breadth of the existing gender gap in ICT access, skills, and leadership. Widely welcomed by the UN, interested NGOs, and private sector actors in the field, its findings set the foundation needed to build strong, evidence-based strategies to close the gap. Doing so will help improve universal gender equality and the health of the global economy, both priority agenda items for the United Nations in 2019.

Dr David M. Malone, Rector of the United Nations University, Under-Secretary-General of the UN

Research on data collection, analysis, and dissemination related to gender digital equality is necessary to achieve informed decisions at the policy level with a gender lens. This report provides an invaluable evidence-based tool essential to all stakeholders and policy makers working in the development of policies and programmes to advance the status of women and girls in the ICT sector.

Houlin Zhao, Secretary-General of the International Telecommunication Union (ITU)
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Gender: To accommodate diverse researchers and data, this report does not subscribe to any particular definition of gender; see Chapter 7 for a discussion of gender variance, acknowledging the complexity of defining gender. The content therefore incorporates multiple notions of gender.

Gender gap: Unless otherwise indicated, gender gaps are calculated using the absolute approach (percent female minus percent male) rather than a relative ratio (such as [percent men minus percent female] divided by percent men). A negative gap means more men than women, while a positive gap means more women than men.

ICTs: For the purposes of this report, ICTs are defined as computers, mobile phones, and the internet. They do not include older technologies such as television and radio, nor new and emerging technologies such as artificial intelligence (except for the forword-looking chapter on artificial intelligence in Part Two).

ICT access: This refers to people’s access to and ownership of computers, mobile phones, and the internet. It also covers the ability to use these technologies in meaningful ways—possession of the requisite basic digital skills, as well as the types of content and services provided.

ICT skills: ICT skills refer to basic digital literacy (overlapping with the access definition) as well as the more advanced technical skills (such as software development) that are required to enable people to become creators, innovators, and leaders in the ICT field.

ICT leadership: This refers to 1) employment in ICT and related fields, especially at leadership levels, and 2) participation as entrepreneurs in the ICT industry.
The nature of available information also affects analysis, as much of the existing research and data (particularly for skills and leadership) relate to STEM, technology, or engineering broadly. Throughout this report, we use a variety of terms including “STEM”, “science and technology”, “technology”, “digital technologies”, “ICT” and “computing”, depending on the scope of the available data.

KEY FINDINGS ON THE STATE OF GENDER DIGITAL EQUALITY

1. While gender gaps are observable in most aspects of ICT access, skills and leadership, the picture is complex. There are large regional variations: some countries are close to parity or have even reversed the gender gap on some indicators, while others still have persistent gaps. Individual countries can have both large and small gaps, depending on the indicator being measured. Interpreting the gaps requires careful and contextualised analysis.

2. Barriers to gender digital equality are generally related to one or more of the following:
   1) availability of infrastructure; 2) financial constraints; 3) ICT ability and aptitude; 4) internet access; 5) perceived relevance of ICTs to safety and security; and 6) socio-cultural and institutional contexts. Most of these barriers cut across issues of access, skills, and leadership, although they may manifest in slightly different ways. While research has documented these barriers, the evidence from different sources is sometimes contradictory, even within the same country contexts.

3. There is no one conclusive strategy for eliminating gender digital inequalities. Recommendations generally call either for targeting specific contributing factors of gender digital inequality (such as affordability or recruiting practices), or for reshaping deeply ingrained social norms and practices (such as gender stereotypes) that are at the root of gender inequalities. As with the evidence on barriers, research results are sometimes contradictory or nuanced.

4. The dominant approaches to gender equality in ICT access, skills, and leadership mostly frame issues in binary (male/female) terms, thereby masking the relevance of other pertinent identities. Insufficient research has been done on the implications of ICTs for intersectional identities. Data collection should move from binary sex-disaggregation towards finer degrees of status disaggregation in order to recognise multiple and intersecting identities (such as sexuality, poverty, class, education, age, disability, and occupation).
1. There is limited internationally comparable sex-disaggregated official data and geographic coverage on most ICT indicators, especially for developing countries. Most of the official statistics and scholarly research are from North America and Europe. Furthermore, only a few countries have longitudinal data for comparison of trends over time.

2. Official data on gender-related negative and unintended consequences of ICTs are not systematically collected. Both data collection and social change are important to ensure that greater gender inclusion (online and in the ICT field) does not lead to increased exposure to negative experiences, such as cyber violence, sexual harassment, and gender discrimination.

3. Despite the existence of commendable research and data collection efforts, measuring gender digital equality is plagued by definitional and methodological challenges. These include: a lack of internationally agreed definitions and methodologies for collecting data; the sheer range of possible dimensions for measuring gender digital equality; the moving target of technological developments; and low research capacity of both government agencies and academic institutions in most countries. In addition, the existing body of scholarly and corporate research is often limited to narrow national or topical contexts, and has sometimes produced contradictory findings, thus limiting the ability to generalise beyond the research context. In addition to carrying out targeted systematic reviews and meta-analyses to make sense of existing research, more data collection as well as original quantitative and qualitative research are needed to conceptualise gender digital equality, identify gender gaps with greater specificity and geographic coverage, understand the contexts in which they occur, and determine what works and why in different socio-cultural contexts.

5. To ensure privacy and safety as well as full participation in the digital economy, women should have equal opportunities to develop adequate basic and advanced digital skills. Cyberstalking, online harassment, image manipulation, privacy violations, geotagging, and surveillance can compromise women’s and girls’ safety both online and offline. In addition, some evidence suggests the digital transformation of labour may be widening gender wage gaps. These outcomes can be averted with the right types of training combined with social and institutional change.

6. Developments in digital technologies open new pathways to gender diversity and inclusion; however, lack of attention to gender dynamics and differences hampers the potential for true progress. For example, evidence suggests that most women’s work in the digital economy, particularly in the Global South, reinforces existing social divisions. Moreover, artificial Intelligence (AI) systems, designed largely by men, tend to ignore the negative gender implications of their designs. Research, government policy and design principles should include gender awareness and analysis, for example, by building in data and privacy protections and avoiding gender stereotypes.

REPORT OUTLINE

The report has two parts. Part One reviews research and data (mostly as of June, 2018) on the three core action areas of the EQUALS Partnership: ICT Access, Skills, and Leadership. It covers trends as represented in official statistics, academic reports, and grey literature, and it assesses the availability of relevant sex-disaggregated data.

Part One begins with a discussion of selected dimensions of access to ICTs (Chapter 1), distinguished broadly as basic access (access to computers, mobile phones, and the internet) and meaningful access (depending on access to use of digital financial services, in the few areas for which official statistics are available). This is followed by a discussion of gender equality in basic and advanced ICT skills (Chapter 2), from early to tertiary education as well as through non-traditional pathways. Chapter 3 examines gender equality in ICT leadership: employment within the industry and academia; attainment of leadership positions; entrepreneurship participation; and inclusion in relevant policymaking. Chapter 4 deals with the dark side of the digital age — risks and dangers associated with digital technologies, as well as negative outcomes and negative responses to advances in gender equality. Chapter 5 summarises observed obstacles and associated recommendations to improve gender equality in access, skills, and leadership. Finally, Chapter 6 assesses the availability of relevant sex-disaggregated data.

Part Two of the report comprises independently authored chapters by members of the EQUALS Research Group. It brings together theoretical perspectives and research data on themes to broaden our understanding of pathways to gender equality in the digital age, outlining potential agendas for the Partnership. These themes fall into three broad categories: People, Digital Skills, and Pathways. The first section focuses on People — specific populations of interest in technology: diverse sexual minorities (“Gender variance and the gender digital divide”); people in low and middle-income countries (“Understanding the gender gap in the Global South”); children and youth (“ technologies and youth”); women with disabilities (“Accessibility, intersectionality and universal design”); and women farmers (“ICT in a changing climate”).

The second section highlights the importance of educational and training institutions in addressing gender gaps in Digital Skills (“The role of educational institutions”) and the implications of gender gaps in the labour market (“The gender wage gap and skills development: Perspectives of young women”). Finally, “A gender perspective on security and privacy” discusses the skills needed to deal with these challenges in the digital age.

The third section, Pathways, places the gender digital equality agenda within broader frameworks: the pitfalls of over-enthusiasm about the equalising potential of technology (“Investigating empowering narratives”); arguments for more inclusive technology-driven social innovation (“Technology and wealth creation”); and the potential of artificial intelligence for eliminating gender inequality (“Hello, Siri”).

REFERENCES


fpsyg.2017.00716
KEY FINDINGS

• Gender digital divides are not all the same. The gender digital divide persists irrespective of a country’s overall ICT access levels, economic performance, income level or geographic location. Cultural and institutional constraints help shape how the gender digital divide manifests itself in a country. A one-size-fits-all approach to the issue will not be effective.

• The gender digital divide widens as technologies become more sophisticated and expensive, enabling more transformational use and impacts.

• Basic digital access and literacy are necessary but not sufficient conditions for women to meaningfully use ICTs.

• Use is not the same as ownership. As ITU begins to collect gender-disaggregated data around mobile phone use and ownership, the disparity between the two indicators appears to be key to understanding women’s disadvantages in access to ICTs.

• The potential of mobile phones is under-realised. Despite its lower cost as compared to using a computer, the number of women using mobile internet remains substantially low relative to men. GSMA estimates that in low- and middle-income countries, women are 26% less likely to use mobile internet than men.

1.1 / INTRODUCTION

ICTs, including use of the internet and mobile technologies, expand opportunities and can potentially empower people who have access to them. Many believe that there is no longer a gender gap in ICT access, given the high levels of mobile phone adoption even in less developed regions. However, the latest data from the International Telecommunication Union (ITU) suggests that there are about 250 million fewer women online than men, and the problem is more pronounced in developing countries. Equality in ICT access involves more than mere availability and use of mobile phones. To what extent do women have equal access to devices other than mobile phones, as well as control over those devices and the ability to use the technology in beneficial ways? This chapter assesses data on a variety of indicators related to computers, mobile phone, and internet access, as well as use of digital financial services, to assess gender divides in these areas.

1.1.1 / WHY IS GENDER EQUALITY IN ICT ACCESS IMPORTANT?

A gender perspective on inequality in digital access is an analytical lens that puts structural issues and core concerns that women and girls face online at the centre of our understanding of the problem. Just learning that more than 3 billion people are offline suggests a different kind of policy response, as opposed to understanding that a majority of those who offline are women and girls. Closing this gender digital divide has the potential to empower women both online and offline, in various facets of their lives including their economic and social conditions. ICTs have the potential to alleviate some of the steep barriers faced by women, including illiteracy, poverty, time scarcity, barriers to mobility, and cultural and religious taboos (SIDA, 2015).

In addition to addressing the structural barriers that women face, closing the gender digital divide on basic access would profoundly affect other aspects of women’s participation in the digital economy, including in knowledge creation and leadership. Meaningful participation in the digital economy requires unfettered access to ICT tools. Improving the economic standing of women requires equipping them with the tools and skills to adapt successfully to the evolving requirements of our increasingly knowledge-based and ICT-driven economies.

In recognition of the transformative potential of ICTs, closing the gender digital divide in access is included as part of the UN’s Sustainable Development Goal (SDG) targets (Box 1.1).

Box 1.1

Women’s ICT Access and the SDGs

To achieve the UN SDG targeting gender equality will necessitate a data regime and policy framework designed to monitor, track, and measure progress in closing the gender divide. To date, the lack of gender statistics and sex-disaggregated data often clouds the ability of policy makers to respond adequately to social problems that affect women and girls.

The SDGs spell out the following targets that, together, would enable greater and equal participation of women in the digital society:

Target 5B: Enhance the use of enabling technology, in particular information and communications technology, to promote the empowerment of women.

Target 9C: Significantly increase access to information and communications technology and strive to provide universal and affordable access to the internet in least developed countries by 2020.

Target 5.2: Eliminate all forms of violence against all women and girls in public and private spheres.
1.2 / BASIC ACCESS

The most reliable global data in relation to basic access can be culled from the database of the ITU. Since 2004, ITU have been working with National Statistics Offices from developing countries to improve the availability and quality of statistics that can be disaggregated by gender (among other individual or household dimensions). Despite having limited data available, ITU's basic access indicators illuminate existing gender digital divides.

The most common understanding of basic access is in reference to access to and use of ICT devices such as a computer or a mobile phone. This device-centric conceptualisation of basic access informs much of the current global data regime on basic ICT access indicators. With the use of internet increasingly seen as a prerequisite to participate in the digital economy, countries have also started collecting data to measure this aspect of access. For example, part of ITU's core list of indicators is gender-disaggregated as they relate to access, as shown in Figure 1.1.

While use of devices and internet are the most accepted way of measuring basic access, this tends to overlook power dynamics that may affect women specifically. It is important to frame “access” as relating to ownership and control as well as use. The indicator “proportion of individuals who own a mobile phone” is included as a factor in basic access, in recognition of the multidimensional aspect of ICT access — beyond measures of use. However, problems in global data coverage prevent us from drawing a global picture of ownership and control. In this section, we use the term “basic access” to refer to the following issues: (i) use of computer; (ii) use of the internet; (iii) use of a mobile phone; and (iv) mobile phone ownership. Appendix B presents the data in more detail at the country level.

Table 1.1
Gender gap in computer use by region

<table>
<thead>
<tr>
<th>REGION</th>
<th>NUMBER OF REPORTING ECONOMIES</th>
<th>PERCENTAGE OF LARGEST GAP</th>
<th>PERCENTAGE OF SMALLEST GAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa</td>
<td>6</td>
<td>-8.9</td>
<td>-0.7</td>
</tr>
<tr>
<td>Americas</td>
<td>13</td>
<td>-7</td>
<td>3.1</td>
</tr>
<tr>
<td>Asia</td>
<td>25</td>
<td>-17</td>
<td>4.3</td>
</tr>
<tr>
<td>Europe</td>
<td>34</td>
<td>-9.3</td>
<td>1.4</td>
</tr>
</tbody>
</table>

Source: ITU WTI Database 2017

Countries in the Middle East and Latin America dominate the group with a higher proportion of women than men who use a computer. Countries in the bottom 10 in women’s computer use include some that are associated with a highly developed ICT infrastructure, such as Japan and South Korea (Figure 1.2).

Figure 1.2
Difference between male and female computer use (top 10 and bottom 10 countries)
INTERNET ACCESS

ITU’s latest flagship annual report, Measuring the Information Society 2017, notes that the global gender gap in internet access has increased from 2013 to 2017 (Figure 1.3). In 2017, there are 250 million fewer women online. Regional variations exist: least developed countries show a substantial gap, while the gender gap has decreased in developed countries. The internet user gender gap increased in Africa, even while it decreased in other regions. With the sole exception of the Americas, there are more men online than women in every region.

Looking at the top 10 and bottom 10 countries in terms of difference in percentage between women and men, the results are more varied, with the gender gap ranging from +6% to -16% (Figure 1.4). Countries in Latin America and Europe dominate the list of countries in the top 10, showing a gender gap in favour of women. However, there are also a number of European countries in the bottom 10 of countries, where the gender gap favours men, as in Germany and Austria. In this sense, the gender gap does not neatly correlate with the degree of economic development of the country.

While the internet is increasingly being accessed over mobile devices, data on use of mobile internet is not one of the indicators that ITU regularly collates. The private sector is taking the lead in measuring the gender gap in this area: the GSMA conducts surveys across different countries; it creates models to estimate the gender digital gap in mobile internet use, even in countries where a survey was not conducted. GSMA’s Mobile Gender Gap Report 2018 (GSMA, 2018) notes that there are about 1.2 billion women in low- and middle-income countries that do not use mobile internet; on average, women are 26% less likely to use mobile internet than men. The report also notes regional differences across low- and middle-income countries, ranging as high as 70% in South Asia to as low as 4% in East Asia & Pacific and Latin America & Caribbean (Figure 1.5).
**Figure 1.5**
Gender gap in mobile internet use in low and middle-income countries by region

- **26%** Overall
- **4%** Europe & Central Asia
- **21%** Middle East & North Africa
- **4%** East Asia & Pacific
- **34%** Sub-Saharan Africa
- **70%** South Asia

**Across low and middle-income countries:**
- 1.2 Billion women do not use mobile internet
- 327 million fewer women than men use mobile internet

Note: GSMA calculates the gender gap by subtracting male users/owners (% of male population) from female owners/users (% of female population) divided by male owners/users.

**1.2.3 / MOBILE PHONE USE**

Access to and use of mobile phones have increased over the years, reflecting a combination of factors, including reduction in cost of ownership. Data collated by ITU shows that, for all 34 economies with gender disaggregated data, more than half of the population already use a mobile phone; the lowest percentage for females, in Zimbabwe, is 68.5% (Figure 1.6). Figure 1.7 shows the top 10 and bottom 10 countries, in terms of difference between percentages of female and percentages of male for mobile phone use. Many developing countries are represented in the top 10, i.e., where more women than men are using a mobile phone. Among the bottom 10 countries, in terms of women’s use of mobile phones, are both developing countries and developed countries, such as Japan (Figure 1.7).

**Figure 1.6**
Percentage of individuals using a mobile cellular telephone by gender

**Figure 1.7**
Difference between male and female use of mobile phone (top 10 and bottom 10 countries)

Note: Data obtained from subtracting female percentage to male percentage mobile phone use. Positive value implies more women using mobile phones than men.
1.2.4 / MOBILE PHONE OWNERSHIP

ITU has recently started collecting data related to mobile phone ownership. In the latest version of the World Telecommunication and ICT Indicators Database 2017, 40 economies show gender-disaggregated data on mobile phone ownership. With the exception of Burundi, which reported female ownership at 7.3%, all other countries reported more than 50% of women owning a mobile phone. For countries with available data, we can see that mobile phone ownership is generally higher among men than women (Figure 1.8).

Figure 1.8 Difference between male and female mobile phone ownership

Note: GSMA calculates the gender gap by subtracting male users/owners (% of male population) from female owners/users (% of female population) divided by male owners/users.

GSMA's Mobile Gender Gap Report 2018 similarly notes this gender gap in mobile phone ownership. According to their estimates, there are 184 million fewer women owning a mobile phone than men. There are also regional differences: for example, women in South Asia are 26% less likely than men to own a mobile phone; while in East Asia and Pacific, women are only 2% less likely than men to own a mobile phone.

1.3 / MEANINGFUL ACCESS

Once online, there may be noticeable differences in usage patterns between men and women. There is growing recognition that basic access to ICTs is not enough to empower women. For both mobile and internet use, the gender digital divide widens as the technology gets more sophisticated and expensive (Hight, 2017; Deen-Swarray et al., 2012). GSMA (2018) notes that the gender gap does not end at mobile phone ownership but increases when we look at usage patterns, especially for more transformational services. As Chapters 8 and 10 demonstrate, intersecting identities (such as gender, age, socio-economic status, or disability) can exacerbate exclusion from both access and meaningful use of ICTs.

Meaningful access refers to digital competencies and applications that have the potential to transform individuals’ activities, opportunities and outcomes. Case Study 1.1 describes an example of promoting meaningful ICT use for entrepreneurial activity; Chapter 11 discusses meaningful use in the context of gender and food security. However, existing quantitative measures for estimating meaningful use are limited to reports on women’s basic ICT or digital skills, and their use of digital financial services. Meaningful use encompasses more than these two aspects, but lack of data obscures other dimensions of meaningful use, such as women’s ability to produce content and disseminate it online.

Beyond differences in access and usage patterns, researchers have also started to examine a third-level digital divide: “disparities in the returns from internet use, within populations of users who exhibit broadly similar usage profiles and enjoy relatively autonomous and unfettered access to ICTs and the internet infrastructure” (Helsper & van Deursen, 2015). In other words, even if people have equal computer access and skills, they may not experience equal material outcomes. However, research on the third-level digital divide is still at its early stage (Scheerder et al., 2017), and converting these various conceptions of ICT use to measurable indicators has yet to be realised.
Case Study 1.1
SheTrades — Empowering Women Entrepreneurs with Digital Skills
Author: Poonam Watine
(International Trade Centre)

In line with the EQUALS Global partnership, the SheTrades Initiative responds to global issues surrounding women and trade, including digital gender-inequality, with a goal of connecting 3 million women entrepreneurs and women-owned businesses to international markets by 2020. SheTrades completed a project with the Indian Ocean Rim Association (IORA), funded by the Australian Department of Foreign Affairs, to support women-owned and led enterprises operating in the services sector in three countries (Jan. 2016–June 2018). IT and ITES (information Technology-Enabled Skills) were the focus in Indonesia and Kenya. The project established networks with private sector, women business associations, and relevant trade and investment support institutions. One key outcome was to increase competitiveness of women entrepreneurs through capacity-building activities, with face-to-face and online trainings geared towards digital marketing, social media, and e-commerce.

Ms. Evelyn M. Kasina, CEO, Eveminet Communication Solutions Ltd.
Evelyn Kasina’s information technology firm specialises in digital intelligence for children, including girls. In its third year, the company is working with corporate employers to equip them with essential digital intelligence skills and cyber security solutions. With support from the SheTrades IORA project, Eveminet Communication Solutions Ltd. participated in several major trade fairs. The company generated almost $5000 in sales and has been chosen as a supplier for Safaricom, a leading mobile network operator in Kenya.

In 2018, Ms. Kasina registered a social enterprise focused on digital literacy and data mining to assist children and youth, providing a digital hub for government resources, supporting women’s economic empowerment, and creating an e-commerce platform for markets and trade. Her vision is to “see the young generation become digitally intelligent citizens, leveraging technology and its opportunities.”

Short-term outcomes include supporting over 250 women-owned and -led firms (213 SMEs in Indonesia and 165 in Kenya). Over 47 SMEs under the project have established sizable contracts, totaling around $2.3 million. Collaboration with Facebook Asia Pacific and their #SheMeansBusiness initiative helped women entrepreneurs from Indonesia broaden their knowledge on Facebook and Instagram marketing. The firms were surveyed on their digital literacy and ICT competency. One key finding was that many firms use social media to market their services, due to the low cost. A database was developed to help track the firms’ sales.

Key Lessons
• Collaborative partnerships with the private sector can result in potential sales with buyers for beneficiaries.
• Online trainings and webinars helped to minimise the cost for capacity-building activities.
• Focusing on select countries and the services sector allowed a tighter and stronger delivery.

1.3.1 / DIGITAL FINANCIAL TRANSACTIONS

One area of meaningful use that has received considerable attention is the use of ICT tools for financial transactions, and the potential to include the unbanked and underbanked in the formal financial system. Data on some aspects of women’s use of digital financial services are available through the World Bank’s Global Financial Inclusion Database (Global Findex), which contains modules on topics related to digital payments, mobile money, and making online transactions. Launched in 2011 and updated every three years, the Global Findex contains nationally representative data on access and use of formal and informal financial services by different demographics, including gender (Figure 1.9).

Figure 1.9
World Bank Findex Indicators on Access and Use of Digital Financial Services

Multistakeholder partnerships and deeper private sector engagement have provided the needed visibility to help widen the reach of mobile financial services. Case Study 1.2 illustrates how the private sector can play a significant role in bridging the gender digital divide in mobile money uptake and even mobile internet use, across different countries in Africa, Asia, and Latin America.
Taking Stock: Data and Evidence on Gender Digital Equality

Case Study 1.2
GSMA Connected Women Initiative: bridging the mobile gender gap
Author: Mariana Lopez (GSMA)

1. Context
Mobile can help empower women, providing access to information, services, and life-enhancing opportunities. However, GSMA Connected Women research estimates that women in low- and middle-income countries are, on average, 10% less likely to own a mobile phone than men — which translates into 184 million fewer women owning mobile phones.¹

Women who own a mobile phone often report using phones less frequently and intensively than men, especially for transformative services such as mobile internet. We estimate that women are on average 26% less likely to use mobile internet than men; in countries covered by the World Bank’s Global Findex database, women are on average 33% less likely to use mobile money. Women in South Asia are 26% less likely to own a mobile than men, and 70% less likely to use mobile internet. Closing the gender gap in mobile ownership and mobile internet use would generate an estimated incremental revenue of $15 billion over the coming year.²

2. Project description
Through the Connected Women Commitment initiative, mobile operators can set defined targets to reduce the gender gap in their mobile money or mobile internet customer base by 2020. As of December 2018, 37 operators across Africa, Asia, and Latin America have made 52 such commitments. Activities include, for example, increasing the number of female agents, improving the mobile data top-up process to be safer and more appealing to women, improving digital literacy among women through educational programmes and interactive content, and developing and marketing use cases designed to appeal to women. To date, since they committed to the Connected Women Initiative, mobile operators have reached over 12 million new women with mobile money or mobile internet services.³

3. Challenges and Key Lessons
Targeted intervention is urgently needed from a wide range of stakeholders to overcome the barriers women face to mobile ownership and use. Based on their research and experience working with operators across Africa and Asia, GSMA Connected Women developed a framework to guide mobile operators (Figure 1.10).⁴

Recommendations for operators and other stakeholders to address the gender gap

1. Understand the gap
Operators need to understand where the gender gap is in their customer base, and why, by analysing their customer data and supplementary field research.

2. Set targets
Set targets and KPIs to increase the proportion of women in the mobile internet and/or mobile money customer base from x% to y% by 2020.

3. Address the barriers women face
Accessibility. Women are less likely than men to have access to quality network coverage, handsets, electricity, agents, and identification documents.
- Affordability. The cost of handsets, tariffs, data plans, and transaction fees need to be affordable for women as well as men.
- Usability and skills. The usability of handsets and services must be improved, along with the ability and confidence of women to use them.
- Safety and security. Women must feel safe when using a mobile phone.
- Relevance. Products and services need to meet women’s needs as well as men’s.

To close the gender gap, operators and other stakeholders need to ensure that their products and services, as well as marketing and distribution approaches, consider women’s needs for these five themes. Initiatives need to be socially impactful and commercially sustainable to succeed over the long term.

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1 ‘Mobile’ or ‘mobile phone’ ownership refers to personally owning a SIM card, or a mobile phone which does not require a SIM, and using it at least once a month.

2 The $15 billion estimate assumes that the gender gap in mobile ownership and mobile internet use would be closed during 2018, and represents the subsequent 12-month incremental revenue opportunity.

3 Connected Women also supports GSMA as lead of the Access Coalition of EQUALS, the global partnership to bridge the digital gender divide.

4 The complete framework can be found at: https://www.gsma.com/mobilefordevelopment/programme/connected-women/framework-mobile-operators-close-gender-gap/
1.3.2 / DIGITAL PAYMENT TRANSACTIONS

Digital payment transactions include online and mobile transactions, such as remittances and agriculture payments, as well as offline transactions, such as use of a debit or credit card. Figure 1.11 shows females lagging behind males in making or receiving digital payments in all regions except in Oceania — represented by two advanced economies, Australia and New Zealand. There are also differences within regions: in Africa, Kenya has over 75% female penetration; and in Asia, Iran and Mongolia both have higher than 85% female penetration rate, much higher than the rest of the region (Figure 1.12).

Figure 1.11
Percentage of females and males who made or received digital payments in 2017

While in general more men make digital transactions, three developing countries have more women than men who made or received digital payments in the past year: Lesotho, Argentina, and Mongolia (Figure 1.13).

Figure 1.13
Gap between men and women who made or received digital payments in 2017 (top and bottom 10 countries)

1.3.3 / ACCESSING AN ACCOUNT USING MOBILE PHONE OR THE INTERNET

While the use of mobile banking has been heralded in many developing countries for bringing the unbanked into the formal sector, with women as the targeted population in most cases, women still lag behind the use of mobile phone or internet to access a financial account. The exception is Oceania, represented by two developed countries, Australia and New Zealand, reporting higher use for females than males (Figure 1.14). The other regions show higher use for males; Africa, the Americas, and Asia show women's usage below 18%. There can, however, be significant variations within regions, as seen on the map of Figure 1.15. Notably, South Korea (in Asia) and Kenya (in Africa) show female usage rates higher than the regional average.

Figure 1.14
Percentage of male and female use of mobile phone / internet to access an account in 2017
Taking Stock: Data and Evidence on Gender Digital Equality

PART ONE

Taking Stock: Data and Evidence on Gender Digital Equality

Figure 1.15
Percentage of male and female use of mobile phone / internet to access an account in 2017

Figure 1.16
Gap between men and women who used a mobile phone or the internet to access an account in 2017 (top and bottom 10 countries)

Figure 1.17
Percentage of male and female use of the internet to pay bills or make purchases online in 2017

1.3.4 / USING THE INTERNET TO PAY BILLS OR MAKE PURCHASES ONLINE

More male respondents reported having used the internet to pay bills or buy something online across all geographical regions (Figure 1.17). In Oceania and Europe, more than 50% of females reported having used the internet to make a purchase or pay their bills.

Africa shows low internet use to pay bills or purchase online for both men and women. In Asia, developed countries such as South Korea and Japan report higher female usage rates (Figure 1.18).

Figure 1.18
Percentage of females who used the internet to pay bills or make purchases online in 2017


Even for countries with high women’s usage rates, women can still be at a disadvantage in relation to men, as in the case of Austria, Japan, and Slovenia (Figure 1.19). Those countries where more women than men use the internet to pay bills or make online purchases, such as the Philippines and Laos, in fact show low usage by both men and women.

**Figure 1.19**
Gap between men and women who used the internet to pay bills or make purchases online in 2017 (top and bottom 10 countries)

1.3.5 / MOBILE MONEY ACCOUNT

The survey on use of mobile money services excludes developed markets in the Americas (such as Canada and U.S.) and most of Europe (except Romania and Albania). We can still observe the same trend: women show less use of mobile money services than men, and their overall average across all regions is less than 20% (Figure 1.20). There are countries where women use these services more than men, as in Lesotho and Jamaica; however, these differences are relatively small compared to the bottom 10 countries, where the percentage difference between women and men can be greater than 10% (Tanzania, Bangladesh, and Uganda) (Figure 1.21).
1.4 / CONCLUSION

This chapter highlights the state of gender digital inequality across several dimensions of basic access and meaningful use. For basic access, available data suggest that gender gaps exist irrespective of the overall level of access. This is true across the four basic access indicators: computer use, mobile phone ownership, mobile phone use, and access to the internet. Beyond basic access, gender inequalities exist in terms of meaningful use, as represented here by data on use of digital financial services — perhaps the only area of meaningful use for which comparative data are available. Even for existing indicators, better data and wider country coverage are needed.

In general, the current state of gender inequality in basic access is well known. We are only beginning to understand the types and levels of inequality between men and women in their use of ICT services, once basic access issues are resolved. While significant progress has been made in establishing measurement standards and definitions to collect gender-disaggregated data on ICT access and use, more needs to be done to achieve global coverage.

REFERENCES


Databases consulted:
• ITU- World Telecommunications/ ICT Database
• UNCTAD Global Cyberlaw Tracker
• UN Stats- SDG Database
• World Bank- Findex Database
2.1 / INTRODUCTION

As ICTs are increasingly ingrained in our everyday life, the ability to make use of digital technology has become an essential competency in modern societies. Despite their potential to empower women, ICTs are entwined with existing gender inequality, hindering women’s participation in the production, management, and use of technology. As the previous chapter demonstrated, considerable gender gaps exist beyond basic access, extending to differential utilisation of ICTs by gender. More than ever, it becomes critical to ask whether men and women have different digital skills not only for accessing and using ICTs, but also for creating digital technologies, ICT services, and contents. Further, where gender gaps exist, it is important to examine whether women and girls have access to equitable education and relevant trainings to obtain adequate digital skills for thriving in the ICT-driven future on par with men. Such understanding will be valuable to achieve the UN’s Sustainable Development Goals 4 and 5, which emphasise (among other goals) inclusive technical, vocational, and higher education for all, including women and the marginalised (Box 2.1). Examining the current contour of our knowledge on gender equality in digital skills, this chapter explores the question: What is the current status of gender equality in digital skills beyond ICT literacy, and what are the opportunities for girls and women to participate in cultivating advanced digital skills?

KEY FINDINGS

- According to the available data, women are less likely than men to have advanced digital skills in the majority of reporting countries.
- While STEM education can provide the foundation for advanced digital skills and a career in the tech industry, girls in secondary education tend to have lower self-efficacy and interests in studying STEM subjects as well as lower aspirations for STEM careers.
- Only 35% of women major in STEM subjects at higher education; within STEM majors, they tend to study natural sciences more than applied sciences related to ICT.
- Multiple pathways have been developed to equip girls and women with advanced digital skills, such as coding schools, bootcamps, and makerspaces, but their effectiveness in enhancing gender equality in ICT skills has yet to be assessed.

Box 2.1: Women’s Digital Skills and the SDGs

Education and training are critical to cultivating digital skills for both men and women. The 2020 Agenda for Sustainable Development Goals underscores the inclusive and equitable education and lifelong learning (SDG 4) and gender equality and empowerment of girls and women (SDG 5). It sets specific targets including:

- Target 4.3: ensure equal access for all women and men to affordable quality technical, vocational and tertiary education including university.
- Target 4.4: substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship.
- Target 4.b: substantially expand the number of scholarships available to developing countries…for enrolment in higher education, including vocational training and ICT, technical, engineering and scientific programmes in developed and developing countries.

2.1.1 / WHY IS IT IMPORTANT FOR WOMEN TO HAVE EQUAL DIGITAL SKILLS?

Gender gaps in digital skills can have significant ramifications for women’s participation in the digital society, especially as we face the so-called 4th Industrial Revolution. Approaching the 2020s, we must expect seismic changes driven by emerging technologies such as artificial intelligence, robotics, internet of things, and biometrics, to mention a few. These new technologies will digitise, automate, and interconnect our everyday functioning across all sectors, in a way that changes how we live, work, and learn (Schwab, 2017). Like other technical revolutions, these changes will come with several challenges affecting the lives of both women and men, and in some regards it may strike women harder than men.

One foreseeable change is the reconfiguration of jobs. By 2020, it is expected that more than 7.1 million jobs will be displaced due to automation and disintermediation, according to a forecast by the World Economic Forum (WEF, 2016). Most of the estimated job loss (4.7 million) will come from office and administrative jobs, of which women perform a larger share, in most countries. The 4th Industrial Revolution will also create 2.1 million new jobs — mostly relating to computing, mathematics, architecture, and engineering (0.7 million). Yet the current participation of women in these booming fields, as discussed in detail in Chapter 3, is low and problematic.

Indeed, despite growing job demands for skilled ICT workers, there is a shortage of women equipped with advanced digital skills (Box 2.2). The gender gap in
digital skills is most notable in high-level digital skills, and in many countries it is widening due to persistently low numbers of young women studying ICT. Related majors at tertiary level and beyond. If this trend persists, we may continue living in a world driven by technologies that are mostly designed, produced, and managed by men.

**Box 2.2 Women's ICT leadership and the SDGs**

The demand for skilled-ICT workers is expected to grow fast, as ICTs permeate all industry sectors including manufacturing, transport, healthcare, banking, retail, energy, military, farming, education, and so on. In Europe, it is forecasted that 9 out of 10 jobs will require some kinds of digital skills in the future (European Commission, 2017), while the shortage of skilled workers in the ICT sector will double — from 373,000 in 2015, to 756,000 by 2020 (European Parliament, 2017). In the U.S., it is projected that employment in computer-specific jobs will grow 13% by 2026, faster than all other occupations. Besides the growing quantity of demand, the quality and types of ICT skills required by industry are also changing (see Chapter 13). Certain skills are already in high demand, including expertise in software development, cloud computing, big data, and information security. Other high employment areas may include mobile apps, web development, data science, cybersecurity, and emerging technologies, such as machine learning, artificial intelligence, and augmented reality. Despite the growing demand, however, the share of women equipped with such ICT skills is limited. The data from OECD countries show that just 14% of female workers have jobs developing, maintaining, or operating ICT systems, compared to 53% of male workers (OECD, 2017). Moreover, the current gap is expected to get worse, with the stagnant female participation to STEM education in many developed countries.

### 2.1.2 / MEASURING GENDER EQUALITY IN DIGITAL SKILLS

Assessing the state of gender equality in digital skills begins with defining digital skills. Until recently, digital skills were understood as more or less equivalent to digital literacy or basic skills to access ICTs. International organisations such as the International Telecommunication Union (ITU) as well as many national governments usually measure digital skills by the range of activities one can perform on a PC or the internet. Although these data are increasingly sex-disaggregated, this techno-specific approach has drawbacks. It requires a constant update of its definition and measurement, in response to rapid technological change. Moreover, just as literacy only asks whether one can read rather than what one reads, this literacy-oriented approach fails to capture the breadth and depth of digital skills related to a variety of ICT activities.

Recognising these limits, researchers have made efforts to conceptualise digital skills as a multifaceted concept (Box 2.3). Cutting across the various frameworks, digital skills are commonly classified into three types: basic skills to access ICTs; intermediate skills to use ICTs as effective digital citizens; and high-level skills to create ICTs and participate in the ICT industry. Yet, beyond the basic skills, these emerging frameworks have not yet been extensively discussed or agreed on at the international level. Globally comparable data are rare, as researchers are still developing new methodologies to measure the comprehensive dimensions of digital skills beyond ICT literacy. Furthermore, these frameworks are often designed for a general populace, without acknowledging the issues of global inequalities of income, race, and gender. Differential needs and contextual barriers associated with women and social minorities are not yet fully reflected in these early efforts. It is essential to begin a global dialogue on how digital skills can be framed in consideration of women and social minorities, before these frameworks are fully established. To do so, we need more evidence-based research to understand the current gender gaps in digital skills and to what extent women and minorities are discouraged from acquiring and utilising more-than-literate digital skills.

### Box 2.3 Global efforts to redefine digital skills

Definitions of digital skills need to be constantly updated in response to rapid technological change. The type of skills required to participate meaningfully in today's digital economy are very different from a decade ago, and various organisations have adopted different ways of defining digital skills. The United Nations (2017) refers to digital skills as “a range of different abilities, many of which are not only ‘skills’ per se, but a combination of behaviours, expertise, know-how, work habits, character traits, dispositions and critical understandings.” OECD (2016) categorises digital skills into three groups: ICT complementary skills for everyday uses; ICT generic skills for work; and ICT specialist skills to develop technology. The Broadband Commission (2017) defines digital skills as “a range of different abilities, many of which are not only ‘skills’ per se, but a combination of behaviours, expertise, know-how, work habits, character traits, dispositions and critical understandings.” They also conceptualise digital skills as a “gradual continuum” from basic functional skills to high-level skills, with a range of intermediate skills existing in between. The European Commission recently developed the “Digital Competence Framework for Citizens,” which identifies and describes key areas of digital competence, providing a conceptual reference model for Europe. In the IEC framework, digital skills comprise five core skills: (i) information and data literacy; (ii) communication and collaboration — interacting through digital technologies; (iii) digital content creation; (iv) safety; and (v) problem solving. Translating this concept into a measurable standard, Eurostat has developed a digital skills composite indicator, based on selected activities related to individuals’ internet or software use in four specific areas (information, communication, problem solving, and software skills). ITU (2018) also suggest five different skills for youth employment, including basic skills for using ICTs, advanced skills for developing ICTs, mid-level skills for producing content, soft skills for collaborating, and digital entrepreneurship skills for doing business. According to ITU, basic digital skills refer to effective use of technology including (for example) web search, online communication, use of professional platforms, and digital financial services. Intermediate skills refer to skills needed to perform work-related functions, such as graphic design and digital marketing; while advanced skills refer to skills that are necessary to create, manage, and test ICTs, including coding.

Another useful way of examining digital skills is to see it as a part of a continuum across three levels: basic, intermediate, and advanced. The Decent Jobs for Youth Initiative, under the lead of the International Labour Organization, adds to these three types of skills soft skills and digital entrepreneurship skills, as essential to succeed in the digital economy.

1 There are several different approaches to collect data on digital skills. First, standardised tests can provide the most accurate assessment of one’s skills, but such measures are costly and difficult to expand in scale. Most available digital skills data collected via self-reported surveys which individuals assess one’s level of knowledge in performing a range of ICT based activities, in such cases it is often estimated via proxies such as qualifications obtained from educational or training programs relevant to ICT specialisation, or in some cases, occupations or salaries to indicate the economic returns of having a certain level of digital skills. In many countries, the status of gender equality in high-level digital skills is often measured by comparing the number of female and male students who enrolled or graduated in STEM majors at tertiary-level education.
2.2 / BASIC DIGITAL SKILLS

Basic digital skills are the minimum foundational skills required to function effectively in the digital economy; they are an integral part of higher-level digital skills. Understanding the issue at this level could provide insights to shape policy proposals with a broader impact. It is also the area where initial work has been done to operationalise and measure the concept, and where gender disaggregated data are available. As part of the World IT Database, the ITU has collated nine indicators of digital skills (Figure 2.1).

Figure 2.1 
Aspects of Gender Equality in Digital Skills

Figure 2.1

ITU's data on digital skills provide a starting point to assess the gender divide on basic digital skills. Of the nine available indicators, we select eight skills that can be classified as basic digital skills to examine the gender divide in these areas. Complete data are reproduced in Appendix C.

Table 2.1 provides a broad summary of data on the percentage of women with the relevant ICT skills clustered by region and skills type. We note that for countries in Africa and the Americas where data are available, the percentage for all eight skills categories falls below 50%. The types of skills with the highest reported percentage of women in those regions are copying or moving a file or folder (42.2%) and using copy and paste tools to duplicate or move information within a document (42.1%). The skill with the lowest percentage in those regions is creating an electronic presentation (0.1%), followed by using basic arithmetic formula in a spreadsheet (1.4%).

In Asia and Europe, there can be extreme variations within the region, even when on average more than 50% of women are reported able to perform a specific skill. In Asia, for example, 89% of women in Brunei are able to copy or move a file or folder, compared to only 3% in Pakistan. In Europe, while 68% of women in Netherlands can find, download, install, and configure software, only 2% of women from Russia are reportedly able to perform the same task.

Where data are available for the eight basic skill categories, in most countries men outperform women; in 35 countries there is no skill area where women outperform men (as illustrated below in Figure 2.7). In 14 countries, women outperform men in one or two skills; in two countries, women outperform men in three to four skills; and in two countries, women outperform men in five or more skills areas.

At the country level, more men than women reported having a specific digital skill in the majority of countries across Africa, Americas, Asia (Table 2.2), and Europe (Table 2.3). Tables 2.2 and 2.3 show that not all countries with a high percentage of men and women reporting ability for a specific skill would necessarily have a low difference in ability, as in Bahrain (see Appendix C). Statistics cannot tell a complete story: the issues underlying the disadvantages faced by women and girls may be very different in different countries. Furthermore, self-reported data may not be completely reliable, as multiple studies find that males tend to overestimate their digital skills while females do the opposite (see Section 2.5.1.2, Attitudes about STEM education).

The reported or perceived low ability of women in basic digital skills should be a cause for concern. If women and girls are disadvantaged at the level of basic skills, we can expect to see greater gender digital divides in higher ICT skills and ICT leadership.

### Table 2.1 
Percentage of women with ICT skills by region

<table>
<thead>
<tr>
<th>TYPE OF SKILL</th>
<th>DIMENSION</th>
<th>REGION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Africa</td>
<td>Americas</td>
</tr>
<tr>
<td></td>
<td># of countries</td>
<td>Lowest %</td>
</tr>
<tr>
<td>Copying or moving a file or folder</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>42</td>
<td>39</td>
</tr>
<tr>
<td>Using copy and paste tools to</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>duplicate or move information within</td>
<td>3</td>
<td>16</td>
</tr>
<tr>
<td>a document</td>
<td>42</td>
<td>37</td>
</tr>
<tr>
<td>Sending e-mails with attached files</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>27</td>
<td>37</td>
</tr>
<tr>
<td>Using basic arithmetic formula in a</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>spreadsheet</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>19</td>
<td>27</td>
</tr>
<tr>
<td>Connecting and installing new devices</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>24</td>
<td>30</td>
</tr>
<tr>
<td>Finding, downloading, installing and</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>configuring software</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>29</td>
<td>15</td>
</tr>
<tr>
<td>Creating electronic presentations</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>with presentation software</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>30</td>
</tr>
<tr>
<td>Transferring files between a</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>computer and other devices</td>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>21</td>
<td>32</td>
</tr>
</tbody>
</table>


Note: Red – low percentage reporting ability to perform the specific skill (bottom quintile). Purple – high percentage reporting ability to perform the skill (top quintile). Color range: red, pink, gray, lavender, purple.
### Table 2.2
**Difference in percentages between males and females on different aspects of digital skills in Africa, the Americas and Asia**

<table>
<thead>
<tr>
<th>Task Description</th>
<th>Males (%)</th>
<th>Females (%)</th>
<th>Difference (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copying or moving a file or folder</td>
<td>3.0</td>
<td>5.7</td>
<td>-2.7</td>
</tr>
<tr>
<td>Using copy and paste tools to duplicate or move info</td>
<td>-2.6</td>
<td>-3.1</td>
<td>-0.5</td>
</tr>
<tr>
<td>Sending e-mails with attached files</td>
<td>1.1</td>
<td>2.0</td>
<td>-0.9</td>
</tr>
<tr>
<td>Connecting and installing new devices</td>
<td>0.5</td>
<td>1.2</td>
<td>-0.7</td>
</tr>
<tr>
<td>Finding, downloading, installing and configuring software</td>
<td>-0.6</td>
<td>-1.3</td>
<td>-0.7</td>
</tr>
<tr>
<td>Creating electronic presentations with presentation software</td>
<td>-0.2</td>
<td>-0.9</td>
<td>-0.7</td>
</tr>
<tr>
<td>Transferring files between a computer and other devices</td>
<td>1.9</td>
<td>2.2</td>
<td>-0.3</td>
</tr>
</tbody>
</table>

**Note:** Red = Low percentage reporting ability to perform the specific skill (bottom quintile). Purple = High percentage reporting ability to perform the skill (top quintile). Color range: red, pink, gray, lavender, purple.

### Table 2.3
**Difference in percentages between males and females on different aspects of digital skills (Europe)**

<table>
<thead>
<tr>
<th>Task Description</th>
<th>Males (%)</th>
<th>Females (%)</th>
<th>Difference (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copying or moving a file or folder</td>
<td>1.9</td>
<td>3.4</td>
<td>-1.5</td>
</tr>
<tr>
<td>Using copy and paste tools to duplicate or move info</td>
<td>-2.5</td>
<td>-2.9</td>
<td>-0.4</td>
</tr>
<tr>
<td>Sending e-mails with attached files</td>
<td>1.1</td>
<td>2.0</td>
<td>-0.9</td>
</tr>
<tr>
<td>Connecting and installing new devices</td>
<td>-0.1</td>
<td>0.3</td>
<td>0.4</td>
</tr>
<tr>
<td>Finding, downloading, installing and configuring software</td>
<td>0.9</td>
<td>1.6</td>
<td>0.7</td>
</tr>
<tr>
<td>Creating electronic presentations with presentation software</td>
<td>1.7</td>
<td>2.2</td>
<td>0.5</td>
</tr>
<tr>
<td>Transferring files between a computer and other devices</td>
<td>1.9</td>
<td>2.2</td>
<td>-0.3</td>
</tr>
</tbody>
</table>

**Note:** Red = Low percentage reporting ability to perform the specific skill (bottom quintile). Purple = High percentage reporting ability to perform the skill (top quintile). Color range: red, pink, gray, lavender, purple.

---

**Figure 2.2**
Number of countries with greater percentage of skilled women than men, per number of skills.

2.3/ INTERMEDIATE DIGITAL SKILLS

Beyond basic skills, there is currently no globally comparable data that, comprehensively measure the multiple dimensions of digital skills, due to the absence of internationally agreed definitions and methodologies. Some recent data may provide snapshots of the gender gap in intermediate digital skills.

Studies show that 90% of Wikipedia contributors and 69% of Wikipedia readers are male (Wikipedia Foundation, 2011; Glott, et. al, 2010; Economist, 2018). Although social media is more popular among women than men in most advanced countries, far fewer women in developing countries use it (Pew Research, 2018), possibly reflecting a lack of intermediate skills (such as downloading an app). The Pew survey of 39 countries found a large gender gap favouring men in social media use in Tunisia, Ghana, India, Kenya, and Senegal (Figure 2.3). Similarly, fewer women overall use mobile finance services than men (see Chapter 1). This evidence on differential use of ICTs by gender indicates a possible gender gap in intermediate skills in everyday ICT uses.

Figure 2.3
Gender divide in social media use

Assessing the gender gaps in intermediate digital skills is conceptually and methodologically challenging. With a vast range of everyday digital activities performed on multiple ICTs, it is difficult to measure overall skill gaps. Moreover, differential uses of ICTs by gender may reflect different levels of motivation, social influence, enabling contexts, or structural barriers. Finally, most of the data on online activities is held by private firms and rarely disclosed fully. Thus, it is difficult to assess how many women have the skills (or have already begun to sell products on Amazon or Alibaba, view or post videos on YouTube, or install anti-virus software).

Beginning in 2014, the European Commission (EC) started to collect data from its 28 member-states on more comprehensive dimensions of digital skills. Reflecting the new framework for “Digital Competence Framework for Citizens”, it measures digital skills in four different categories: information, communication, problem-solving, and software skills (Table 2.4). Compared to the ITU data on basic skills, a greater variety of digital activities are included, such as seeking information, using social media, uploading contents, using online learning, selling online, and writing a code. (Note that each of these categories may include a range of skill levels, from basic to advanced; the EC survey relies on individuals’ self-reports).

Table 2.4
European Commission comprehensive digital skills

<table>
<thead>
<tr>
<th>Type</th>
<th>Activities used for measuring the skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information Skills</td>
<td>- Copied or moved files or folders;</td>
</tr>
<tr>
<td></td>
<td>- Saved files on Internet storage space;</td>
</tr>
<tr>
<td></td>
<td>- Obtained information from public authorities/services’ websites;</td>
</tr>
<tr>
<td></td>
<td>- Founding information about goods or services;</td>
</tr>
<tr>
<td></td>
<td>- Seeking health-related information;</td>
</tr>
<tr>
<td>Communication Skills</td>
<td>- Sending/receiving emails;</td>
</tr>
<tr>
<td></td>
<td>- Participating in social networks;</td>
</tr>
<tr>
<td></td>
<td>- Telephoning/video calls over the internet;</td>
</tr>
<tr>
<td></td>
<td>- Uploading self-created content to any website to be shared;</td>
</tr>
<tr>
<td>Problem solving skills</td>
<td>- Installing software and applications (e.g.,)</td>
</tr>
<tr>
<td></td>
<td>- Changing settings of any software, including operational system or security programs;</td>
</tr>
<tr>
<td></td>
<td>- Online purchase (in the last 12 months);</td>
</tr>
<tr>
<td></td>
<td>- Selling online;</td>
</tr>
<tr>
<td></td>
<td>- Used online learning resources;</td>
</tr>
<tr>
<td></td>
<td>- Internet banking;</td>
</tr>
<tr>
<td>Software skills</td>
<td>- Used word processing software;</td>
</tr>
<tr>
<td></td>
<td>- Used spreadsheet software;</td>
</tr>
<tr>
<td></td>
<td>- Used software to edit photos, video or audio files;</td>
</tr>
<tr>
<td></td>
<td>- Created presentation or document integrating text, pictures, tables or charts;</td>
</tr>
<tr>
<td></td>
<td>- Used advanced features of spreadsheet to organize and analyze data (sorting, filtering, using formulas, creating charts;</td>
</tr>
<tr>
<td></td>
<td>- Have written a code in a programming language;</td>
</tr>
</tbody>
</table>


In the EC findings, a sex-disaggregated analysis shows no gender gap in basic digital skills. However, slightly more men (31%) than women (27%) reported having “above basic” digital skills (Figure 2.4). Among those with “above basic skills”, the gender gap increases with age. Except the young group (i.e., teens and young adults), moderate gender gaps exist disfavoring women: among the adult group, 4 percentage points, and among elders (over 55 years old), 5 percentage points.

Figure 2.4
Gender difference in overall digital skills and by age

The group with “above basic” digital skills shows some variation by specific skill types. There are only minimum differences between men and women in information and communication skills. However, more men than women have higher skills in both problem-solving and software skills, by 7 percentage points (Figure 2.5). This finding indicates that European women are generally less skilled than men in handling computer or mobile applications, managing data, using the internet for business and learning, or creating software and digital content.

The OECD’s Survey of Adult Skills (PIAAC) also provides sex-disaggregated data on applied ICT skills (OECD, 2016b). Along with literacy and numeracy, it assesses the ability to solve problems in technology-rich environments, which require integrated skill-sets of digital competency and cognitive abilities such as acquiring, evaluating, and organising information from ICTs. While the digital skills data from the EC and ITU are measured by self-reported surveys, the PIAAC uses a standardised test based on role-playing scenarios. “Acting” as a job seeker, the respondent is given multiple tasks such as: using a search engine to find a job agency, evaluating the information, registering, and bookmarking the page.

The OECD’s sex-disaggregated data on problem-solving skills shows moderate gender differences overall (Figures 2.6). In the lower level groups (Level 1 and below), women predominate slightly, while in the higher score groups (Level 2 and 3) there are slightly more men. The country breakdown of the highest-level group shows a larger (but still moderate) gender gap among the countries with stronger economies, such as Japan (5.1 points), UK (3.7), Ireland (3.1), and Germany (2.7) (Figure 2.7).

The data on the advanced economies of Europe and OECD countries suggest — in the absence of global data — that the gender gap becomes greater (in favour of men) in higher-level skills. In the following section, we examine the sex-disaggregated data on programming skills and data sciences, as two examples of high-level digital skills.

2.4 / ADVANCED SKILLS: PROGRAMMING

ITU’s World ICT Development Indicator database includes one advanced digital skill — “write a computer program using a specialised programming language”. The data covers 49 countries; it is based on self-reported surveys and is sex-disaggregated. On average, only 3.5% of women in the reporting countries can write a computer program, as compared to 7.8% of men. At the country level, the share of females who used programming skills in the last year was higher than average in Brunei Darussalam (17%), Iceland (12%), Bahrain (11%), Denmark (9%), and Greece (6%), but lower than the average in most reporting countries. Figure 2.8 presents the difference in programming skills between men and women by country. Interestingly, the percentage gap is wider among advanced economies in Scandinavia and Western Europe, such as Luxembourg (12.7), Iceland (11.9), Norway (10.9), Sweden (10.6), Denmark (10.4), and Belgium (10.2); it is much smaller in less advanced or developing countries such as Qatar (-1.0), Brunei Darussalam (0), Zimbabwe (0.3), Egypt (0.4), Iran (0.5), Romania (0.8), and Russia (0.9). Similar patterns will also be seen in the following section on STEM education, at the secondary and tertiary levels.
Taking Stock: Data and Evidence on Gender Digital Equality

PART ONE Taking Stock: Data and Evidence on Gender Digital Equality

2.5 / PATHWAYS TO DEVELOP DIGITAL SKILLS: STEM EDUCATION

The gender gap in digital skills is more pronounced in the high-level skills required to create ICT software, hardware, and content — and this critical skills gap is closely related to gender imbalance in employment and leadership in the ICT and tech industry. Higher education in STEM and ICT is often seen as a pathway to acquiring the high-level digital skills required for ICT, science, and technology professions. (See Chapter 12 for discussion of the role of educational institutions.) For instance, most senior software developer positions require a college or graduate degree in computing disciplines, while system engineers or robotics designers would need at least some STEM education at the tertiary level. This pathway is more than a standard college education; described as a “STEM pipeline”, it involves early education, secondary school specialisation, undergraduate major, and a master’s or Ph.D. degree.

2.5.1 / SECONDARY EDUCATION

Girls’ and women’s participation in education has made significant progress in the last two decades. According to UNESCO’s school enrolment data in 2015, global average figures show gender parity in both primary and secondary education, although the gender gap persists in some regions, including sub-Saharan Africa and Western Asia. The number of countries reporting gender parity in both primary and secondary education has almost doubled, from 36 in 2000 to 62 in 2015 (UNESCO, 2015). As illustrated in Figures 2.9 and 2.10, the available data shows that the learning gap between boys and girls is also closing in many countries (UNESCO, 2017). Still, considerable gender differences exist in students’ level of interest in STEM subjects and motivation for STEM careers. However, caution is needed when interpreting global data due to the limited data availability, particularly from developing countries, and due to the complex variation that may exist within a region or country. Also, there is a lack of globally comparable data relating to the drivers and barriers of achievement, beyond school enrolment and test scores.

2.5.1.1 / Participation and achievement

Several studies suggest that early exposure to STEM subjects is critical in students’ decision to specialise in higher education and future careers (Kermani & Aldemir, 2015; Lee, et al., 2011). In most countries, math and sciences are part of the core national curriculum for all primary and secondary students, so educational exposure to STEM subjects is more or less similar for boys and girls at the primary and lower-secondary level. The gender gap in STEM participation begins to be more noticeable in lower secondary education, when students start to make choices for subject specialisation (UNESCO, 2017; Spearman & Watt, 2013). A survey of young women in 12 European countries shows that girls become interested in STEM between the ages of 11 and 12 (Microsoft, 2017). With a lack of sex-disaggregated data on students’ selection of specialisation courses, it is hard to confirm whether gender gaps exist at that stage. Among the very few available data, the Trends in International Mathematics and Science Study (TIMSS) Advanced 2015 shows that more boys than girls take advanced math or physics in Grade 12 (Figure 2.8); note that the data is limited to only nine countries (IEA, 2016; UNESCO, 2017).

Figure 2.9
Percentage of grade 12 female students taking advanced math or physics courses

Internationally standardised test scores show only marginal differences between girls and boys in lower secondary education. According to the Programme for International Student Assessment (PISA) data published in 2015, at age 15 girls outperform boys by almost 27 points in reading, but they slightly underperform in math and science, by 8 and 4 points (Figure 2.10). Similar patterns are found in TIMSS scores and other regional education data, according to a study by UNESCO (2017).
Taking Stock: Data and Evidence on Gender Digital Equality

PART ONE

Taking Stock: Data and Evidence on Gender Digital Equality

**Figure 2.10**
Gender difference in student performances at grade 8 (total scores)

<table>
<thead>
<tr>
<th></th>
<th>Reading</th>
<th>Math</th>
<th>Science</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>506</td>
<td>486</td>
<td>491</td>
</tr>
<tr>
<td>Male</td>
<td>479</td>
<td>494</td>
<td>495</td>
</tr>
</tbody>
</table>

Source: TIMSS Advanced, 2015

**Figure 2.11**
Number of countries with gender gaps in science and math scores in 2015

<table>
<thead>
<tr>
<th>Country</th>
<th>Science Grade 4 (N=47)</th>
<th>Science Grade 8 (N=39)</th>
<th>Math Grade 4 (N=47)</th>
<th>Math Grade 8 (N=39)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>23</td>
<td>23</td>
<td>37</td>
<td>18</td>
</tr>
<tr>
<td>Male</td>
<td>36</td>
<td>51</td>
<td>16</td>
<td>67</td>
</tr>
</tbody>
</table>

Source: TIMSS, 2017

Figure 2.11 shows that close to or more than half of the countries studied in TIMSS 2015 showed no gender difference in math and science performance. For Grade 8 science, a substantially larger number of countries reported girls scoring higher than boys.

**Figure 2.12**
Gender differences by countries in math scores at grade 4

Source: TIMSS, 2015

Although the TIMSS 2015 data is based on less than 50 countries and covers only a few least developed countries, the participating countries are relatively diverse and regionally proportionate. It can provide a useful outline of gender gaps in student STEM performance in different social, economic, and political contexts. Math score differences by gender and country (Figure 2.12) show regional contrasts. Several European countries (Italy, Croatia, Spain, Slovakia, Portugal, Netherlands, and Denmark) showed a conventional gender gap, with boys scoring higher in math than girls. In contrast, countries in Western Asia (Saudi Arabia, Oman, Jordan, Bahrain, and Kuwait) show girls performing better than in math boys. This pattern of country variation will be revisited in the following section on gender and STEM in higher education.

**2.5.1.2 / Attitudes about STEM education**

Beyond the gender gaps in school enrolment or test results, several studies suggest that considerable gender differences exist in relation to students’ attitudes and perceptions. Such attitudinal or psychological differences may include an internalised belief in their ability in STEM, their interest and motivation to study STEM subjects, and an aspiration to pursue a career in STEM. Given the lack of internationally comparable data measuring these psychological factors, we can only glimpse the picture by using psychometric indicators of the PISA data, coupled with a few small-scale surveys with limited geographic coverage.

Confidence. Significantly, girls tend to be less confident than boys about STEM subjects. Several studies have found that self-concept (a belief in one’s abilities) and self-efficacy (a belief that one can do a certain task) affect successful learning and advancement (Pajares & Miller, 1994; Bandura, et al., 2001; MacPhee, et al., 2013). Notably, girls tend to have less self-confidence in math and sciences and feel more anxious than boys about their ability to solve problems in those subjects (OECD, 2015). Figure 2.13 shows that girls in OECD countries have much lower self-confidence in math and sciences than boys. Similarly, in a survey of 7,411 students in Vancouver, female students had lower self-perceived ability than males relating to STEM subjects including computer science, engineering and physics and gave lower estimates of their computer skills (Chan, et al., 2001).
Interest. Girls are reported to be less interested than boys in STEM subjects. Studies show that girls tend to lose interest in STEM earlier than boys do, often during their adolescence and before they choose a specialisation (UNESCO, 2017). A survey of 11,500 girls in 12 European countries shows differences by age. As shown in Figure 2.14, girls’ average interest in STEM peaked at 12 and continued to decrease until 17 and 19, when they would usually make decisions on majors in higher education (Microsoft, 2017).

A study in the UK found that boys and girls were almost equally interested in STEM at the age of 10 and 11 (75% of boys versus 73% of girls), but the gender gap became wider at the age of 18 (33% of boys versus 19% of girls) (Kearney, 2016).

Aspiration. Girls tend to have less aspiration for STEM career. Studies based on the PISA data found that, while girls tend to be more ambitious than boys, only 5% of girls in OECD countries expected a career in computing and engineering when they grew up, compared to 18% of boys who wanted to work in these fields (Gikora & Pokropék, 2011). The list of popular career choices shows a clear difference between boys and girls: ICT-related occupations do not appear at all in the girls’ list of dream careers, while boys highly rank engineers, computer programmers, and other ICT-related professions (Figure 2.15). There was no OECD country where more girls than boys were interested in entering computing and engineering careers.

Despite the efforts by many governments to include more girls and women in STEM education, this gender gap in student’s aspiration in STEM careers seems to have persisted over at least the past decade. Initially collected in 2006, the data has barely changed in the latest survey of OECD countries. According to PISA data from 2015, similar percentages of boys (25%) and girls (23.9%) are interested in pursuing some type of science-related career. Within the science field, however, girls are much more inclined to pursue health professions (doctors, nurses, and healthcare workers); only 0.4% of girls aspire to become ICT professionals, compared to 4.8% of boys (Figure 2.16).

The 12 countries are Belgium, Czech Republic, Finland, France, Germany, Italy, Ireland, Netherlands, Poland, Russia, Slovakia, and the UK.
These data indicate that girls at the secondary level tend to have lower self-efficacy and lower interest in STEM subjects, as well as lower aspiration for STEM careers, compared to boys. While STEM education at the secondary level creates a critical foundation for further developing their high-level digital skills, it seems that girls gradually move away from STEM studies regardless of their competence and potential. Apparently, these gender differences in attitude and motivation in STEM can affect their decision to choose a college major.

2.5.2 / TECHNICAL AND VOCATIONAL EDUCATION AND TRAINING (TVET)

Instead of following conventional academic curricula, some secondary-level students pursue vocational training to prepare early careers. While the history of vocational education is long, the term TVET (technical and vocational education and training) was internationally recognised only in 1999. TVET has received relatively little attention due to underinvestment from governments, poor institutional capacity, and low social status of TVET graduates (UNESCO, 2015b). While TVET education can also be offered in post-secondary, tertiary, and adult life-long education, the most common approach is secondary-level training via public or private vocational schools. According to the UNESCO Institute of Statistics (UIS), globally around 10% of secondary-level students were enrolled in TVET schools in 2016, and the figure has remained almost steady since 2000. The share of female students in TVET education has hovered around 45% over the last 15 years (Figure 2.17). Regional differences exist: based on available data, participation in TVET is higher in Oceania (33.2%) and Europe (23.6%) as compared to Asia (9.3%) or Africa (5.6%).

The OECD data breaks out the gender gap in secondary vocational education by specialisation (OECD, 2017b). In OECD countries, most upper secondary vocational graduates earn a diploma with a specialisation in either engineering (33%) or business, administration, and law (19%). When the sex-disaggregated data is examined, however, it shows a considerable gender gap especially in engineering, manufacturing, and construction, where women represent only 11% of the graduates (Figure 2.18); with the exception of Brazil and Estonia, the OECD countries show fewer than 20% of female students graduating with a vocational diploma in that specialisation. By contrast, in the health and welfare specialisation, 80% of the graduates are women.

Because ICT/computing has not been classified as a separate specialisation, we cannot say how many women specialise in ICT or high-level digital skills in their secondary vocational education. One notable case is Mirim Meister Women’s High School in South Korea, offering training in digital creation skills such as programming, app development, User Interface (UI) design, and online content production skills, with 99% of graduates starting their careers in the ICT sector.

2.5.3 / HIGHER EDUCATION IN STEM

Looking at the data for the past 15 years, three major trends are identified. First, despite significant progress in women’s participation in higher education, the percentage of women majoring in STEM studies has been remained low across the regions. Second, considerable gender-segregation exists even within STEM fields, as more women choose to study natural sciences rather than computer sciences and engineering. Third, notable country-level or regional differences exist: the gender gap in STEM tends to be larger in countries with higher levels of gender equality—a counter-intuitive trend referred to as the “gender & STEM paradox” (Stoet & Geary, 2018).

According to the UIS data, the global enrolment of female students in higher education has almost doubled since 2000, and there are now more women than men pursuing either bachelor’s degree (53%) or master’s degree (54%). The growing female participation in tertiary education has become a common trend across all regions. Europe showed the highest share of female in higher education (53.8%) and Asia the lowest (49.8%), as of 2016. Nevertheless, as shown in Figure 2.19, the share of women in STEM majors has remained low, averaging less than 35% of total graduates in STEM in the past decade.
Furthermore, regardless of majors, the percentage of women proceeding to pursue a doctoral degree (45%) is still lower than for men (55%). In low-income countries, women constituted only 27% of Ph.D. students in 2015, and this has marginally decreased over the past 15 years, according to the UIS data. As discussed in Chapter 3, this leak in the pipeline contributes to the low participation of women in research, accounting for only 29% of the world’s researchers (UNESCO, 2017).

As shown in Figure 2.20, women represent the majority of students enrolled in education (70%), humanities and arts (62%), and social sciences (61%). In contrast, the share of women in STEM majors is significantly lower, at 36%. Among the STEM fields, the distribution of women’s majors is heavily skewed towards natural or life sciences (54.8%) and much lower in either computer sciences (28.9%) or engineering (27.1%).

Inequality in education can be exacerbated by the intersectionality of factors such as ethnicity, income, and urban-rural location. However, such data are unavailable except for the U.S., where only small percentages of women of colour earned bachelor’s degrees in any STEM field: black women at 2.9%, Latinas at 3.6%, and Asian women at 4.8% (National Centre for Education Statistics, 2016; Aspray, 2016). Considerable regional and national variation exists in categorising the field of education. For instance, UIS uses 11 categories, including ICT as a separate field, while OECD has more than 20 sub-categories but does not list ICT as a separate field of study. Eurostat also has 11 categories, with computing as a distinct field. Individual countries also may have their own categorisations; many classify ICTs as part of information sciences, information technology, communications, or other science disciplines.

2.5.3.3 / The gender and STEM paradox: More gender equality, fewer women in STEM

Gender-segregation in fields of study varies between developed and developing countries. In fact, the gender gap is often larger in more economically developed countries (Charles & Bradley, 2009). Exceptions are noted in Malaysia, Pakistan, and India, where more women than men participate in STEM education (Mellström, 2009; Shabib-ul-Hasan & Mustafa, 2014; Gupta, 2012). More recently, researchers have argued that countries that rank higher on the Global Gender Gap Index (GGI, measured by the World Economic Forum) — that is, those making greater progress toward gender equality — tend to have fewer women graduated with STEM degrees (e.g., Stoet & Geary, 2018). This phenomenon has been referred to as the gender paradox in STEM education.
How should we understand this paradox? Researchers interpret that, in countries with higher gender inequality, high-paying and more stable STEM occupations can be attractive options for women, who experience fewer economic opportunities as well as higher gender barriers. For instance, studies found that computer-related jobs are perceived as women-friendly and better careers for women than men in Malaysia and India (Lagesen, 2008; Varma, 2010).

But this does not explain the persisting small share of women studying STEM and ICT majors in more developed countries. Even in the wealthier countries of OECD, the economic benefits of a STEM career are clear: graduates in engineering tend to earn, on average, 10% or more than other college graduates, while those in education and teacher training earn 15% less (OECD, 2016c).

The gender imbalance in fields of study is closely related to an individual’s future career and economic well-being as well as socio-political participation. Women’s individual choices may be influenced by socio-cultural factors such as parents, peer-pressure, gender-stereotyping of STEM careers, and lack of role models and mentoring. As discussed in Chapter 5, many of these factors function as gendered barriers that discourage women from pursuing studies and careers in the STEM field and developing higher-level ICT skills to design and create technology.

### 2.5.4 / ALTERNATIVE PATHWAYS FOR HIGH-LEVEL DIGITAL SKILLS

As a metaphor to describe the educational requirements to incubate STEM and ICT professionals, many educators prefer the term “pathway” to “pipeline” (Aspray, 2016) — emphasising that there can be multiple pathways to train the necessary digital skills rather than a single pipeline. Indeed, there are many different occupations in the tech industry, with a wide spectrum of qualification and skills that can be obtained via various educational and training pathways.

With the increasing relevance of digital skills in today’s world, we see more innovative approaches to provide STEM education, certainly in relation to computing skills. Traditionally, higher education in computer sciences or related STEM majors has been the conventional pathway to develop students’ skills for careers in tech industries. Responding to the soaring demands for a skilled ICT workforce, however, new approaches advocate that computing education should be provided for all, including children and youth, rather than only in university classrooms. Further, experts argue it is necessary to equip all citizens with computational thinking and necessary computing skills, as coding skills become a new literacy of the 21st century (Rushkoff, 2011; European Schoolnet, 2015, 2017).

Innovative initiatives include: introductory computing education for national curricula; informal or private coding schools; bootcamps; MOOCs; hacker and makerspaces. These alternative pathways present new possibilities to bring ICT skills training to more girls and young women, though as yet there is no evidence-based research to assess their impact. (Chapter 14 also discusses the promise and pitfalls of skills development through on-the-job training at call centres.)

#### 2.5.4.1 / Introductory computing education

A growing consensus holds that computing education should be an essential part of national education. Advocates suggest that, just as schools teach children how electricity works or how body’s digestive system works, today’s children need to learn how computers, networks, and programming work, and what they mean to our society. Beyond this basic knowledge, “computational thinking” (CT) is also a critical competence to develop cognitive abilities (decomposition, recognition, abstraction, and algorithm) as well as integrated skills in problem-solving, collaboration, and creativity (Wing, 2006).

Many governments have implemented or plan to integrate computing education in their national curricula: approaches vary from a mandatory national curriculum on computational thinking to optional basic coding courses. According to a study by European Schoolnet (2017), at least 20 European countries have integrated or are planning to adopt computing education in their curricula (Figure 2.23). Note that their policy documents use a variety of terms interchangeably, including coding, programming, computational thinking, problem-solving, and algorithmic thinking. The UK government replaced the existing ICT syllabus with computing education for students aged 5–16.

A survey by Google and Gallup (2016) reports that about 40% of U.S. school principals say their school offers computer classes in programming or coding; the non-profit College Board introduced a computer science exam to their roster of Advanced Placement tests. South Korea announced plans to teach programming and computational thinking through primary, secondary, and high schools beginning in 2018, while China has introductory computing courses at the high school level, with optional subjects such as algorithms, multimedia applications, network applications, data management, and artificial intelligence.

![Figure 2.21 Status of computing education in Europe (2016)](image)

However, these movements are mostly very new, and there seems to be a lack of policy discussions or research on gender participation in introductory computing education. The gender barriers within current STEM education (Chapter 5) may persist despite the new initiatives. In the UK, an evaluation study of computing education shows that only 9% of girls-only schools offer computing at A-level, compared to 44% of boys-only schools and 25% of mixed-sex schools (Kemp, et al. 2016). Still needed are gender-sensitive computing curricula and institutional environments.

#### 2.5.4.2 / Coding training

A growing number of initiatives aim to provide practical coding skills for youth and adults. Although they cannot offer the same depth of education as a conventional college education, such initiatives can be a cost-effective and efficient means of learning programming skills. A StackOverflow survey of 64,000 global programmers shows that 76.5% of the respondents have a bachelor’s degree or higher, and about the half (54%) of those with college education have studied computer science or software engineering. However, 32% of the respondents said that formal education was not very important or not important at all to their career success. Along with the formal education, many also have taken alternative pathways, such as online courses (45%), on-the-job training (41%), and Hackathon (24%) (Figure 2.24).
Coding bootcamp is an intensive training programme offering practical programming and career development skills. The coding bootcamp learning experience is project-based, using lectures, collaborative work, and online exercises. There are four models, ranging from early education to ready-to-work (Table 2.5). Bootcamp students are, on average, 29 years old, hold a university degree (71%), and are male (over 60%) (ITU, 2016). As women make up nearly 40 per cent of bootcamp participants, this option could contribute to narrowing not only the skills gap but also the employment gender gap in the technology industry.

Globally, a growing number of initiatives in coding education focus on girls and women. Several international organisations and national governments promote women’s advanced digital skills and support grassroots efforts to provide coding education for girls and women, as in Case Study 2.1. The EQUALS Global Partnership conducted research in 2016 to identify initiatives to bridge the gender digital divide. The research found 837 gender tech projects (as of May 2018), including 143 projects from 70 organisations in 56 countries that provide coding education for girls and women. Another 319 projects provide training on digital skills, while others focus on awareness (132), capacity building in computing (116), networking among women developers (106), and mentoring current and future female developers (81) (Figure 2.25).

Table 2.5

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ready-to-Work model</td>
<td>Traditional approach to coding bootcamps - intensive 12 to 24 weeks full or part-time rapid skills training programmes that prepare people to qualify for employment shortly after the training ends.</td>
</tr>
<tr>
<td>Bootcamp model</td>
<td>An extended training approach - longer training programmes (1 to 3 years) that equip students with a broader range of sustainable income-generation skills in addition to coding competencies. Found mainly in Africa, they tend to focus on adding entrepreneurship training.</td>
</tr>
<tr>
<td>Mini Bootcamp model</td>
<td>Very short-term training programmes ranging in length from two days to one month. They are typically designed to spark interest in learning the basics of programming, to recruit or identify talent, for professionals to update their skills, and for outreach and community building.</td>
</tr>
<tr>
<td>Software skills</td>
<td>Efforts to trigger interest in programming at an early age. This model includes workshops, hackathons, and online platforms as well as more encompassing efforts such as schools integrating coding skills into their curriculum. Although not focused on employability in the short term, the early education model is an important trend to monitor.</td>
</tr>
</tbody>
</table>

Figure 2.23

Digital Skills Initiatives for women, by project types and regions

Figure 2.22

Importance of formal/alternative education for coding career

Source: Author’s elaboration, using Stack Overflow Survey data, 2017.
In conjunction with Germany’s G20 presidency 2017, the German Federal Ministry for Economic Cooperation and Development (BMZ) launched the initiative to overcome the gender digital divide and promote education, skills, and employment for women and girls in a digital world, particularly in emerging and developing countries. The initiative found strong support among G20 member states as well as the private sector, civil society, and the general public. GIZ, as a federal enterprise, implements numerous activities under the initiative, to support the German Federal Government in achieving its goals in international cooperation, including collaboration between governments, private sector, academia and civil society organisations.

Case Study 2.1 #eSkills4Girls – A global initiative to promote digital skills for women and girls

Author: Birgit Frank (BMZ) and Vanessa Dreier (GIZ)

BMZ has expanded its portfolio with new projects and a special focus on #eSkills4Girls in Ghana, Rwanda, Cameroon, Mozambique and South Africa. In 2019, projects will focus on digital skills trainings for women and girls, the integration of digital technologies in vocational trainings and non-formal education settings, and raising awareness for tech careers.

The EQUALS partnership – Advancing gender equality in the digital age

BMZ together with UNESCO spearheads the Skills Coalition of EQUALS, working on improving the data base on women’s digital skills, developing principles for gender-inclusive digital trainings, and creating a digital skills fund for grassroots women leaders and activists to scale-up their digital skills projects.

Implementation of #eSkills4Girls projects

BMZ has expanded its portfolio with #eSkills4Girls in Ghana, Rwanda, Cameroon, Mozambique and South Africa. In 2019, projects will focus on digital skills trainings for women and girls, the integration of digital technologies in vocational trainings and non-formal education settings, and raising awareness for tech careers.

Creating networks to foster learning among grassroots programs

In May 2017, BMZ brought together over 30 female tech leaders from all over Africa, at the #eSkills4Girls Africa Meetup, resulting in the #eSkills4Girls network to continue the dialogue.

Strategic partnerships with the private sector to promote local innovations

Since 2015, BMZ is supporting Africa Code Week, initiated by the German software company SAP. This continent-wide digital literacy initiative involves hundreds of schools and teachers, along with governments, businesses, and non-profits. In 2018, coding workshops in 16 African countries shared a curriculum designed for girls and young women.

An online platform to allow knowledge exchange

The #eSkills4Girls online platform showcases 32 flagship projects on digital skills, shares stories about female role models, and bundles information about studies, data, and events by G20 partners.

2.5.4.3 / MOOCs and online learning

Massive Open Online Courses (MOOCs) are a form of e-learning, characterised by large enrolments and free or low-cost access. Unlike traditional e-learning courses offered by universities and businesses, students can select the courses that interest them and complete them at their own pace, driven by their interests, passions, and, in many cases, the desire to develop job skills or professional certifications (Glass et al., 2013; Ho et al., 2015). As early MOOC courses on Machine Learning and Artificial Intelligence drew over 150,000 students to a single course, the emergence of MOOCs in 2012 was heralded for their potential to “usher in an era of global access” for learners who were underserved by traditional educational pathways (EDUCAUSE, 2013; Brown & Adler, 2008).

However, in recent years, research has shown that, despite the potential for MOOCs to democratise access to education to anyone with an internet connection, there remain wide disparities in the types of learners who access and complete MOOCs. Early analyses suggested that the typical MOOC learner was a white, college-educated male, suggesting a potential rich-get-richer effect — that primarily learners with access to higher education were accessing online learning resources in the form of MOOCs (Ho et al., 2014). Due to the flexibility that MOOCs offer for learning across time, place, and context, much has been made of their promise in providing alternative pathways to education in low-resource areas, particularly for ICT domains lacking in local experts. Again, however, research has consistently found that learners from less developed parts of the world were less likely to enrol in and complete MOOCs (Ho et al., 2014; Kielicke et al., 2015). Obstacles to greater MOOC uptake include access to a reliable internet connection and the digital literacy needed to access MOOCs (Christensen et al., 2013; Garrido et al., 2016), as well as differences in language and pedagogical style. Some research suggests that facilitating in-person workshops for MOOC learners at telecentres might mitigate those challenges (Cutrell et al., 2015; Madaio et al., 2016; Lyanagunawardena et al., 2013).

If MOOCs represent a possible alternative pathway for women’s computer science and STEM education, are there gaps in how women around the world participate in and complete MOOCs? Across multiple studies, male MOOC learners outnumber female learners by nearly 2 to 1, in contrast to traditional distance courses and online universities, where female learners outnumber males by a similar ratio (Christensen et al., 2013; Dillahunty et al., 2014; Ho et al., 2014; Kielicke et al., 2013; Breslow et al., 2013). However, the gender gap in MOOC participation may reflect gender gaps in women’s participation in STEM courses more broadly, as discussed earlier in this chapter. In a two-year retrospective of all MOOCs offered by Harvard and MIT on the MOOC platform edX, Ho et al. (2014) found that men outnumber women by five-to-one in CS courses and three-to-one in STEM courses, while women represented 40% of learners in the humanities and social science courses offered on edX (Ho et al., 2014). Once enrolled in MOOCs, however, multiple studies indicate that, across domains, female students complete courses at the same rate as male students (Ho et al. 2014; Breslow et al., 2013; Cislé, 2014). Two studies suggest that women in developing countries were more likely than men to complete a MOOC course (Jiang et al., 2016; Garrido et al., 2016).

With the high enrolment rates in MOOCs, there are equally high non-completion rates, with many learners signing up for free courses and never completing them (Ho et al., 2015). However, researchers have argued that these course completion rates may be misleading indicators of the potential impact of MOOCs. Some (Breslow et al., 2013) suggest that learners may stop participating at points that are appropriate for them individually; while others (Madaio et al., 2016) find that MOOC learners in developing countries may have different patterns of access than the course designers expected (such as downloading MOOC videos to be accessed in an offline repository), thus altering the definition of what completion looks like.

While much work has been done to develop empirical studies to understand who participates in MOOCs and how they learn, there remain gaps in obtaining comprehensive data that is broadly representative across regions and domain areas, as well as gaps in the research that understands the factors that might influence learners’ participation and success in learning with MOOCs. Moving forward, there is a need to collect more data to investigate MOOCs’ potential to provide an alternative pathway for digital skill acquisition among women, particularly in developing countries contexts with limited access to high-quality formal STEM education.

2.5.4.4 / Hackspaces and makerspaces

Hackspaces are workspaces for people with similar interests (often in computers, machining, technology, and digital art), allowing them to collaborate and share knowledge to innovate. Hackspaces are not rigidly defined in order to allow inclusivity, thus resulting in a variety of different hackspaces and formats. Hackspaces are alternatively referred as Hack Labs, Makerspaces, Fab Labs, Men’s Sheds, DIY makers, and Repair Cafes. Currently, 1,407 hackspaces are reported to be in operation, while 2,269 hackspaces are reported globally.4

Research in 2011 showed that out of a total of 250 survey respondents, only 10% were women. Fully 85% of respondents were based in North America and Europe (Molanan, 2012). Within the hackspaces, men generally engaged in software and hardware hacking, while women were most interested in software development. Some of the barriers to women’s participation in hackspaces were lack of interest in STEM, finding the

4 https://wiki.hackspaces.org/List_of_Hackspace_Spaces
hacker spaces male-dominated and thus intimidating or unpleasant, lack of clear outcome goals, and limited access to opportunities (Laws, 2015). While men tend to dominate hacker spaces, they are hacker spaces founded by women. Feminist hackerspaces offer an environment where women are comfortable to learn, teach, work, and collaborate. These hackerspaces recognize the struggle of other minorities and are often trans- and queer-inclusive spaces.

As women increasingly participate in hackerspaces, a backlash has emerged, female hackers are ganged, harassed, and discriminated against, especially at hacker conferences and hackerspaces. Beyond verbal abuse and misogynist behaviour, some feminist hackers have also received death threats (Toupin, 2014). Hackerspaces and makerspaces might still be a social space, informal means of improving gender balance in STEM as well as coding and digital skills, as part of a multipronged strategy for creating informal structures to integrate girls into coding and STEM. Empirical studies are needed to explore not only the potential of hackerspace, but also possible adverse consequences for women and potential solutions. Existing studies tend to be qualitative in nature, and focus on hackerspaces in the western hemisphere. More research may point to ways for women to safely benefit from hackerspaces.

35% over the past 15 years. Moreover, most women in STEM chose to study natural sciences (56%) rather than applied sciences such as computer science (29%) or engineering (27%). Interestingly, the share of women in STEM studies, including ICT majors, is lower in countries with higher gender equality: smaller percentages of women study ICTs in many European or North American countries than in Middle Eastern and Asian countries.

Alternative pathways are emerging to cultivate digital skills with more innovative pedagogic approaches: introductory computing is increasingly included in national educational curricula, and coding bootcamps, MOOCs, and hackerspaces offer alternative digital skills training and opportunities in the area of coding skills. While these new movements seem promising, there is still a lack of data and evidence-based research on the effectiveness of these alternative pathways for closing the gender gap.

2.6 / CONCLUSION

This chapter examined the status of gender gaps in basic, intermediate and advanced digital skills by reviewing the available sex-disaggregated data on high-level digital skills, as well as women’s participation in conventional and alternative STEM education. The industry demand for high-level ICT skills continues to increase, and many future jobs are expected in computing and engineering. However, from gender comparisons of the currently available data, women are far less equipped with programming and advanced digital skills. In developed countries, more men than women tend to have advanced digital skills to apply ICT skills for problem-solving or high-level tasks; more men than women tend to have advanced skills to apply ICT skills for problem-solving or high-level tasks; women are far less equipped with programming skills continues to increase, and many future jobs are expected in computing and engineering.

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To resolve those gender gaps, it is critical for more women to enter STEM education that provides a pathway to develop knowledge and skills to create and manage technologies, and to prepare for participating in the ICT industry. Nevertheless, the participation of girls and young women remains low, in STEM education and learning high-level digital skills. The analysis found only marginal gender differences in students’ STEM performance but considerable gender gaps in motivation to study STEM, self-efficacy to do well in STEM studies, and aspiration to have a career in STEM. The percentage of women studying STEM subjects has remained low, hovering around
KEY FINDINGS

- Although gains have been made, women's representation remains low across different dimensions of ICT employment, entrepreneurship, and policymaking. On average, women constitute less than 35% of ICT and related professions. However, there is wide variation by country and by ICT sub-sector, ranging from as low as 2% to as high as 60%.

- Women in ICT tend to be in junior and support rather than managerial roles. Where women have made inroads into management, they are often in staff positions rather than the line positions that constitute the main pathway to executive roles.

- Evidence from North America and Europe indicates that women leave science and engineering jobs at higher rates than men. Their reasons for doing so are contested; some researchers cite family demands, while others point to workplace discrimination.

- Women are less likely than men to start enterprises in the ICT sector.

- Women have a very low rate of leadership in ICT policymaking. Worldwide, only 28 countries have a woman ICT minister, and only 25 have a woman heading the telecom regulator.

3.1 / INTRODUCTION

To what extent are women gaining employment in ICT and related industries, and what is their representation at senior management levels? Are women engaged in digital entrepreneurship, and how does their access to business capital compare to men’s? This chapter draws on existing research and data to explore the question: What is the current status of women’s participation in ICT industry leadership around the world? We review the literature on dimensions of gender equality in leadership within the ICT industry, presenting relevant data where available, and we discuss knowledge gaps and implications. Our starting premise is that women are capable of leadership in ICT fields, and that there is often a sizable pool of talented women for existing technology jobs.

3.1.1 / WHY IS WOMEN’S EQUAL LEADERSHIP IN THE ICT INDUSTRY IMPORTANT?

The case for gender equality in technology leadership is usually presented as either an ethical argument or a business argument. From the ethical perspective, advocates note that in the digital age, technology jobs usually command more power, greater prestige, and higher pay. Those jobs are also more influential in driving economic development and producing the systems and tools that shape people’s lives (Frehill, Abreu, & Zippel, 2015; Sassler, Michelmore, & Smith, 2017). Low proportions of women in leadership means that women’s ability to have decision-making impact within the industry is limited. This argument aligns with the UN’s Sustainable Development Goals, several of which advocate gender equality in the labour force (Box 3.1). Part Two of this report presents discussions on the importance of gender-diverse participation in designing information security technology (Chapter 13), technology innovation and transfer (Chapter 17), and artificial intelligence systems (Chapter 18), as well as reflections on the tendency to devalue women’s work at all levels (Chapters 14 and 16).

Box 3.1
Women’s ICT leadership and the SDGs

While none of the SDGs refer specifically to women in the technology industry, several targets are relevant to gender equality in tech. Progress on the related indicators would contribute to an enabling environment and signal progress in bringing more women into leadership in the technology industry.

Target 5.1: End all forms of discrimination against all women and girls everywhere.

Target 5.4: Recognise and value unpaid care and domestic work through the provision of public services, infrastructure and social protection policies and the promotion of shared responsibility within the household and the family as nationally appropriate.

Target 5.5: Ensure women’s full and effective participation and equal opportunities for leadership at all levels of decision-making in political, economic and public life.

Target 5.C: Adopt and strengthen sound policies and enforceable legislation for the promotion of gender equality and the empowerment of all women and girls at all levels.

Target 8.5: By 2030, achieve full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value.
More recently, arguments have shifted to targeting organisations’ self-interest by outlining business arguments for gender equality. Proponents, backed by research, argue that diversity leads to organisational benefits, such as improved financial health and returns on investment, higher staff productivity, a healthier workforce, and more creative problem-solving (Chanavat & Ramsden, 2013; Dawson, Kernley, & Natella, 2014; Gompers & Wang, 2017a; V. Hunt, Layton, & Prince, 2015; V. Hunt, Yee, Prince, & Dixon-Fyle, 2018; ILO, 2017a; Thomas, Dougherty, Strand, Nayar, & Jaram, 2016; Vassilou et al., 2015). For example, Thomas et al. (2016) found a correlation between diversity in tech company workforces and higher revenues, profits, and market value (in the U.S. and globally). They estimated that closing the global gender leadership gap could generate up to a 0.6% increase in global GDP. Companies in the U.S. and UK with the most gender diverse teams (especially at executive level) are 21% more likely to outperform other companies on profitability, according to (Hunt et al., 2018). More inclusiveness could also help to address industry skills shortages (e.g., Hewlett & Sheraton, 2014).

3.1.2 / MEASURING GENDER EQUALITY IN THE ICT INDUSTRY

Because technology now permeates every industry sector and an increasing number of jobs, the lines have blurred noticeably, making it more difficult to precisely quantify the tech workforce. (CompTIA, 2018, p. 11)

There is no single high-tech industry; rather, new technology has transformed industries . . . and the functions of numerous occupations . . . Occupations unknown a decade earlier have become common . . . Classification schemes that rely on a single measure of technological expertise, as many do, may incorrectly rank industries and/or classify sectors. (U.S. Equal Employment Opportunity Commission, 2016, p. 4)

Gaining an understanding of the true state of gender equality in the ICT industry presents several research and data collection challenges. First, there is lack of sufficiently fine-grained gender-disaggregated, consistently collected and comparable occupational data at the sector level for most countries (Data 2x, 2017; WIT Leadership Round Table Metrics Working Group, 2016). This limits researchers’ ability to compile data at the global level and to do cross-country analyses. Most organisations do not collect and/ or share diversity data, either because they are not required to do so by law or because they are reluctant to do so (Donnelly, 2017; Evans & Rangarajan, 2017).

Secondly, significant definitional issues affect this type of research. The continually evolving nature of technology developments gives rise to questions such as, what falls within the ICT industry, what constitutes an ICT or ICT-related occupation, and what does it mean to be a leader in this context. With the tentacles of digital technology reaching into diverse sectors, there are now at least three contexts in which a person could have an ICT-related occupation: 1) within the formal ICT industry; 2) within the informal ICT industry (e.g.; unregistered microenterprises, black market); and 3) within existing ICT sectors that make intensive use of technology (e.g., health sector). Different categorisation schemes — many of which collapse ICT sectors into general technology groupings — often make it necessary to use a technology as a proxy for ICT or to measure a narrow slice to represent the larger ICT category (Appendix D). This report is primarily concerned with gender equality in the ICT sector; particularly the formal ICT industry, where more adequate conceptualisation, research, and data collection exist. Future efforts should acknowledge and account for the informal and non-ICT contexts as well.

The definition of a leadership position also impacts what situations are captured. Leadership can be found within the ranks of people working in technical roles, but also within the broad category of management, which includes people in non-technical roles. Indeed, technology company executives often come from non-technical positions (WIT Leadership Round Table Metrics Working Group, 2016).

For a comprehensive assessment of gender equality in the ICT industry, the WIT Leadership Round Table Metrics Working Group (2016, p. 3) recommends looking at both stationary metrics (e.g., female hires relative to all hires, or percentage of women at different organisational levels) and flow metrics (e.g., women promoted relative to all promotions, or attrition rates among women and men). This level of granularity — especially of flow data — is mostly unavailable through global public data sources, although individual organisations may have such data in their administrative records. We therefore focus on recruitment, retention, advancement, and work environment trends for industry in general, referring to specific data on the ICT industry where available.


distributed with regional or country-specific data to signal the general status of women in the ICT industry.

For a comprehensive assessment of gender equality in the ICT industry, the WIT Leadership Round Table Metrics Working Group (2016, p. 3) recommends looking at both stationary metrics (e.g., female hires relative to all hires, or percentage of women at different organisational levels) and flow metrics (e.g., women promoted relative to all promotions, or attrition rates among women and men). This level of granularity — especially of flow data — is mostly unavailable through global public data sources, although individual organisations may have such data in their administrative records. We therefore focus on recruitment, retention, advancement, and work environment trends for industry in general, referring to specific data on the ICT industry where available.

6 For example, Blau, Blumrnund, and Liu (2013) demonstrate how changes to occupational coding systems can affect research results. Also see UNCTAD (2015).

7 This particularly applies to low- and middle-income countries where a high proportion of the population are employed in the informal sector (ILO, 2018).

3.2 / EMPLOYMENT – RECRUITMENT

This section covers gender-relevant recruitment trends for selected occupational skill levels, technology-related industries, and technology-related occupations, supplemented with regional or country-specific data when possible.

Figure 3.1

Percentage of women employees at three occupation skill levels, global

Source: ILOSTAT. ILO modelled estimates. Notes: ILO defines skill levels as follows: Level 1 (low) = Elementary occupations; Level 2 (medium) = Clerical support workers, Service and sales workers, Skilled agricultural, forestry and fishery workers, Craft and related trades workers, Plant and machine operators, and assemblers; Levels 3 and 4 (high) = Managers, professionals, and technicians. See ILO indicator description: http://www.ilo.org/ilostat-files/Documents/ indicators/IOGO_N.pdf

6. This report is co-produced by the ILO, ICTD, UKD, and Oceania.

7. OECD’s Digital Economy (2018) which includes people in non-technical roles. Indeed, technology company executives often come from non-technical positions (WIT Leadership Round Table Metrics Working Group, 2016).

3.2.1 / OCCUPATION SKILL LEVELS

Since leadership in the technology industry tends to require relatively high technical and/or managerial skills, it is instructive to first examine global data on women’s employment at different skill levels. This data covers all industries and does not distinguish between ICT and non-ICT occupations. Globally, women’s participation in jobs requiring high (level 3 and 4) skill levels has consistently been slightly above 40% since 2000 (Figure 3.1).
Although the data span both technology and non-technology industries, they do indicate fairly high levels of women employed in occupations that are associated with high skills, especially in Europe (51%), Oceania (50%), and the Americas (46%) (Figure 3.2). In Africa, however, progressively higher skill occupations are associated with lower proportions of women; the opposite applies in Oceania; and the numbers converge at around 35% for Asia. The picture is more mixed in Europe and the Americas, where the highest proportions of women are found at the extremes, in Level 1 and Level 3-4 jobs. Notably, there has been very little change in these trends over the last two decades, apart from a large drop in the proportion of women in low-skill (Level 1) occupations. The reasons for this drop are unclear, as it is not associated with a corresponding increase in employment at other skill levels. One possibility is that it could be an artifact of changes in data collection methods or the number of countries reporting.

Figure 3.2
Percentage of women by occupation skill level (2017)

3.2.2 / ICT INDUSTRIES AND RELATED FIELDS

Most studies of gender diversity in the technology industry focus either on specific countries (usually the U.S.), geographic locations (e.g., Europe, Silicon Valley) or large global companies (e.g., Fortune 500, FTSE100, S&P100). While individual organizations show some variation8, on average, levels of participation by women are low and the pace of change is slow. Thus, although (as the previous section notes) 40% of high-skill occupations are filled by women, it appears these jobs are mostly not in the ICT industry. The proportion of women in the U.S. technology industry, for example, remained at 22% between 2005 and 2015, according to the US Government Accountability Office (2017).

Even women technology workers were more likely to be employed outside the technology industry than within it. Similar findings were reported for Silicon Valley: women’s employment was 30% in leading tech firms compared to 49% in non-tech firms (U.S. Equal Employment Opportunity Commission, 2016). In Europe, women comprised 21% of the workers in the digital work force (Quirós et al., 2018).

A global study of 54 telecommunications companies found that most (75%) had female employment between 10% and 40% of their workforce, and only one had more than 50% (Molina, Lin, & Wood, 2015). This finding is consistent with ILO data, which show levels between 18% (Africa) and 35% (Asia) in 2016 (Figure 3.3). The 2016 median for each region was between 28% and 34% (Table 3.1). However, Table 3.1 also shows that the averages mask wide variations between countries.

Table 3.1
Percentage of women employees in telecommunications industry, by region

<table>
<thead>
<tr>
<th>REGION</th>
<th>2010</th>
<th>2016</th>
<th>MEDIAN 2016</th>
<th>LOWEST PERCENTAGE</th>
<th>HIGHEST PERCENTAGE</th>
<th>NUMBER OF REPORTING COUNTRIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa</td>
<td>35.5</td>
<td>17.9</td>
<td>33.3</td>
<td>11 (Malawi)</td>
<td>55 (Uganda)</td>
<td>13</td>
</tr>
<tr>
<td>Americas</td>
<td>35.8</td>
<td>33.2</td>
<td>33.3</td>
<td>21 (Guatemala)</td>
<td>51 (Ecuador)</td>
<td>11</td>
</tr>
<tr>
<td>Asia</td>
<td>28.1</td>
<td>35.3</td>
<td>34.4</td>
<td>5 (Pakistan)</td>
<td>50 (Mongolia)</td>
<td>18</td>
</tr>
<tr>
<td>Europe</td>
<td>32.4</td>
<td>30.5</td>
<td>32.3</td>
<td>17 (Bosnia-Herzegovina)</td>
<td>60 (Latvia)</td>
<td>36</td>
</tr>
<tr>
<td>Oceania</td>
<td>31.8</td>
<td>27.6</td>
<td>28.2</td>
<td>28 (Australia)</td>
<td>29 (New Zealand)</td>
<td>2</td>
</tr>
</tbody>
</table>

Source: ILOSTAT, ISIC level 2.
*Percent for last known year.

Source: ILOSTAT, ILO modelled estimates.
Because of the limited number of reporting countries, however, the trends displayed in Figure 3.3 are only meaningful for Europe, where multiple countries have reported consistently over the years. By 2016, only three of Europe’s 32 reporting countries had reached or exceeded parity (Figure 3.4). A closer look at changes between 2011 and 2016 shows a lot of variation at the country level: women’s share increases in some countries (15 countries), remains essentially stagnant in a few (5 countries), and decreases in others (13 countries). Similar country variations can be seen in other world regions (Table 3.1). Regional analyses therefore need to be complemented with country-level breakdowns to get a true picture.

**Figure 3.4** Percentage of women telecommunications industry employees, Europe

![Percentage of women telecommunications industry employees, Europe](image)

Source: LOSTAT. Note: Kosovo uses 2014 data; Moldova uses 2014 and 2015 data.

### 3.2.3 / EMPLOYMENT IN ICT PROFESSIONS

Several studies confirm the existence of significant occupational segregation by gender (that is, gender concentration within specific fields), in both emerging and advanced economies, with women being most concentrated in education, health, and social work (e.g., Blau, Brummund, & Liu, 2013; ILO, 2017b). Furthermore, ILO reports that occupational segregation has “increased by one-third over the past two decades” (2017, p. 1). This tendency appears to be particularly pronounced in sectors related to ICTs. For example, women make up only 21.5% of the digital workforce in Europe (Quirós et al., 2018), 34% of the technology workforce in the U.S. (CompTIA, 2017), and 17% of IT specialists in the UK (BCS, 2017). After studying trends in computer and engineering education and employment in the U.S., Sassler et al. (2017, p. 19) conclude that “even though female employment throughout the life course has become increasingly normative in American society, and computer science jobs have proliferated and generally provide good wages, the occupation is not succeeding in drawing women. Instead, the evidence suggests that something about the field of computer science is repelling rather than attracting women.” (See Chapter 5 for a discussion of reasons for women’s low representation.) The Sassler study found that women with engineering and computer science degrees were 8% and 14% (respectively) less likely to work in STEM occupations than their men counterparts, suggesting that the engineering field is attracting more recent women graduates than the computer science field. The OECD Digital Economy Outlook placed the proportion of women workers who are ICT specialists at less than 2%, compared to over 5% for men (OECD, 2017). In the cybersecurity field, a global study of 170 countries estimated that women constitute 11% of professionals (Frost & Sullivan, 2017). (For more detail on issues related to women’s participation in the information security profession, see Part Two, Chapter 9 of this report.)

Other research, however, identifies contradictory trends, such as a decrease in occupational segregation among STEM graduates (Shauman, 2017). Furthermore, within the ICT industry, some sectors may be attracting higher proportions of women — for example, in the U.S., women’s participation is only 27% in the Computer Systems Design sector, but almost 40% in Internet Publishing and Web Search Portals.

To explore this topic, we selected ICT-related professions for which some global data exists (using ILO occupational classification): ICT Professionals; Electrical and Electronic Trades Workers; and Science and Technology Researchers. Two other relevant professions, STEM Faculty and Software Developers, are also briefly discussed.

**Figure 3.5** Percentage of female employees in ICT-related occupations, regional (2016)

![Percentage of female employees in ICT-related occupations, regional (2016)](image)

Source: LOSTAT.

9 ICT specialists are defined as people whose jobs include “tasks related to developing, maintaining and operating ICT systems and where ICTs are the main part of their job” (OECD, 2017, p. 183).
### Table 3.2
Percentage of female ICT professionals (%)

<table>
<thead>
<tr>
<th>REGION</th>
<th>2010</th>
<th>2016</th>
<th>MEDIAN 2016</th>
<th>LOWEST PERCENTAGE</th>
<th>HIGHEST PERCENTAGE</th>
<th>NUMBER OF REPORTING COUNTRIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa</td>
<td>29</td>
<td>25</td>
<td>33.3</td>
<td>19 (South Africa)</td>
<td>40 (Ethiopia)</td>
<td>5</td>
</tr>
<tr>
<td>Americas</td>
<td>22</td>
<td>22</td>
<td>25</td>
<td>14 (Mexico)</td>
<td>45 (Peru)</td>
<td>11</td>
</tr>
<tr>
<td>Asia</td>
<td>24</td>
<td>26</td>
<td>30.9</td>
<td>5 (Indonesia)</td>
<td>34 (Thailand)</td>
<td>11</td>
</tr>
<tr>
<td>Europe</td>
<td>15</td>
<td>16</td>
<td>17.6</td>
<td>7 (Greece)</td>
<td>40 (Macedonia)</td>
<td>35</td>
</tr>
<tr>
<td>Oceania</td>
<td>16</td>
<td>19</td>
<td>19</td>
<td>19 (Australia)</td>
<td>-</td>
<td>1</td>
</tr>
</tbody>
</table>

Source: ILOSTAT (ISCO-08).
*Percent for last known year.

### Table 3.3
Percentage of female electrical and electronic trades workers

<table>
<thead>
<tr>
<th>REGION</th>
<th>2010</th>
<th>2016</th>
<th>MEDIAN 2016</th>
<th>LOWEST PERCENTAGE</th>
<th>HIGHEST PERCENTAGE</th>
<th>NUMBER OF REPORTING COUNTRIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa</td>
<td>8</td>
<td>11</td>
<td>8.6</td>
<td>2 (Algeria)</td>
<td>14 (South Africa)</td>
<td>4</td>
</tr>
<tr>
<td>Americas</td>
<td>8</td>
<td>2</td>
<td>4</td>
<td>2 (Mexico, Brazil, Ecuador)</td>
<td>60 (Peru)</td>
<td>9</td>
</tr>
<tr>
<td>Asia</td>
<td>29</td>
<td>7</td>
<td>3.7</td>
<td>&gt;1 (Pakistan, Turkey)</td>
<td>24 (Philippines)</td>
<td>11</td>
</tr>
<tr>
<td>Europe</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>1 (general)</td>
<td>26 (Russia)</td>
<td>29</td>
</tr>
<tr>
<td>Oceania</td>
<td>5</td>
<td>4</td>
<td>35</td>
<td>2 (Australia)</td>
<td>67 (Fiji)</td>
<td>2</td>
</tr>
</tbody>
</table>

Source: ILOSTAT (ISCO-08).
*Percent for last known year.

### 3.2.3.2 Software developers

At present, data on software developer employment is available mainly from individual countries or private surveys by the hosts of developer communities (such as Stack Overflow). OECD's intellectual property database also provides an avenue for investigating this topic, potentially covering a broader number of countries.

The software developer community appears particularly devoid of women, with potentially damaging consequences (Case Study 3.1). Analysis of a repository of intellectual property indicates that women comprise a very small proportion of R package developers (23%) and ICT patent holders (23%) in G20 countries (OECD STI, 2018). 10

10 R code is a free programming language and software environment for statistical computing (https://www.r-project.org/).
Case Study 3.1

Women's participation in online software developer communities

Author: Michael Madaio & Araba Sey (UNU-CS)

Participation in online developer communities is becoming one of the primary ways for software developers to learn new programming languages, improve their skills, develop collaborative projects, and find new job opportunities (David & Shapiro, 2008; Ford et al., 2016; Vasilescu, 2015). These communities boast millions of users — over 29 million on GitHub (2018) and over one million on Stack Overflow (2018). GitHub users contribute code to about 60 million public “repositories” on the site, which are used by recruiters in hiring decisions. Professional software developers also hone their skills by asking and answering questions on coding Q&A sites like Stack Overflow. Stack Overflow developers also gain a public reputation from answering questions, further boosting their attractiveness to recruiters. Developers are also increasingly participating in coding challenges to hone their skills and signal their coding prowess to potential employers, through sites such as HackerRank.

Among the users of Stack Overflow and HackerRank, men were nearly 15% more likely to be senior developers, nearly twice as likely to be in manager positions, and nearly four times as likely to be in executive roles. Male respondents on HackerRank were also nearly 15% more likely than women to be in hiring positions. However, women were more likely than men to be new graduates and junior developers, suggesting a newly burgeoning female software developer workforce. In addition, women on Stack Overflow were nearly twice as likely as men to fill technical roles like “data scientist” and “development operations engineer”, which were listed as the top two best-paying jobs in 2018 (GlassDoor, 2018). Thus, while women in online developer communities still face gaps in traditional leadership roles, they may be emerging as leaders in new technical developer roles.

Do women and men participate differently? On Stack Overflow, women were significantly less likely than men to have a registered account, and more likely to simply view Q&A on the site without responding or posting questions themselves. For GitHub, women were less likely than men to contribute code or “follow” other developers’ repositories. These publicly visible acts of participation are precisely the types of “signaling incentives” that have been cited as a benefit of online developer communities for hiring decisions (e.g., Lakhani & Von Hippel, 2003; Vasilescu, 2014). In fact, when developers on GitHub were asked how interested they were in contributing to open-source projects in the future, there was no noticeable difference in male and female levels of interest; but when asked how likely they were to contribute in the future, female respondents reported feeling significantly less likely than male respondents to contribute code on GitHub in the future. While online developer communities can be valuable tools for skill development and recruitment, the lower rates of female participation suggest that women may not yet be reaping the benefits of these platforms. As a result, gender gaps in online developer communities may exacerbate existing gender gaps in ICT occupations.

3.2.3.3 / Faculty and researchers

There is surprisingly little publicly available and internationally comparable data on the proportions of women faculty employed in STEM or ICT-related academic programs. Possibly the most extensive source of substitutable data is the UNESCO Institute for Statistics’ (UIS) data on female researchers, mostly in European countries. The National Science Foundation (NSF) also collects detailed information on workforce participation of college graduates in the U.S. Statistics on other parts of the world are sparse and often dated, such as a 2015 USAID report presenting statistics on the leaky STEM academic pipeline in Africa dating back to 2008 (Cummings, 2015). This section presents UIS data on the proportion of female science and technology researchers as well as research on women faculty in STEM-related programs and business schools.

When women are estimated to comprise nearly 20% of the software development workforce (Wang et al., 2018), their participation in online developer communities is only a fraction of that. In a survey of approximately 100,000 software developers using Stack Overflow, only 4% of respondents identified as female. On GitHub’s survey of 5,500 users, only 2% identified as female. HackerRank, the coding competition site, came closer to replicating the estimated gender gap in software development overall, with 16% of the 25,000 respondents identifying as female.

Do women on GitHub, women were significantly less likely than men to contribute code or “follow” other developers’ repositories. These publicly visible acts of participation are precisely the types of “signaling incentives” that have been cited as a benefit of online developer communities for hiring decisions (e.g., Lakhani & Von Hippel, 2003; Vasilescu, 2014). In fact, when developers on GitHub were asked how interested they were in contributing to open-source projects in the future, there was no noticeable difference in male and female levels of interest; but when asked how likely they were to contribute in the future, female respondents reported feeling significantly less likely than male respondents to contribute code on GitHub in the future. While online developer communities can be valuable tools for skill development and recruitment, the lower rates of female participation suggest that women may not yet be reaping the benefits of these platforms. As a result, gender gaps in online developer communities may exacerbate existing gender gaps in ICT occupations.

Female researchers in engineering and technology (2010–15)

Source: UNESCO UIS

11 UIS defines a researcher as a professional engaged in the conception or creation of new knowledge (UNESCO Institute for Statistics, 2017, p. t).

12 For example, data is available for nine African countries in 2010 and a different set of three countries in 2015.
STEM Faculty. Most of the studies carried out in North America and Europe show low proportions of women faculty in some STEM fields (often below 20%), particularly in fields related to engineering and computer science (e.g., Ling, 2017; Yoder, 2016). For example, workforce participation data from the 2013 National Science Foundation survey of doctoral recipients shows that, although women make up an equal proportion of United States graduates employed in science and engineering-related occupations in universities, they constitute only 34% of science and engineering occupations overall, and even fewer (17%) of computer and information scientists (https://www.nsf.gov/statistics/srvydoctoratework/).

Understanding the data from disparate research can be challenging; results may be contradictory or require nuanced interpretation. For example, Shauman (2017) found that women STEM graduates were more likely than men to enter tenure-track faculty positions within two years of degree completion, and equally likely to get such positions at research-intensive universities. However, while women were more likely than men to have jobs that require a doctorate, they were less likely to have research-oriented jobs. Furthermore, women graduates in engineering, mathematics, and computer science were less likely than other STEM graduates to work in business and industry. A controversial study by Ceci and Williams (2015) concluded that “women have substantial advantage in STEM careers undermines our capacity to provide adequate, scalable, replicable and sustainable solutions for gender inequalities. (Cummings, 2015, p. 2)

Business School Faculty. Business schools represent an important context preparing individuals for leadership in both the corporate world and entrepreneurship. Analyses of the Global Salary Survey (a product of AACSB International, the Association to Advance Collegiate Schools of Business) indicate low proportions of women at leadership levels, shown in Table 3.4 (Brown, 2016). In 2017/18, 75% of deans and 66% of associate deans were men, and in 2015/16, just 20% of full professors were women (AACSB International, 2016). A report by the Association of Academies and Societies of Sciences in Asia (AAASSA, 2015) reviewed the state of women in science and technology in ten Asian countries, and found generally low representation of women in academic communities. In reference to Africa, Cummings (2015) laments the scarcity of robust data on women’s representation in the STEM academic pipeline, noting that this hampers researchers’ ability to provide a clear picture of the state of the academic pipeline in Africa.

The current inadequate data related to the underrepresentation of women faculty in STEAM careers undermines our capacity to provide adequate, scalable, replicable and sustainable solutions for gender inequalities. (Cummings, 2015, p. 2).

Table 3.4 Percentage of women faculty at business schools, by region

<table>
<thead>
<tr>
<th>REGION</th>
<th>PROFESSORS</th>
<th>ASSOCIATE PROFESSORS</th>
<th>ASSISTANT PROFESSORS</th>
<th>INSTRUCTORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asia</td>
<td>13</td>
<td>27</td>
<td>38</td>
<td>50</td>
</tr>
<tr>
<td>Europe &amp; near East</td>
<td>18</td>
<td>35</td>
<td>42</td>
<td>38</td>
</tr>
<tr>
<td>Middle East</td>
<td>13</td>
<td>21</td>
<td>25</td>
<td>47</td>
</tr>
<tr>
<td>Canada</td>
<td>23</td>
<td>34</td>
<td>41</td>
<td>39</td>
</tr>
<tr>
<td>US</td>
<td>28</td>
<td>31</td>
<td>29</td>
<td>42</td>
</tr>
<tr>
<td>Latin America and the Caribbean</td>
<td>20</td>
<td>33</td>
<td>37</td>
<td>40</td>
</tr>
<tr>
<td>All regions</td>
<td>20</td>
<td>33</td>
<td>38</td>
<td>40</td>
</tr>
</tbody>
</table>

Source: Adapted from Brown (2016)

Table 3.4 / EMPLOYMENT RETENTION AND ADVANCEMENT

Official statistics on retention rates are not collected at the global level. Evidence from North America and Europe indicates that women leave science and engineering jobs up to twice as frequently as men (Aune & Santagata, 2016; Bumpertz, Durodoye, & Wilson, 2017; Hunt, 2010). Most of this research, however, examines retention rates within the broad category of science and engineering, not the ICT industry specifically. Furthermore, much of the more recent literature on retention focuses on the reasons women leave the technology industry, rather than on their rate of leaving (e.g., Annabi & Lebovitz, 2016; Bumpertz, Durodoye, & Wilson, 2017; Hunt, 2010; Servon & Visser, n.d.; Tapia & Kvasny, 2004). In Europe, Quirós et al. (2018, p. 10) assert that attrition is especially high for women aged 30-40 years: “the prime working age and... the period when most Europeans have their first child and/or have to take care of their small children.” Kahn and Ginther (2015) make a similar observation in their U.S. study. Research is needed to illuminate this topic, as much of what exists is limited in scale or scope and makes it difficult to compare churn rates for men and women technology workers, or across other types of industries. Reasons for attrition are contested; some researchers attribute it to family life demands, while others attribute it to workplace discrimination, including unequal pay, low access to advancement opportunities, dominant male culture, and unwelcoming environments. (This issue is further discussed in Chapter 4.)

According to the 2017 Global Gender Gap report (World Economic Forum, 2017), despite some gains since 2007, “every industry exhibits a leadership gender gap” and “the largest gaps are found in the STEM fields: Software and IT Services, Manufacturing and Energy and Mining” (p. 32). In the absence of global data on women managers and executives in the ICT industry, this section examines three metrics on women female leaders more generally: employment in management positions; employment in senior and middle management positions; and employment as chief executives, senior officials and legislators. It also briefly covers women in academia leadership and ICT management, drawing on scholarly and other literature.

Table 3.3.1 / GENERAL LEADERSHIP POSITIONS

While regional trends suggest that women’s employment in leadership positions is below 40% for all countries, a few countries nevertheless report close
to or above parity (Figures 3.7–3.9). Regional trends appear essentially unchanged since 2009, despite some changes in several countries. Thus, as with the indicators in the previous sections, these metrics are best examined at the country level.

Exploring the data on senior and middle management positions for the last known year, we see wide variability in all regions (Figure 3.8). In Africa, the percentage of women managers ranges from 4% (Malawi) to 44% (Seychelles), with 12 reporting countries. For the two countries with multiple year data (Mauritius and Seychelles), there is a rising trend between 2011 and 2015 of about 9% for Seychelles and 6% for Mauritius. Out of 13 countries reporting from the Americas, Uruguay has the lowest proportion of women senior and middle managers (33.7%), while the Dominican Republic has the highest (47%). Yearly data for the Americas (2011–2014) shows the proportion of women rising in two countries, remaining the same in two countries, and falling in three countries. Similar variability is seen in Asia (with 15 reporting countries), where women’s employment as senior or middle managers ranges from 4% (Pakistan) to 37% (Mongolia); the proportion is increasing in three countries, decreasing in four, and remains the same in two. Likewise, in Europe, the proportion of women increases in nine countries, decreases in 21 countries, and is stagnant in two countries. The variation in Europe for the last known year ranges from 14% (Kosovo) to 48% (Russia). Finally, in Oceania, the figures range from 33% (Australia) to 42% (Samoan); the only country with yearly data (Australia) shows a slight increase from 30% in 2010.
Figure 3.7
Female share of employment in managerial positions –
Total management

Source: ILOSTAT

Figure 3.8
Female share of employment in managerial positions –
Senior & middle management

Source: ILOSTAT

Note: Limited data from most countries. For example, number of economies reporting for 2016: Africa 2; Americas 1; Asia 9; Europe 32; Oceania 2.

Figure 3.9
Female share of employment as chief executives, senior
officials and legislators

Source: ILOSTAT

3.3.2 / LEADERSHIP POSITIONS IN THE ICT INDUSTRY

Data for the ICT industry is even less available than for general management trends. The most readily available data tends to come from a few national statistics departments. Other insights can be obtained from market research conducted by private organisations (which is often not freely available), and from academic research (addressing relatively narrow contexts). This section reviews examples of those studies covering three areas: the telecommunications industry, academies of science, and board membership. The variation in management levels, job titles, and business sectors sampled by various researchers limits the comparability of studies.

Telecommunications. A GSMA study of gender diversity in 54 telecom companies (Molina et al., 2015) showed that in all regions, women were employed in much larger proportions as entry-level staff rather than in middle and senior management positions. The largest gap was in Africa and the smallest in North America (Table 3.5). As with our observations on gender diversity in general management, the trends appear to be shifting, though from such a low level that the gap remains large. For example, the Global Telecoms Business lists the 100 most powerful people in the industry; it included 14 women in 2017 — up from only six in 2016, but still representing just 14%.
Using the European landscape, Quiros et al. (2018, p. 13) report that in 2015 the IT sector "was the only sector without women occupying CEO positions in any of the corporations in STOXX 600." Women held 9.5% of CEO positions in the Telecom Services sector; only 25% of workers in the ICT sector had women bosses, compared to 48% in non-ICT sectors. In a global study, Dawson et al. (2014, p. 3) concluded that women were more represented in senior management of "new economy" companies, although overall women tended to be in less influential management roles. Table 3.6 shows that the proportion of women senior managers in several technology-related sectors exceeds the global average — except at CEO level.

### Table 3.5
Percentage of female telecom company employees

<table>
<thead>
<tr>
<th>ENTRY LEVEL</th>
<th>MIDDLE MANAGEMENT</th>
<th>SENIOR MANAGEMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa</td>
<td>35</td>
<td>21</td>
</tr>
<tr>
<td>Middle East</td>
<td>26</td>
<td>19</td>
</tr>
<tr>
<td>Asia-Pacific</td>
<td>28</td>
<td>19</td>
</tr>
<tr>
<td>Europe</td>
<td>43</td>
<td>30</td>
</tr>
<tr>
<td>North America</td>
<td>40</td>
<td>37</td>
</tr>
</tbody>
</table>


### Table 3.6
Women in senior management – Technology companies

<table>
<thead>
<tr>
<th></th>
<th>CEO</th>
<th>Operations</th>
<th>CFO/Strategy</th>
<th>Shared Services*</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tech – hardware</td>
<td>3.4</td>
<td>3.4</td>
<td>17.3</td>
<td>8.5</td>
<td>7.1</td>
</tr>
<tr>
<td>Telecoms</td>
<td>4.9</td>
<td>9.8</td>
<td>18.3</td>
<td>24.2</td>
<td>15.4</td>
</tr>
<tr>
<td>Tech – other</td>
<td>0</td>
<td>8.2</td>
<td>22.5</td>
<td>42.1</td>
<td>16.4</td>
</tr>
<tr>
<td>Tech – software</td>
<td>3.3</td>
<td>18.9</td>
<td>17</td>
<td>31.6</td>
<td>19.5</td>
</tr>
<tr>
<td>Global Average</td>
<td>3.9</td>
<td>8.6</td>
<td>17.5</td>
<td>18.9</td>
<td>12.9</td>
</tr>
</tbody>
</table>

Source: Dawson et al., 2014, p. 15.
Note: * HR, Legal, IT, External Relations

Data from the U.S. Bureau of Labor Statistics indicates that women currently make up about 29% of Computer and Information Systems managers. Similarly, the Equal Employment Opportunity Commission (2016) found that women comprised 20% of Executives, Senior Officials, and Managers in the high-tech industry in 2014. This percentage had not changed much by 2015; the U.S. Government Accountability Office (2017) reports that women occupied 19% of senior management positions in technology sector companies, and that this has essentially been unchanged since 2007. Bell and White (2014), on the other hand, conclude that progress has been made towards having more women in top positions over the past two decades, although they are still underrepresented. Overall, women tend to be in junior and support rather than managerial roles. Where women have made inroads into management, they are often in staff positions, rather than the line positions which constitute the main pathway to executive roles (Molina, Lin & Wood, 2015; United States Government Accountability Office, 2017; World Economic Forum, 2017). These trends appear to be repeated in the new industries developing around artificial intelligence (Case study 3.2; Parsheera, 2018).
Case Study 3.2Where are the women? Gender disparities in AI research and development
Author: Mike Best & Dhaval Modi (UNU-CS)

The artificial intelligence (AI) community has a diversity problem. Kate Crawford, a Microsoft researcher and NYU professor, asserts that AI has a “white guy problem” (Crawford, 2016). She explains why this matters: “Like all technologies before it, artificial intelligence will reflect the values of its creators. So inclusivity matters. . . . Otherwise, we risk constructing machine intelligence that mirrors a narrow and privileged vision of society, with its old, familiar biases and stereotypes.”
The low level of female presence among AI researchers, developers, and thought leaders epitomises this diversity challenge. Hannah Wallach, a Microsoft-based AI researcher and founder of Women in Machine Learning (WiML), estimates that the entire field of machine learning is only 13.5% female (Weissman, 2016). To better amass evidence as to this gender disparity, we have accumulated data on women participation in leadership among top AI companies, as well as scholarly presence among the top U.S.-based university computer science faculty.

To calculate the percentage of women in executive management at leading AI startups, we began with CB Insights’ 2018 “AI 100”, their ranking of the top 100 promising start-ups in Artificial Intelligence (https://www.cbinsights.com/research/artificial-intelligence-top-startups/). CB Insights’ 2018 “AI 100” list includes companies from the U.S., Canada, the UK, France, Spain, Japan, China, Taiwan, and Israel (https://www.cbinsights.com/research/artificial-intelligence-top-startups/). We were able to establish the gender balance among executive management for 95 of these companies. (One C-level manager is identified as non-binary and is not categorised here.) Only two companies have equal numbers of women and men in their C-level positions and none are majority female. Three in five have less than 20% women in their leadership team, and one in five have no females at all. Women overall made up 18% of these AI leaders.

3.3.3 / LEADERSHIP ON BOARDS

A similar trend of low representation of women is seen with board membership (Deloitte & Alliance for Board Diversity, 2016; Institutional Shareholder Services, Inc & Regulation, 2017; Quiros et al., 2018). However, it is unclear whether the situation is worse in the ICT industry than in other areas. Some data are difficult to interpret, due in part to varying definitions and the diversity of industry sectors. Adams and Kirchmaier (2016) studied data for listed firms in 20 countries and found that firms in STEM and Finance sectors had 1.8% fewer women on boards than firms in non-STEM sectors. In cybersecurity, men are four times more likely than women to hold executive-level positions, and nine times more likely to hold managerial positions (Frost & Sullivan, 2017). Women comprise 9% and 15% respectively of directors and executive officers in Canada’s technology industry (MacDougall et al., 2017), while according to Bell (2016), Silicon Valley firms have relatively low proportions of women directors, at 14% (compared to 23% for large public companies).

Table 3.7
Percentage of women on boards, by industry

<table>
<thead>
<tr>
<th></th>
<th>2010</th>
<th>2013</th>
<th>0</th>
<th>&lt;10%</th>
<th>10% - 20%</th>
<th>20% - 30%</th>
<th>&gt;30%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology</td>
<td>8.1</td>
<td>10.9</td>
<td>40.8</td>
<td>7.9</td>
<td>32.1</td>
<td>15.8</td>
<td>3.4</td>
</tr>
<tr>
<td>Telecoms</td>
<td>11.1</td>
<td>14.2</td>
<td>34.1</td>
<td>12.2</td>
<td>22</td>
<td>20.7</td>
<td>11</td>
</tr>
<tr>
<td>Total</td>
<td>9.6</td>
<td>12.7</td>
<td>33.7</td>
<td>11.1</td>
<td>31.4</td>
<td>16.9</td>
<td>6.9</td>
</tr>
</tbody>
</table>

Source: Dawson et al., 2014, p. 10.

These mixed findings complicate any analysis of gender equality in board membership of ICT companies. Furthermore, board size impacts diversity as well, as the boards of larger companies tend to be more gender diverse than those of smaller and younger companies (Bell, 2016; Brush, Greene, Balachandra, & Davis, 2014). This suggests that understanding and measuring board diversity may require more than simple headcounts.

Figure 3.10
Women in senior management – Technology companies

We computed the percentage of female professors at top U.S.-based university AI programs, based on the top 20 programs listed in the US News & World Report 2018 ranking of best artificial intelligence graduate programs (https://www.usnews.com/best-graduate-schools/top-scienceschools/artificial-intelligence-graduate). We calculated the number of faculty members (including adjuncts) from each university’s website and from laboratory staff listings (e.g., for Stanford University), as well as from research interests as stated on faculty websites (e.g., Carnegie Mellon). We were able to obtain faculty gender information for all but two programs (UCLA and Cal Tech). The average percentage of female AI faculty was 22%, ranging from 8% (University of Pennsylvania) to 43% (Harvard). No university had achieved gender parity among its AI faculty.
3.3.4 / ACADEMIES OF SCIENCE

Analysis of data from the European Institute for Gender Equality (EIGE) shows that in the 28 EU member states, women comprise less than 22% of membership and less than 16% of presidents or chairs of the highest decision-making body in national academies of science (EIGE database, 2017). Only eight countries have women presidents or chairs. Similar trends likely prevail elsewhere; a survey by the Academy of Science of South Africa (2015) finds that, globally, women make up only about 12% of the membership of science academies. The highest proportion was at the Cuban Academy of Sciences (27%) and the lowest at the Polish and Tanzanian Academies of Sciences (4% each). Women constitute 12% of elected Fellows of The World Academy of Sciences (TWAS) and 32% of its Young Affiliates programme (The World Academy of Sciences, 2018). As Table 3.8 shows, the distribution of women TWAS fellows across different disciplines mirrors the tendency for women science scholars to be concentrated in the medical and social sciences.

Table 3.8
The World Academy of Sciences Fellows

<table>
<thead>
<tr>
<th>FIELD</th>
<th>NUMBER OF FEMALES</th>
<th>NUMBER OF MALES</th>
<th>PERCENTAGE OF FEMALES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social &amp; economic sciences</td>
<td>12</td>
<td>32</td>
<td>27%</td>
</tr>
<tr>
<td>Medical &amp; health sciences including neuroscience</td>
<td>20</td>
<td>124</td>
<td>19%</td>
</tr>
<tr>
<td>Structural cell &amp; molecular biology</td>
<td>21</td>
<td>116</td>
<td>15%</td>
</tr>
<tr>
<td>Agricultural sciences</td>
<td>18</td>
<td>85</td>
<td>17%</td>
</tr>
<tr>
<td>Biological systems &amp; organisms</td>
<td>14</td>
<td>70</td>
<td>17%</td>
</tr>
<tr>
<td>Chemical sciences</td>
<td>16</td>
<td>142</td>
<td>10%</td>
</tr>
<tr>
<td>Astronomy, space and earth sciences</td>
<td>15</td>
<td>117</td>
<td>11%</td>
</tr>
<tr>
<td>Physics</td>
<td>14</td>
<td>167</td>
<td>8%</td>
</tr>
<tr>
<td>Mathematical sciences</td>
<td>7</td>
<td>106</td>
<td>6%</td>
</tr>
<tr>
<td>Engineering sciences</td>
<td>5</td>
<td>112</td>
<td>4%</td>
</tr>
</tbody>
</table>

Note: out of 58 positions. Most countries have just one leadership position per academy, but may have several academies.

15 Note: out of 58 positions. Most countries have just one leadership position per academy, but may have several academies.

16 A “global science academy dedicated to building science in the developing world” (TWAS website), with membership from 100 countries.

3.4 / ENTREPRENEURSHIP

While some of the issues women face in the ICT employment realm may also apply to their participation in digital entrepreneurship, other issues are unique to women entrepreneurs. Access to venture capital is one that has received considerable attention in recent months, as data reveals how little such capital is available to women entrepreneurs. However, there is still limited data on this and other relevant issues (Kuschel & Lepelay, 2016). Thus, we use indicators relating to women entrepreneurship broadly, with a few additional sources about the ICT industry. The discussion below covers women’s participation in ownership of businesses, access to business training, and access to business capital.

3.4.1 / FIRM OWNERSHIP

Globally, the gender gap in entrepreneurship has narrowed since 2014; however, women are less likely than men to start enterprises in the ICT sector (Kelley et al., 2017). Women constitute only 6% of information technology entrepreneurs in the U.S. (Kompers & Wang, 2017b); Europe has a higher proportion of women entrepreneurs in the ICT industry, at 23% (Ouirou et al., 2018).

The data presented below relates to women’s participation in ownership of firms in general, in the absence of global data on women’s ownership of technology or ICT firms. (Note, however, that relatively few countries report even this: 10% of countries in Oceania, 47% in Europe, 61% in Africa, 64% in Asia, and 63% in the Americas.) The available data shows that less than 50% of firms have at least one woman owner (Figure 3.11). Data collected by the Global Entrepreneurship Monitor (2015 dataset) shows a higher proportion of men entrepreneurs in most countries. That entrepreneurial gender gap ranges from 5% in the Philippines — where women are more likely than men to be engaged in entrepreneurial activity — to —11% in Lebanon, where men are more likely than women to be engaged in entrepreneurial activity. Women exhibit more entrepreneurial behaviour than men in six countries, of which five are in Asia.

At the country level, we see an entrepreneurship paradox similar to the education paradox mentioned in Chapter 2: the lower a country’s level of socio-economic development, the smaller the gender gap in entrepreneurship seems to be. However, women entrepreneurs in lower-income countries are more likely to be driven by necessity rather than opportunity motives (Kelley et al., 2017; OECD, 2012), and this can compromise the long-term sustainability and growth of their ventures. There is also insufficient data to determine whether women venture into digital entrepreneurship. Some evidence suggests that the digital economy has generated opportunities (such as airtime sales, phone repairs, data entry, community information services, and call centres) for women entrepreneurs in developing countries; see, for example, Heeks (2005) and UNCTAD (2014). However, more data is needed to determine the relative proportion of men to women in these enterprises, and whether there are differences in the conditions under which they work.

Figure 3.11
Percentage of firms with women participating in ownership

Note: Variable data availability for different regions.

17 The reasons for this are beyond the scope of this report, but some relevant factors may be found in the entrepreneurship literature.
3.4.2 / ACCESS TO BUSINESS TRAINING

Most discussions of gender gaps in ICT entrepreneurship tend to approach the subject from the perspective of access to the appropriate technical training, with less attention being paid to obtaining the requisite business skills. Most ICT entrepreneurs require business knowledge to be successful in running the enterprise and, importantly, to raise business capital. Indeed, an interest in business — instead of an interest in technology — represents an alternative route to digital entrepreneurship.

OECD data indicates that women generally have less access than men to training on how to start a business (Figure 3.12). The tendency is the same in the six non-OECD economies included in the dataset. Only in four countries (Mexico, Estonia, Australia, and Sweden) are women equal to or slightly more advantaged than men with regard to such training. The gap is highest in Luxemburg (19% more men) and lowest in Sweden (3% more women).

---

3.4.3 / ACCESS TO BUSINESS CAPITAL

Access to capital is critical for entrepreneurs, regardless of business size. Some indication of ability to secure capital can be gleaned from data on the use of formal financial instruments by the general population. This section presents OECD data, on access to capital to start a business, as well as World Bank data, on ownership of a bank account, saving, and borrowing from a financial institution.

Overall, women are disadvantaged in access to financial services that could facilitate access to business capital. In most OECD countries, women are less likely to have access to capital to start a business compared to men (Figure 3.13).

Levels of financial inclusion are low for both men and women in Asia, the Americas, and Africa. Even so, all regions except Oceania exhibit a gender gap in favour of men, though very narrow in some cases (Figures 3.14–3.16). The gap in account ownership ranges from 2% (Europe) to 11% (Africa). The gap in saving activity ranges from 3% (Asia) to 5% (Americas). And the gap in borrowing activity ranges from 2% (Africa) to 3% (Europe). In the two Oceania countries represented, women have equal access to bank accounts, they are more likely to save than men, and they are more likely to have borrowed from a financial institution. Globally, a pilot survey of 28 central banks and other regulators found that 40% of account holders and borrowers are women (IMF, 2018).
3.4.4 / ACCESS TO VENTURE CAPITAL

The availability of venture capital (VC) investment provides a view on the experience of women trying to start ventures in the ICT industry, since a majority of venture capital goes into the ICT and related sectors (Ernst & Young, 2015). The U.S. (and especially the San Francisco Bay area) receives almost three-quarters of global venture capital (Ernst & Young, 2015), and a majority of this goes to the software (36%) and biotechnology (17%) sectors (NVCA, 2016).

Data on entrepreneurs’ access to venture capital is only recently becoming public. It shows that investment in businesses with women partners has increased but still remains low, and women-run companies receive a dismal proportion of venture capital. Brush et al. (2014) examined a database of 6,793 VC recipients in the U.S. between 2011 and 2013 and found that over 15% of the companies had a woman on the executive team, up from less than 5% in 1999. However, only 2.7% of the companies had a woman CEO, and those companies only received 3% of total VC investments (see also: Bradley, Gicheva, Hassell, & Link, 2013; and Scott, Kapor Klein, McAlister, Martin, & Koshy, 2018). A study of 58 investment funds that ascribe to gender-lens investing found, on the positive side, that 59% of these funds had all-women partners (compared to the industry norm of 7%). However, they also noted “an inverse relationship between fund size and the proportion of women fund partners or investment committee members: the more women at the top, the less capital raised” (Biegel, Hunt, & Kuhlman, 2017, p. 6). Similarly, Quiros et al. (2018) observed that in Europe, wholly woman-owned startups received less than 5% of all VC deals in 2016 — an improvement over previous years — and that in the UK, for example, men entrepreneurs were 86% more likely to obtain VC funds than women (p. 12).

A lack of diversity can also be seen within venture capital firms, with very few women venture capitalists. For example, a review of 160 venture capital firms in the UK found that only 13% of partners were women; 48% of investment teams had no women (Diversity VC, 2017). Likewise, Scott et al. (2018) report that women constitute just 11% of investment professionals in the U.S. This is important if, as some evidence suggests, VC firms with women partners are more likely to invest in businesses with women managers or CEOs, compared to VC firms with women in their management teams (Brush et al., 2014).
3.5 / POLICYMAKING

The dearth of gender perspectives in the technology industry could potentially be addressed by including more women in senior policymaking positions, not only in technology organisations but also in political institutions.

Table 3.9
Proportion of seats held by women in national parliaments

<table>
<thead>
<tr>
<th>Region</th>
<th>Single House or Lower House</th>
<th>Upper House or Senate</th>
<th>Both Houses Combined</th>
</tr>
</thead>
<tbody>
<tr>
<td>Americas</td>
<td>28.8</td>
<td>29.5</td>
<td>28.9</td>
</tr>
<tr>
<td>Europe</td>
<td>27.6</td>
<td>27</td>
<td>27.5</td>
</tr>
<tr>
<td>Sub-Saharan Africa</td>
<td>23.9</td>
<td>23.1</td>
<td>23.8</td>
</tr>
<tr>
<td>Asia</td>
<td>19.7</td>
<td>17.5</td>
<td>19.5</td>
</tr>
<tr>
<td>Arab States</td>
<td>18.5</td>
<td>12.6</td>
<td>17.7</td>
</tr>
<tr>
<td>Pacific</td>
<td>15.5</td>
<td>37.1</td>
<td>17.9</td>
</tr>
</tbody>
</table>

Source: Inter-Parliamentary Union, April 2018, [http://archive.ipu.org/wmn-e/arc/world010418.htm](http://archive.ipu.org/wmn-e/arc/world010418.htm)

3.5.1 / PARTICIPATION IN NATIONAL GOVERNANCE

At the level of national governance, gender diversity is already low, as seen in the proportion of seats held by women in national parliaments (Table 3.9). All regions have less than 30% representation of women.

Table 3.10
Proportion of female heads of policymaking agencies

<table>
<thead>
<tr>
<th>Region</th>
<th>ICT Ministry</th>
<th>Telecom Regulator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Americas</td>
<td>20%</td>
<td>23%</td>
</tr>
<tr>
<td>Africa</td>
<td>14%</td>
<td>9%</td>
</tr>
<tr>
<td>Europe</td>
<td>13%</td>
<td>13%</td>
</tr>
<tr>
<td>Oceania</td>
<td>7%</td>
<td>23%</td>
</tr>
<tr>
<td>Asia</td>
<td>2%</td>
<td>6%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>12%</td>
<td>13%</td>
</tr>
</tbody>
</table>

Source: UNU-CS desk research, June 2018

3.5.2 / PARTICIPATION IN ICT-RELATED POLICYMAKING AGENCIES

Public information is available relating to two key types of ICT-related government agencies — ICT ministries and telecommunications regulators. Worldwide, only 28 out of 203 countries have a woman in charge of the ICT ministry (Table 3.10). Nearly 88% of ICT ministers are men (Figure 3.17). Africa and the Americas have the highest percentage of ICT ministries led by a woman (17% and 23%, respectively).

Figure 3.17
Countries with a woman in charge of the ICT ministry

Source: UNU-CS desk research, June 2018
The 28 countries with a woman ICT minister in 2018 were: Algeria, Barbados, Benin, Bolivia, Burkina Faso, Cameroon, Chad, Chile, Colombia, Cyprus, El Salvador, Estonia, Finland, Ghana, Guyana, Jordan, Monaco, Montenegro, New Zealand, Portugal, Puerto Rico, Sint Maarten, South Africa, Sudan, Switzerland, Togo, Trinidad and Tobago, and Uruguay.

Similarly, in 2018, only 25 countries had a woman heading the telecommunications regulator (Figure 3.18). The Americas and Oceania have the highest percentage of woman telecommunication regulators (23% in each region). The 25 countries with a woman as head of the telecommunications regulator were: Argentina, Australia, Chile, Denmark, El Salvador18, Finland, Guyana, Hong Kong, Hungary, Japan, Liberia, Macau, Macedonia, Namibia, Niger, Norway, Paraguay, Puerto Rico19, Samoa, Sint Maarten, Slovenia, Suriname, Uganda, Vanuatu, and Zambia.

**Figure 3.18**
Countries with a woman in charge of the telecommunications regulator

18 The head of El Salvador’s telecommunications regulator is also the Minister of Communications and Information Technology (ICT).
19 The head of Puerto Rico’s telecommunications regulator is also the Minister of Communications and Information Technology (ICT).

### 3.6 / CONCLUSION

This chapter reviewed data and research on women’s employment in the ICT workforce, women’s contribution to the industry as entrepreneurs, and women’s inclusion in related policymaking. The results suggest that, although gains have been made over the years, women’s representation is low across different dimensions. While more and more women are holding highly skilled jobs, few of them are in ICT-related fields; however, we see wide variation by country. Within ICT and STEM occupations, women are nearly absent from software development, in engineering and technology research, and in university teaching. There is a high rate of women leaving science and technology jobs, whether due to the lack of work-life balance frequently found in male-dominated fields or to a range of gendered obstacles to achieving their career goals. Few women are found at any level of technology leadership, and those tend to serve in subordinate roles with little chance for advancement. Women are also less likely to become ICT entrepreneurs; they generally lack training in business startups and have very little access to venture capital. Most seriously, they have a very low rate of representation in science and technology policy making.

However, the severe lack of relevant data makes it difficult to reach an accurate assessment of the global situation. European and North American countries tend to have the most ICT-specific data; and even there, the data is variable and often requires nuanced interpretation.
KEY FINDINGS

- Greater female inclusion in ICT access, skills, and leadership could become associated with increased exposure to undesirable experiences, unless that inclusion is accompanied by corresponding changes in the social and institutional cultures that enable or tolerate negative behaviour.
- About 73% of women have already been exposed to or have experienced some form of cyber violence.
- Most countries have legislation against workplace-related sexual harassment. However, as of 2018, the majority (65%) of reporting countries have no sexual harassment legislation for schools and 83% have no legislation covering public spaces.
- Evidence on gender pay gaps within the technology industry is contextual and sometimes contradictory.
- A masculine-oriented work model pits work-devotion against family-devotion, and the associated tension can lead to overload among women in ICT professions.
- In theory, most countries have legal provisions to support working mothers; however, it is unclear the extent to which this legislation is helping attract and keep women in the ICT industry.

4.1 / INTRODUCTION

Promoting digital gender equality means more than women’s capabilities to access, meaningfully use, and create ICTs. Neither does it mean merely opening doors to enable women to participate on an equal footing with men, as workers, employers, or decision-makers in the digital economy. For all its advantages, the digital age comes with gender-related risks and pitfalls; some are an extension of already existing dangers, while others are a direct response to women’s increasing connectivity and visibility in male-dominated spaces. Greater female inclusion in the EQUALS Partnership action areas can become associated with increased exposure to undesirable experiences — unless that inclusion is accompanied by corresponding changes in the social and institutional cultures that currently enable or tolerate negative behaviour. Areas of concern include cyber violence against women and girls, sexual harassment in educational and employment settings, education- and work-related discrimination, and work and life balance. Other potentially relevant issues, such as internet addiction, risky online behaviours like sexting, or human exploitation, are not covered in this report. (See Unwin (2017) for a detailed discussion of the dark side of internet access.)

4.2 / CYBER VIOLENCE AGAINST WOMEN AND GIRLS

In 2015, the Broadband Commission sounded the alarm on the emerging threat of Cyber Violence Against Women and Girls (Cyber VAWG). At present, there is no globally agreed-on definition for cyber VAWG, as the issue is evolving together with its scope (Box 4.1). Accounting for instances of technology-enabled gender-based violence is complicated, and no single measure adequately captures its complexities. Hinson et al. (2017) note, that while existing tools such as the Cyber Psychological Abuse Scale and the Revised Cyber Bullying Inventory provide tangible methods, they are limited in that they measure specific cases of technology-enabled GBV and have been tested mostly in developed-country settings. However, different stakeholders have started laying the groundwork for developing valid and reliable measures. For example, the World Bank Group and the Sexual Violence Research Initiative have engaged the Centre for Research on Women to develop a way to measure technology-facilitated gender-based violence (GBV) on a global scale.
in developed countries, have served to highlight the perspective. High-profile cases of cyber VAWG, often online privacy and violence in Brazil, from a youth Part II Chapter 3 for qualitative research results on and anecdotal rather than global in scope. (See cyber VAWG is mostly issue- and country-specific, other reasons. At present, evidence on the extent of tend to be under-reported because of the associated international repository of data on cyber VAWG. Where data is available, the proportion of ever-partnered women and girls subjected to IP or non-IP physical, sexual, or psychological violence by a current or former intimate partner in the previous 12 months, by form of violence and by age. Even for physical VAWG, there is a lack of country coverage. Where data is available, the proportion of women and girls subjected to IP or non-IP physical, sexual, or psychological violence varies in range across different countries and regions (Figures 4.2 and 4.3).

Even for physical VAWG, there is a lack of country coverage. Where data is available, the proportion of women and girls aged 15 years and older subjected to sexual violence by persons other than an intimate partner in the previous 12 months, by age and place of occurrence.

4.2.1 / LEVELS OF CYBER VAWG

Tracking cyber VAWG is tricky because of the evolving nature of technology and the evolving kinds of cyber VAWG that can emerge. In the EU, it is estimated that one in ten women have already experienced a form of cyber violence since the age of 15 (EIGE, 2017). Global data is harder to come by, with no single international repository of data on cyber VAWG. Where data are available, the issue of under-estimation is also a concern, as cases of harassment and abuse tend to be under-reported because of the associated stigma and shame attached to being a victim, among other reasons. At present, evidence on the extent of cyber VAWG is mostly issue- and country-specific, and anecdotal rather than global in scope. (See Part II Chapter 3 for qualitative research results on online privacy and violence in Brazil, from a youth perspective.) High-profile cases of cyber VAWG, often in developed countries, have served to highlight the problem of cyber VAWG and help to galvanise deeper investigation and action on the topic (Box 4.2).

4.2.2 / PHYSICAL VIOLENCE AGAINST WOMEN

The closest indicators with global coverage that can give a sense of the issue of cyber violence are the indicators for physical violence against women — intimate-partner (IP) and other — that are tracked as part of the SDGs (Figure 4.1). The World Health Organisation (2013) estimates that one in three women throughout the world will experience physical and/or sexual violence by a partner or sexual violence by a non-partner in their lifetime. While offline and online violence are different, offline violence indicators can be used as a proxy indicator, as cyber VAWG forms part of the continuum of exploitation that women and girls encounter as a result of an unequal society. In fact, the Broadband Commission (2015) notes that cyber violence is as harmful as physical violence or sexual abuse.

Box 4.1 Definitions of cyber VAWG

- The Broadband Commission (2015) defines cyber VAWG as “any act of gender-based violence that results in, or is likely to result in, physical, sexual or psychological harm or suffering to women, including threats of such acts.”
- The European Institute for Gender Equality (2017) includes the following acts as some forms of cyber VAWG: cyber stalking, non-consensual pornography (or “revenge porn”), gender-based slurs and harassment, “slut-shaming”, unsolicited pornography, “sexortion”, rape and death threats, “doxing”, and electronically enabled trafficking.
- Women’s Aid takes a broader view of the problem of cyber VAWG by looking at two broad categories of cyber VAWG: (1) online abuse — the use of the internet or other electronic means to direct abusive, unwanted, and offensive behaviour at an individual or group of individuals; (2) online harassment and stalking — the use of the internet or other electronic means to stalk or harass an individual, group of individuals, or organisation (Laxton, 2014). Online violence against women is also referred to as technology-facilitated gender-based violence (GBV).
- Other threats or acts that can fall under the scope of cyber VAWG include hate speech (publishing a libel), hacking (intercepting private communications), identity theft; online stalking (criminal harassment); and uttering threats. It can also entail persuading a target to end their life (counselling suicide or advocating genocide).
- While the terms cyber VAWG or technology-enabled GBV provide convenient anchor terms to frame online abuse and harassment faced by women and girls, these types of dangers are dissimilar in degree and scope. Each of these problems may require specifically tailored policy responses and policy actions.

Box 4.2 Tracking cyber VAWG

In spite of the lack of global data on cyber VAWG, the following types of cyber VAWG have been documented.

Online harassment. Amnesty International notes that Twitter is a “toxic place for women”, based on the survey conducted in the UK: 78% of women responded that women cannot share their opinions without receiving online vitriol, including death threats, rape threats, and racist attacks. In the U.S., it is found that 21% of women aged 18-29 have been sexually harassed online, double the share of men (9%) in the same age group, although overall, men (44%) are more likely to experience online harassment than women (37%) (Pew Research Center, 2017).

Non-consensual pornography/ image-based abuse/ revenge porn. The widespread use of social media and image-capturing devices enable graphic forms of harassment. The first academic study of the subject, in Australia, revealed that one in five people are victims of revenge porn (Henry, et al., 2017). While women (22%) and men (23%) were equally likely to be victimised in general, women were more likely to be victimised by an intimate or ex-partner and were also more likely than men to have a stranger take a sexual image of them without permission. In South Korea, almost 5,200 sexual harassment cases involving spy-cam footage were reported in 2016; over 80% of the victims were women. In the UK, a Revenge Porn Helpline was launched in 2015 to respond to the severity of the issue. In most cases, the abuse aimed to control, intimidate, or gain monetary or sexual gratification from the victim.

Cyber bullying. Sex-deaggregated data on cyber bullying are sparse and limited in coverage. In the U.S., the Cyberbullying Research Centre has been collecting data related to cyberbullying. A survey of a nationally-representative sample of 12-17-year-olds across the U.S. shows that 36.7% of females have been cyberbullied, higher than the rate for males (30.5%) (Hinduja & Patchin, 2014).

Figure 4.1 SDG Indicators related to Violence Against Women and Girls

Indicator 5.2.1 Proportion of ever-partnered women and girls aged 15 years and older subjected to physical, sexual or psychological violence by a current or former intimate partner in the previous 12 months, by form of violence and by age.

Indicator 5.2.2 Proportion of women and girls aged 15 years and older subjected to sexual violence by persons other than an intimate partner in the previous 12 months, by age and place of occurrence.

Figure 4.2 Percentage of women subjected to physical and or sexual violence by a current or former intimate partner in the previous 12 months. (most recent year, 2005–2016).
Beyond the UN data on intimate and non-intimate-partner violence, some other organisations collect data on cyber VAWG. The EU Agency for Fundamental Rights (European Union) deployed a survey in 2014 which included questions on cyber stalking and cyber harassment. In the U.S., the Pew Centre conducted a survey on online harassment in 2017. In developing countries, attempts to measure the problem are mostly spearheaded by NGOs and are donor-funded. For example, the Women’s League Bureau (2015) through the Association for Progressive Communication has carried out research and country case studies on online gender-based harassment. In Pakistan, the Digital Rights Foundation’s Hamara Internet project in 2017 included attempts to measure women’s experiences of online violence. The study revealed that 40% of women in Pakistan had faced various forms of harassment on the internet, and most complaints related to harassment on Facebook. In all these studies, the figures reported are likely to be underestimates, due to the issue of under-reporting.

4.2.3 / RESPONDING TO CYBER-VAWG

While reliable data is lacking on the incidence of cyber violence against women, international organisations track legislation that can help address this problem. The UNCTAD Global Cyberlaw Tracker maps the status of cyberlaws in 194 UNCTAD member states, focusing on the state of e-commerce legislation in the fields of e-transactions, consumer protection, data protection or privacy, and cybercrime. As of May 2018, 140 countries or 72% of the 194 member states have enacted legislation related to cybercrime, and 112 countries — 58% of countries worldwide — have enacted laws related to data privacy and protection (Table 4.1).

Europe leads the other regions in terms of enacting cybercrime legislation, with 43 countries having passed a law related to cybercrime. Only the Vatican has no data reported. Out of the 35 countries with no cybercrime law, 15 are in Africa, 8 in Oceania, and 6 each in Asia and the Americas (Figure 4.4).
Despite existing legal frameworks, reporting of cybercrime cases can be challenging for women, as social obstacles can prevent them from accessing the justice system. In Pakistan for example, reporting online harassment requires disclosing one's phone number and identity card, which can expose victims to further harassment. Moreover, leaving the house to visit the local police office would often require the accompaniment of a male guardian, which can be problematic if the perpetrator is a relative (Toppa, 2017).

In broader terms, we can also examine data on national legislation that addresses all types of violence against women and girls. The Women, Business and the Law Report (World Bank Group, 2018) collates data on various measures of gender discrimination that affect women's full participation in the economy, viewed from a legal perspective. More than 50% of countries globally have enacted legislation against domestic violence. More than half of the countries with no domestic violence legislation are located in Africa, where 26 countries have yet to pass such legislation (Figure 4.6).

Violence against women and girls comes in different forms — economic, sexual, emotional, and physical. Out of 189 countries surveyed in the World Bank report, the type of abuse with least legislation is economic violence, followed by sexual violence, emotional violence, and finally physical violence (Figure 4.7).
4.3 / SEXUAL HARASSMENT

In recent years, several gender-related scandals in the technology industry have dominated the news headlines, pointing to a culture of gender-based discrimination and harassment that discourages women from pursuing technology careers or that makes professional life challenging for those who stay. Although sexual harassment is often discussed in the context of the workplace, other areas such as public education and the public sphere are increasingly becoming recognised as sites of harassment (National Academies of Sciences, Engineering, and Medicine, 2018; World Bank, 2018).

Increased access to ICTs unfortunately means increased potential to experience sexual harassment, not only through cyber violence but also in offline spaces such as cybercafes. Likewise, increased access to educational and professional opportunities in male-dominated STEM and related areas also increases the possibility of encountering unwelcoming or hostile masculine environments. These environments act as barriers to entry or access for some females, and as physical and psychological burdens to those who choose or need to endure them. For example, one in ten female tech job leavers in the U.S. reported having experienced unwanted sexual attention in their last job (Tech Leavers Study, 2017). A similar problem affects men, as one in twelve men in the same study had also received unwanted sexual attention.

According to National Academies of Sciences, Engineering, and Medicine (2018, p. 52), academic environments (and especially science, engineering, and medicine education environments) present several of the features that create a high risk of sexual harassment (Box 4.3). Their study found that more than 50% of science, engineering, and medicine faculty and staff had encountered sexual harassment perpetrated by faculty, staff, and students.

**Box 4.3**

**Conditions that foster sexual harassment in academic settings**

- Male-dominated environment, with men in positions of power and authority
- Organisational tolerance for sexually harassing behaviour (e.g., failing to take complaints seriously, failing to sanction perpetrators, or failing to protect complainants from retaliation)
- Hierarchical and dependent relationships between faculty and their trainees
- Isolating environments (e.g., labs and field sites) in which faculty and trainees spend considerable time


As women increasingly participate in online communities, the backlash against the changing status quo can include sexual harassment. A study by Toupin (2014) reports female hackers regularly experiencing groping, harassment, and discrimination, especially at hacker conferences and hackerspaces. Beyond verbal abuse and misogynist behaviours, some feminist hackers have also received rape and death threats.

The extent of sexual harassment experienced by women is difficult to estimate, as there is limited official data on this topic. We instead review data on the prevalence of legislation prohibiting sexual harassment. Globally, a majority of economies (more than half in each region) have enacted legislation on sexual harassment. As of 2018, 118 out of 189 countries (65%) have yet to pass such legislation (Figure 4.9). In Europe, Africa, and the Americas, such legislation is often designed to protect both men and women (Figure 4.10). For other contexts, the vast majority of countries have no legislation dealing with sexual harassment in schools (65%, or 123 countries) or in public spaces (83%, or 157 countries).

**Figure 4.8**

Percentage of countries by region with legislation dealing with sexual harassment (2018)


**Figure 4.9**

Number of countries with no legislation on sexual harassment in the following areas (2018)

4.4 / DISCRIMINATION

Simply having more women students, employees, managers, or entrepreneurs in the ICT industry does not mean that gender disadvantage has been erased; the conditions under which women participate may also contribute to perpetuating inequality. Gender-based discrimination in occupational settings may be either overt or subtle, and it tends to affect women more than men. Types of gender-based discrimination include: unfairness in hiring, firing and promotions; unequal pay; unequal access to professional advancement opportunities; and unconscious biases. In this section we discuss two broad areas that affect genuine gender equality in ICT occupations: pay gaps and discriminatory work environments.

4.4.1 / GENDER PAY GAP

Unequal pay for the same work is one of the more enduring forms of gender-based discrimination in the workplace. At the global level, there has been a persistent unaccounted-for gender pay gap, although the gap is narrowing for certain professions (ILO, 2016). The Global Wage Report for 2016/17 assesses national-level gender pay gaps at between 0% and 45%, noting that the gap is almost 50% at higher levels of pay (ILO, 2016). Global data specific to the ICT industry are unavailable. However, ILO’s research indicates that gender pay inequality is higher in enterprises and occupations with higher average pay. Since the ICT industry falls within the group of enterprises associated with higher levels of pay (ILO, 2018; US Government Accountability Office, 2017), it could be assumed that it would also exhibit higher gender pay gaps.

We examined ILO data on occupational gender wage gaps, focusing on three categories: managers; professionals; and technicians and associate professionals. The raw data is difficult to interpret, as it shows contrasting patterns depending on the region or country (Figures 4.11–4.13). There is currently no data on gender pay gap by occupation for Africa and Oceania.

In Europe, where data is available for 10 economies, a pay gap exists in favour of male workers at all three professional levels, ranging from 6.6% to 38%. The Americas show a similar trend for the six reporting economies: mostly higher wages for men (by 2% to 25%), except for managers and technicians in Belize. The seven reporting economies in Asia show male workers earning more than female workers in most cases (from 2% to 33% more); however, in some cases women earn more than their male counterparts – e.g., professionals in Thailand, managers in Pakistan, and technicians or associate professionals in Brunei.

Notwithstanding ILO’s (2016) finding of higher gender pay gaps at higher levels of pay, the limited data for these three categories shows no clear hierarchy of gaps. The management category does not always have the largest pay gap; in Russia, Iceland, and Pakistan, the largest pay gap is among technicians or associate professionals.

20 Covering 46 countries, of which 22 are in Europe; data is for 2013 or earlier.
There is insufficient longitudinal data to determine trends. For the few countries with data for both 2010/2011 and 2014, the picture is mixed: the gap widens, narrows, or stays the same for some occupations in some countries, with no clear pattern. For example, in Portugal the gap for managers increases by under 1%, while for professionals it decreases by 2%, and for technicid and associate professionals it increases by about 3%. Conversely, in Malaysia, the trend shows a 7% increase for managers, 0.6% decrease for professionals, and 0.1% decrease for technicid and associate professionals.

Reasons frequently cited for the gender pay gap include gendered differences in occupation, expertise, experience, and work patterns (Ardanaz-Badia & Rawlings, 2018; Cook, Diamond, Hall, List, & Oyer, 2018; ILO, 2018). Research has shown, however, that a gender pay gap remains after controlling for such factors. A UK study found that female IT professionals earned 11% less than male IT professionals, even after accounting for number of working hours (BCS, 2017). The career review platform Glassdoor conducted an analysis of 505,000 salaries, controlling for variables such as age, education, experience, occupation, industry, location, company, and job title (Zarya, 2016). The results showed that even when workers were almost identical in every way except gender, the gender pay gap for technology workers (at 28.3%) was several times higher than the gender pay gap for all workers (5.9%). ILO (2018, p. 95) recommend more attention to identifying the “unexplained” part of the gender pay gap. (See also Part II Chapter 7 of this report, which examines differences in skill endowments and returns to skills between men and women in digital and less digital-intensive industries.)

One of the few studies of why people leave technology jobs found that technical workers (at 40%) were more likely than non-technical workers (32%) to leave jobs in the U.S. technology industry due to unfairness (Scott, Kapor Klein, & Onovakpuri, 2017). Perceptions of unfairness were higher in the tech industry (42% of leavers) than in the non-tech industry (33% of leavers) and was a major reason for both men and women to leave their tech jobs. Overall, employees within the technology industry report unwanted sexual attention at almost double the rates (10%) reported by tech employees in other industries (8%). These findings suggest that the technology industry has a particularly deep problem with unfairness and inappropriate sexual behaviour.

Female technology workers typically respond to discriminatory work environments either by changing jobs or developing strategies to avoid or rationalise their participation, such as downplaying their femininity, adopting male behaviours, enduring the organisational culture, or adopting the veneer of “professionalism” as a coping mechanism (Alfrey & Twine, 2017; Annabi & Lebovitz, 2018; Servon & Visser, n.d.). For instance, when online, some female developers masquerade as males to avoid discrimination (Vasilescu et al., 2015).

Various national policies address discriminatory work environments, including constitutional provisions on gender discrimination as well as implementing legislation related to professional advancement, training and pay. Overall, most economies have some legislation in place. Europe has the strongest record of legislation protecting against discrimination across the four areas shown in Figures 4.14 to 4.17, although only a few countries in Europe include any mention of gender in their constitutions’ non-discrimination clauses (Figure 4.14). In all regions except Oceania, more than 51% of countries have legislated against each type of discrimination.
**Figure 4.14**
National constitution mentions gender in non-discrimination clause

- [Graph showing percentage of countries by region (Africa, Asia, Americas, Oceania, Europe) with Yes and No categories.]

Source: World Bank
Note: West Bank and Gaza = Palestine. Kosovo data included in Europe.

**Figure 4.15**
National constitution mentions gender in non-Legislation protecting women from discrimination in promotion or demotion

- [Bar chart showing percentages for different countries.]

Source: World Policy Research Center, Discrimination at work database

**Figure 4.16**
Legislation protecting women from discrimination in access to vocational training

- [Graph showing percentages by region (Europe, Africa, Americas, Asia, Oceania) with Yes and No categories.]

Source: World Policy Research Center, Discrimination at work database

**Figure 4.17**
Legislation guaranteeing equal pay

- [Bar chart showing percentages for different categories (Europe, Africa, Americas, Asia, Oceania).]

Source: World Policy Research Center, Discrimination at work database
4.5 / WORK AND LIFE BALANCE

Several authors have argued that a masculine-oriented work model pits work-devotion against family-devotion, and the associated tension can lead to overload for women in technology professions (Blair-Loy & Cech, 2017; Bright Horizons, 2017; Weisgram & Diekman, 2015). The number of hours men and women work, and the prevalence and distribution of unpaid domestic and care work, serve as indicators of work and life balance.

Figure 4.18
Global gender gap in mean weekly hours of work per employee, by sex and occupation

4.5.1 / NUMBER OF HOURS OF WORK

The labour force data shows that women generally work fewer paid hours than men and spend a much larger proportion of their time than men on unpaid domestic and care work. In all six occupations represented in Figure 4.18, men consistently work more hours than women. Discrimination, as Nafus (2012) found within the Free Libre Open Source Software community.

This tendency to work fewer hours could reflect women’s personal choices, and a variety of considerations may factor into their choices, such as a desire for flexible work arrangements because of other social roles and personal values. Efforts to address gender inequality in employment that do not target these quality of life issues are unlikely to achieve maximal impact.

4.5.2 / UNPAID DOMESTIC AND CARE WORK

Data on this indicator is sparse for most regions, but it shows that compared to men, women spend a much larger proportion of their time on unpaid domestic and care work, at 10%–28% for women versus 3%–10% for men (Figures 4.19–4.22). Erosa, Fuster, Kambourova, & Rogerson (2017) provide some evidence of impact on labour force participation, arguing that an “asymmetry in household production” leads to women self-selecting out of occupations that reward long hours (p. 4). They conclude that a 10% reduction in women’s discretionary time, due to their nonmarket activities, causes a 14% reduction in their labour market participation and an 11% increase in the gender wage gap. Others such as Xie (2006) assert that having children is the most important factor preventing women from pursuing careers in science and engineering.

However, other scholars have argued that women’s primary reason for leaving technology jobs is not family-related but rather due to obstacles to achieving company and career goals (Ashcraft, McLain, & Eger, 2016; Hunt, 2010; Melksins, Beddoes, Masters, Mich, & Shah, 2016; Sassler, Glass, Levitte, and Michalovics 2017) found no difference in the tendency for career-minded versus family-oriented women to enter computer science professions in the U.S. They also observed that being married and having children equally affected men and women’s propensity to work in computer science, leading to the conclusion that “is difficult to account for the factors associated with these employment disparities” (p. 19). Another issue is the potential quality-of-life compromises made by women in combining family and professional responsibilities. Some studies note the tension between work-devotion and family-devotion expectations, and the incidence of overload among women in technology professions (Blair-Loy & Cech, 2017; Bright Horizons, 2017; Weisgram & Diekman, 2015).
4.5.3 / PARENTAL LEAVE POLICIES

One major aspect of the unpaid care work that women often shoulder is child care. The extent to which organisations make it possible for women to combine motherhood with work can be a crucial factor affecting the size of the female work force. The World Policy Research Center tracks several gender policy indicators\(^{22}\), four of which are relevant for this discussion. The data shows that, at the policy level, most countries have some provisions to support working mothers. European countries tend to have the most generous policies, while countries in Oceania tend to have the least generous allowances (Figures 4.23–4.26). The U.S. is one of just two countries in the Americas with no legislated parental leave.

Fifty-eight per cent of European countries provide 52 weeks (one year) or more paid leave; in contrast, in Oceania and the Americas, over 70% of countries provide either no leave or less than 14 weeks (Figure 4.23). Most countries in Africa and Asia provide between 14 and 52 weeks paid maternal leave. Paid maternal leave also covers above 60% of salary in most countries (Figure 4.24). European countries are also the most generous in offering breastfeeding options: about 80% of countries (37 out of 45) allow paid breastfeeding breaks at work for at least six months; only seven countries have no such provisions (Figure 4.25). With the exception of Oceania (at 38%), a majority of countries in the other regions (57%–74%) also support paid breastfeeding breaks. While 50% (103) of countries worldwide guarantee either paid maternal leave or breastfeeding breaks at work for at least six months, only 43 countries (mostly in Europe) guarantee both (Figure 4.26). Again, Europe fares the best in this regard, with only one country failing to provide any guarantees. Oceania and the Americas have the largest proportion of countries not guaranteeing either option (63% and 40% respectively).

\(^{22}\) Maternal and Child Health Equity (MACHEquity) research program.
4.6 / CONCLUSION

With violence against women widespread globally, access to ICT further increases the exposure of girls and women to cyberbullying. The response to this must include overall culture change in attitudes towards sexual harassment and all forms of gender-based violence. Similarly, as more women venture into STEM and related training and occupations, they risk exposure to sexual harassment and various forms of discrimination associated with the field. A dominant masculine-oriented work ethic also presents challenges for people interested in ICT careers but seeking greater work and life balance. However, from a gender perspective, our understanding of the dark side of ICT access, skills, and activities is still limited; much work needs to be done to collect relevant data and scope the issues. This is particularly challenging because of the complex issues involved and the evolving nature of ICTs and related landscapes.

REFERENCES


KEY FINDINGS

- Barriers to gender digital equality are generally related to one or more of the following: 1) availability of infrastructure; 2) financial constraints; 3) ICT ability and aptitude; 4) interest and perceived relevance of ICTs; 5) safety and security; and 6) socio-cultural and institutional contexts. Most of these barriers cut across issues of access, skills, and leadership.

- There is no single strategy for eliminating gender digital inequalities. Recommendations generally call either for targeting specific symptoms (such as affordability or recruiting practices), or for reshaping deeply ingrained social norms and practices (such as gender stereotypes) that are at the root of gender inequalities.

- Strategies to increase gender equality in ICT access generally focus on: addressing accessibility and affordability barriers; providing relevant content; improving safety and security online and offline through public education, technical, and legal means; mainstreaming gender perspectives into policies and budgets; sharing good practices; investing in women’s education and basic digital skills capacity-building.

- The main proposals for closing gender gaps in advanced digital skills and STEM education range from making training more accessible for women and underrepresented groups, to addressing gender stereotyping of STEM education and building girls’ self-efficacy and confidence in STEM.

- Most proposed remedies for gender inequality in ICT leadership recommend one or several of the following: combating gender stereotypes and biases at individual, institutional, and societal levels; establishing programs and supportive structures to encourage female participation and advancement in ICT occupations; legislating diversity obligations; and diverting resources to institutions that are more gender-diverse.

5 / INTRODUCTION

This chapter compiles literature and research that have identified barriers to gender digital equality and made recommendations for dealing with the barriers as they relate to ICT access, skills and leadership.

The barriers and disadvantages inhibiting gender digital equality are diverse, multifaceted, and often embedded in longstanding social structures that privilege men over women. Most of these barriers cut across access, skills, and leadership: they may manifest in slightly different ways (Table 5.1). The six broad types of barriers identified in Table 5.1 are discussed in more detail below.
5.2 / BARRIERS TO ICT ACCESS

5.2.1 / AVAILABILITY OF INFRASTRUCTURE

In resource-poor communities, access to ICTs is affected not just by economic conditions but also by the lack of technical infrastructure such as signal coverage. Although infrastructure availability affects all rural residents, the GSMA Gender Gap Report notes that, for both mobile ownership and mobile internet use, the gender gap is wider in rural areas than in urban areas; even where overall ownership levels are minimal, the percentage of rural women who own mobile phones is still far lower than men (GSMA, 2018). However, even in urban communities, some gender digital divides persist. For instance, the World Wide Web Foundation (2015) found that among the urban poor, women were nearly 50% less likely than men to access the internet. Van der Spuy and Aavriti (2015) have also identified infrastructure as one of the three key themes related to barriers to ICT access, in addition to cost/affordability issues and availability of relevant and appropriate content.

5.2.2 / FINANCIAL CONSTRAINTS

Studies on the gender digital divide point to affordability as one of the main (and in some cases the greatest) barriers to ICT adoption among women (Deen-Swarray et al., 2012; GSMA, 2018a; Hilbert, 2011). Of course, the prohibitive cost of access devices and of accessing the internet affects both men and women. Organisations such as the Alliance for Affordable Internet (A4AI, 2017) have noted that in some countries, access to the internet is the greatest) barriers to ICT adoption among women (Deen-Swarray et al., 2012; GSMA, 2018a; Hilbert, 2011; Milek et al., 2011). For example, Part II Chapter 2 notes that one reason why women in Africa are not online is the lack of relevant content in local languages. A possible lack of confidence in using the internet, compounded with negative perceptions of ICTs, may also be influencing how women utilise the internet. For instance, in a small case study of Turkish students, Varank (2010) showed that gender was a significant variable predicting computer attitudes.

5.2.3 / ABILITY AND APPTITUDE

This relates to women’s educational background, aptitude, and skills to use ICTs. Even if costs of ICT devices and services go down, women would still be at a disadvantage if they are not equipped with the basic digital skills and literacy needed to operate in the digital economy. Education levels and functional literacy have been identified as significant barriers to accessing and using technology by women in both developed and developing countries (Antonio & Tuffley, 2014; GSMA, 2018a; Hilbert, 2011).

5.2.4 / INTEREST AND PERCEIVED RELEVANCE

Key findings of a four-country survey conducted by Intel (2012) showed that one of the main reasons why women did not access the internet is that they did not know what the internet is or how it might benefit them. The top three answers to questions about low usage levels were: (1) I’m not interested in it; (2) I’m not familiar or comfortable with the technology; and (3) I don’t need to access the internet. Women’s low interest in using ICTs could be linked to the unavailability of content that is of relevance to their daily lives and aspirations, in accessible languages and formats (Chair, 2017; Ya’u & Alis, 2017). For example, Part II Chapter 2 notes that one reason why women in Africa are not online is the lack of relevant content in local languages. A possible lack of confidence in using the internet, compounded with negative perceptions of ICTs, may also be influencing how women utilise the internet. For instance, in a small case study of Turkish students, Varank (2010) showed that gender was a significant variable predicting computer attitudes.

5.2.5 / SAFETY AND SECURITY

Complacency and failure to address and solve cyber violence could significantly impede the uptake of broadband services by girls and women worldwide. (ITU Secretary-General Houlin Zhao, Combatting Online Violence Against Women & Girls: A Worldwide Wake-Up Call in 2015)

Safety issues are linked to the discussion of the dark side of ICT access; these include threats or experience of cyber VAWG, which some studies (e.g., GSMA, 2018) have shown affect women’s interest in using ICTs. Once online, intimidation and harassment may inhibit women from fully engaging with the Internet. A report by Amnesty International (2018) on violence against women on Twitter stated that the abuse experienced on the platform leads women to “self-censor what they post, limit their interactions, and even drives women off Twitter completely.” Focusing on developing countries, APC launched a report chronicling case summaries of women’s experiences of technology-related violence against women in six countries (APC, 2015).

5.2.6 / SOCIO-CULTURAL AND INSTITUTIONAL CONTEXTS

Local cultural contexts may also limit women’s access to...
and use of technology. These social norms, stereotypes, and cultural constraints are harder to measure than other types of barriers, especially since evidence on how they affect women is specific to particular countries and cases. For instance, in societies where cultural norms constrain women’s ability to move around in public, female access to ICTs in some locations (such as community centres or internet cafés) is restricted (Alao et al., 2017). Likewise, where discrimination makes it difficult for women to acquire a good education and develop basic literacy, their ability to meaningfully use ICTs is also hampered (CTIFD, 2017; Lazic et al., 2015). More often, these socio-cultural and institutional contexts interact with issues related to safety and security. Hassan, Unwin, and Gardner (2017) examined the extent of mobile phone penetration in Pakistan, which has a complex institutional configuration that entwines patriarchy, religion, and culture. Among other things, their research shows that women are far more frequently harassed than men when they are sexually harassed; they trace this tendency to the “traditional patriarchal Islamic character of Pakistan’s society, with its strong emphasis on family honor and shame.”

5.3 / BARRIERS TO ICT SKILLS

5.3.1 / PERCEIVED ABILITY AND APTITUDE

Research indicates that girls tend to underestimate their digital abilities, and their self-assessment is often biased by several internalised perceptions. This is especially pronounced in STEM and related training. For instance, an OECD (2012) report pointed out that when girls were told to “think like scientists”, they performed much worse than boys. It suggested that the gender gap in academic performance in STEM originates from girls’ perceptions about themselves as less capable than boys. This tendency continues throughout the pipeline, as young women in STEM reportedly feel lower self-efficacy and higher self-doubt in their ability compared to men. In studies of U.S. computer science students, this lower self-perception has been associated with the sense of not belonging in the field (SWE, 2016; Miller, 2016; Ro & Knight, 2016). The perception that girls don’t have the aptitude for computing and related studies may also come from others, such as family, friends, and teachers, and can affect the guidance girls receive when making education choices. For example, a PISA study showed that teachers may harbour conscious or unconscious stereotyped notions about girls’ and boys’ strengths and weaknesses in school subjects (OECD, 2015). OECD (2012) also reported that parents are more likely to expect their teenage sons, rather than their daughters, to work in STEM occupations, despite their equal performance.

5.3.2 / PERCEIVED ABILITY AND APTITUDE

When girls make choices about secondary school specialisation or college majors, they often do not have adequate information about options related to STEM studies. In a survey of 4,500 girls and parents in the UK and Ireland, it was found that information on STEM subjects and career paths was perceived to be more fragmented and less obvious than other disciplines, making it difficult for students, parents, and teachers to evaluate options (Accenture, 2015, 2017). Girls’ parents believe that the biggest influence on their subject and career choice, but 51% of the parents felt that they were ill-informed on the benefits of STEM subjects, and only 14% said they were well aware of different career opportunities in STEM for their daughters. Moreover, the existing underrepresentation of women can perpetuate future underrepresentation, as the lack of role models inhibits young women from imagining themselves as successful computer scientists or engineers (Dasgupta, 2011; Melzoff, 2013; Murphy et al., 2007). Indeed, most parents (82%), teachers (89%), and young people (68%) agree that the STEM field lags high-profile female role models (Accenture, 2015). and Ireland believed that STEM subjects are for “male careers” and are a better fit for boys’ brains (29%), personalities, and hobbies (27%) (Accenture, 2015). In addition, syllabus difficulty was the biggest reason behind not wanting to study STEM, with more than half of 12-year-old girls believing that STEM subjects are too difficult for them to learn.

Researchers also suggest that some STEM subfields have failed to present themselves as areas where women can pursue their values and goals. The lack of gender-sensitive curricula and gender-balanced learning environments in schools and colleges causes female students to avoid or drop out from engineering and technology studies. Some point to evidence that students perceive STEM fields as individual-centric and object-oriented, whereas women prefer more community-centric and people-oriented careers (Goddink et al., 2016; Stout et al., 2016; Wang & Degol, 2013). Others point to the masculine culture of engineering or geek culture in computer science, including “the stereotypes of socially awkward males who possess innate abilities that women allegedly lack” (SWE, 2016, p. 14; see also Cheryan et al., 2016). There is a general perception that STEM and ICT learning environments need to adapt to include participation of people with diverse values and career goals.

5.3.3 / SAFETY AND SECURITY

Anticipation of gender discrimination, such as harassment or promotion disadvantage, have been suggested as additional barriers dissuading girls and women from STEM study and career aspirations (Ceci et al., 2007; Moss-Racusin et al., 2012). Furthermore, as noted in Chapter 4, educational programs in science, engineering, and medicine tend to have environments that exacerbate vulnerabilities and foster gender discrimination and harassment.

5.3.4 / SOCIO-CULTURAL AND INSTITUTIONAL CONTEXTS

Critics have long been raised over the culture associated with STEM education — particularly the stereotyping of certain subfields as more suited to males than females and the highly competitive environment (“swim or drown” culture) of introductory math and science courses. The result is to discourage both women and minority students (NAS, 2016). In fact, gender stereotypes about intellectual ability emerge as early as age six, when girls start to categorise more boys as “smart” and steer away from playing with the “smart” group (Bian et al., 2017). Gender career stereotyping is also strengthened by exposure to gendered toy labels as objects for boys (Owen & Padron, 2016; Let Toys Be Toys UK, 2015). This notion persists through secondary education: for instance, nearly half of girls in the UK and law, starting at a similarly low level, have now reached parity. Furthermore, women venture capitalists in Information Technology stood at 5.5%, the lowest of all industries. Gompers, Song, Murnane, Weihs, and Xuan (2017) found that nearly 80% of VC firms had never hired a female investor. In Europe, studies estimate the percentage of female-led angel deals between 10% and 30% (Quirose et al., 2018); a 2017 study found that women make up a minority (13%) of decision makers in U.K. venture capital firms (Diversity VC, 2017).

A few studies suggest that networking constraints limit women’s ability to gain access to business opportunities, with men having better access to relevant networks in technology and finance sectors, as well as different modes of utilising them (Alakalek & Cooper, 2017; BarNo, 2012; Kuschel & Lepely, 2016). There are also indications that venture capitalist assess male-led firms differently from female-led firms. A study by Lee & Huang (2018) found that female-led ventures were evaluated more highly when their proposals were given a social impact framing, though that standard was not applied in assessing male-led ventures.

5.4.2 / PERCEIVED ABILITY AND APTITUDE

A lack of adequate technical, business, or entrepreneurship training continues to be cited as reasons why there are few women in ICT leadership positions (Brush, Greene, Balachandra, & Davis, 2014). This is countered by studies demonstrating that women are acquiring relevant degrees — in IT, computer science, engineering, business management, and investment banking — at much higher rates than their representation in the workforce for these fields (Brush, Greene, Balachandra, & Davis, 2014). This is partially due to the occurrence of social, economic, and cultural factors that are hostile or discouraging to women. Educational pathways to technology careers are also somewhat inflexible (Corbett & Hill, 2015), potentially ushering both males and females onto narrow career paths based on perceived technical versus non-technical capabilities.

5.4 / BARRIERS TO ICT LEADERSHIP

Women’s severe underrepresentation in science and engineering is an extremely complex social phenomenon that defies any attempt at simplistic explanations. (Xie, 2006, p. 167.)

5.4.1 / FINANCIAL CONSTRAINTS

As discussed in Chapter 3, on ICT leadership, women entrepreneurs tend to have less access to business capital than male entrepreneurs. There is insufficient research to determine the extent to which this inhibits women from pursuing ICT entrepreneurship, especially in the information and communication technology sector. Most of the existing evidence relates to venture capital and focuses on documenting the levels of funding that goes to female entrepreneurs. In this area, researchers attribute the extreme skew in funding for female-managed businesses to biases in VC firms, driven in large part by homophily — “the tendency of individuals to associate with similar others” (Gompers & Wang, 2017b, p. 36), evidenced in low representation of women in VC firms. Brush (et al., 2014) reported that, in 2013, only 6% of VC firms in the U.S. had women partners (a decline from 10% in 1999). Gompers & Wang (2017b) showed that over the almost three decades since 1990, women have consistently constituted less than 10% of the VC labour pool in the U.S., whereas other fields like medicine
5.4.3 / INTEREST AND PERCEIVED RELEVANCE

Beliefs about gender difference can thus spawn powerful self-fulfilling prophesies. (Charles and Bradley, 2009, p. 109.) Social attitudes about gender capabilities as well as the values associated with technology occupations may inhibit women from considering careers in some science and technology fields. Despite the expansion of job opportunities generated by the digital economy, both sectoral and occupational segregation by gender have increased over the last two decades. According to ILO (2017b, pp. 10–11), “to achieve matched allocation of men and women in every sector would require a shift of one in every five men or women to different sectors.” Competing explanations for occupational segregation by gender cover a broad range: comparative advantages (based in biology); under-investment in women’s education and training; preferences and advantages (based in biology); under-investment in women’s education and training; preferences and advantages (based in biology); and policy environments (e.g., unsupportive business regulations) shape the extent to which various demand-side rationales for gender gaps include: the “critical mass hypothesis” (women are handicapped because they are not good at mathematics); the “pipeline problem” (women drop out of science training or careers); “productivity puzzle” (female scientists are less professionally productive than men); and “family life hypothesis” (women prioritize family life over careers in science) (Xie, 2006). Demand-side rationales include: perceived or assumed lack of aptitude; biased recruiting and financing practices; gender-based discrimination; and unwelcoming professional environments (Mekuria, Layne, Baddoo, Masters, Roediger, & Shah, 2016).

5.4.4 / SAFETY AND SECURITY

As discussed in Chapter 4 on the Dark Side, technology firms are seen as perpetuating particularly hostile environments, characterised by a hypermasculine culture that is unwelcoming or even threatening to women. The model . . . is increasingly unsuitable for both men and women who need or want to participate in other activities important to them and their communities. The traditional scientific or engineering career . . . is predicated on the assumption that the faculty member will have an unlimited commitment to his or her academic career throughout his or her working life. Attention to other serious obligations, such as family, is taken to imply lack of dedication to one’s career . . . The model . . . is increasingly unsuitable for both men and women who need or want to participate in other activities important to them and their communities. (National Academy of Sciences, National Academy of Engineering, and Institute of Medicine, 2007, p. 160.)

The overarching contexts of social structures (e.g., social norms and pressures regarding female roles) and policy environments (e.g., unsupportive business regulations) shape the extent to which various demand and supply issues can facilitate or inhibit women’s equal participation (Box 5.2).

5.4.5 / SOCIO-CULTURAL AND INSTITUTIONAL CONTEXTS

Starting at an early age, we acquire implicit biases simply by living in a society where different types of people fill different roles and jobs. . . . Passive exposure to widespread beliefs registers these beliefs in our minds without our even knowing it. (Corbett & Hill, 2015, p. 38.)

The traditional scientific or engineering career . . . is predicated on the assumption that the faculty member will have an unlimited commitment to his or her academic career throughout his or her working life. Attention to other serious obligations, such as family, is taken to imply lack of dedication to one’s career . . . The model . . . is increasingly unsuitable for both men and women who need or want to participate in other activities important to them and their communities. (National Academy of Sciences, National Academy of Engineering, and Institute of Medicine, 2007, p. 160.)

The overarching contexts of social structures (e.g., social norms and pressures regarding female roles) and policy environments (e.g., unsupportive business regulations) shape the extent to which various demand and supply issues can facilitate or inhibit women’s equal participation (Box 5.2).
Case Study 5.1
“Ok Google: Is AI Gendered?”
Author: Araba Sey and Lisandra Fesalbon (UNU-CS)

As artificial intelligence (AI) products such as Siri, Alexa, and Cortana become prominent fixtures in daily life, debates rage about their potential and dangers. There are high expectations that AI will engender diversity, social inclusion, fairness, and equality. However, evidence is already emerging that even AI is prone to reproducing social biases and stereotypes (Gustavsson & Czarniawska, 2004; Gustavsson, 2005). Against this backdrop, we explored some of the more overt ways in which AI might be mirroring societal biases regarding female roles. Specifically, we asked: Are AI products given gender identities — and, if yes, to what extent do these identities reinforce occupational gender stereotypes?

Methodology. We conducted internet searches using Google Play Store and Apple Store, as well as lists such as Imanuel (n.d), Pappas (2015), and Wycislik-Wilson and Ellis (2018). The search yielded 129 AI products, mostly cost-free, that are marketed on the internet:

- 98 virtual personal assistants: software and applications that respond to requests from users
- 31 text-to-speech services: software and applications that allow users to hear text read out loud

To determine gender identity, we classified the names, voices, and appearances of the AI product, based on information on product websites as well as product advertisements and demos. Names were classified based on the Worldwide Gender-Name Dictionary (Raffo, 2016). For products with a voice feature, gender of the voice was classified by downloading and listening to a demo and assigning female to higher-pitched voices and male to deeper-pitched voices. Appearance, for products with an embodied virtual agent, was determined by whether the agent resembled a female, a male, or looked neutral.

Findings. Virtual personal assistants had primarily female identities: 41% had a female name, 68% had a female voice, and 50% had a female appearance (Table 5.2). Male identities were less common. However, there was also a fair amount of neutral identities: 28% had a neutral name, 13% offered both male and female voices, and 29% were neutral in appearance.

Table 5.2
Gender identities of virtual personal assistants

<table>
<thead>
<tr>
<th></th>
<th>Female</th>
<th>Male</th>
<th>Neutral</th>
<th>Both</th>
<th>Unsure</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAME</td>
<td>40 (61%)</td>
<td>23 (23%)</td>
<td>27 (28%)</td>
<td>0</td>
<td>8 (8%)</td>
<td>96 (100%)</td>
</tr>
<tr>
<td>VOICE</td>
<td>48 (68%)</td>
<td>9 (13%)</td>
<td>9 (13%)</td>
<td>4 (6%)</td>
<td>70 (71%)</td>
<td></td>
</tr>
<tr>
<td>APPEARANCE</td>
<td>21 (50%)</td>
<td>8 (19%)</td>
<td>12 (29%)</td>
<td>1 (2%)</td>
<td>0</td>
<td>42 (43%)</td>
</tr>
</tbody>
</table>

Text-to-speech software and applications, on the other hand, were overwhelmingly neutral (Table 5.3). Practically all had generic names and non-gendered appearances. However, most (84%) offered the option to choose gendered names and accompanying voices within the software.

These findings suggest that AI products tend to be assigned gendered identities that to some degree replicate occupation stereotypes, especially regarding “pink-collar” jobs. Most virtual personal assistants are designed to carry out basic clerical tasks, such as answering e-mails, reading or sending messages, and planning calendar agendas. The fact that most of our sample of virtual personal assistants were female-gendered is consistent with the tendency for these types of frontline services to be associated with female workers in the offline world (Gustavsson, 2005; Piper, 2016; Zdenek, 2007). Indeed, some researchers argue that both men and women prefer interacting with virtual females (LaFrance, 2016; Piper, 2016; Zdenek, 2007). However, the strong presence of products with neutral identities indicates that some developers are proactively eliminating overt gender stereotypes from their products. It is notable that the “older” product type, text-to-speech services, was the most likely to give users gender choices.

Recommendations. This is a relatively new area, with room for more exploration. Future research should expand the scope to include more AI products of varying types, life-stages, sectors, geographic origins, and languages. Demand-side analyses would shed light on consumer preferences as well. To mitigate widely held gender stereotypes that continue to shape people’s career decisions, AI product developers could take a cue from text-to-speech products and assign their products neutral identities, or, at the very least, incorporate multiple options, allowing consumers to decide.

Table 5.3
Gender identities of text-to-speech software and applications

<table>
<thead>
<tr>
<th></th>
<th>Female</th>
<th>Male</th>
<th>Neutral</th>
<th>Both</th>
<th>Unsure</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAME</td>
<td>1 (3%)</td>
<td>0</td>
<td>30 (97%)</td>
<td>0</td>
<td>0</td>
<td>31 (100%)</td>
</tr>
<tr>
<td>VOICE</td>
<td>5 (16%)</td>
<td>0</td>
<td>0</td>
<td>26 (84%)</td>
<td>0</td>
<td>31 (100%)</td>
</tr>
<tr>
<td>APPEARANCE</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>31 (100%)</td>
<td>31 (100%)</td>
</tr>
</tbody>
</table>
In addition, although the evidence is contradictory, it
appears that, to a considerable extent, personal and
societal expectations that a woman prioritise family
over work hold some women back from pursuing
academic and industry careers in ICT — or impose
heavy professional and personal burdens. The “culture
of overwork” (Corbett & Hill, 2015, p. 35) associated
with technology firms exacerbates the situation for
employees who shoulder domestic care and other such
responsibilities.

Institutionalised discrimination also stunts involvement
in computing careers. Unfortunately, a prevailing
belief that technology firms are guided by meritocratic
principles leads to women being unjustly excluded
from candidate pools and advancement opportunities
(Corbett & Hill, 2015; Dryden, 2013; Hewlett &
Sherbin, 2014; National Academy of Sciences, National
Academy of Engineering, and Institute of Medicine,
2007; Sassler, Glass, Levitte, & Michelmore, 2017). For
example, practices such as assessing candidates based
on their activity on particular platforms (such as GitHub)
stacks the deck against women, if these platforms are
themselves inhospitable towards women.

In relation to entrepreneurship, although not specific
to ICT entrepreneurship, some research suggests that
limited policy support can inhibit female participation.
The World Bank Group (2018) reports that fewer
women work or own businesses in economies that have
lower levels of gender legal equality23. Furthermore,
data from the Internet Inclusiveness Index (Economist
Intelligence Unit, 2018) shows that, globally, only 25
countries have a national “plan addressing female-
driven innovation and women-owned businesses”;
those countries are located in Africa (7), Asia and the
Pacific (8), Europe (8), and the Americas (2). Research
by Libersa and Zajkowska (2017) concludes that
innovation policies in Europe fail to actively account for
gender, leading to a focus on male-dominated sectors.
In sum, barriers to gender digital equality can be
grouped into six broad categories (Table 5.1).

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Table 5.4
Summary of barriers to gender digital equality

<table>
<thead>
<tr>
<th>BARRIER</th>
<th>NUMBER OF FEMALES</th>
<th>SKILLS</th>
<th>LEADERSHIP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability of infrastructure</td>
<td>✔</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Financial constraints</td>
<td>✔</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Ability and aptitude (real and perceived, by self or others)</td>
<td>✔</td>
<td>-</td>
<td>✔</td>
</tr>
<tr>
<td>Interest and perceived relevance</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Safety and security</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Socio-cultural and institutional contexts</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>

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23 Note that this contrast somewhat with the conclusion of Kelley et al. (2017) conclusion (reported in Chapter 3) that there is more female entrepreneurship in countries with lower gender equality ratings.

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5.5 / RECOMMENDATIONS

Resolving digital gender inequalities will require
addressing the different barriers that affect women’s
engagement with ICTs, including development
of digital skills and career opportunities in the
ICT industry. Table 5.2 summarises the range of
recommendations identified in the literature, as they
relate to the barriers discussed here. Some proposed
remedies target specific manifestations or symptoms
of gender digital inequality, such as affordability or
recruiting practices: see Box 5.4 for UN Women’s
recommendations targeted at the business sector.
Others recommend reshaping deeply ingrained
social norms and practices that are at the root of
gender inequality: see Case Study 5.2 for a life course
perspective. Specific recommendations are discussed in
more detail below.

Table 5.5
Recommendations for addressing barriers to gender
equality in ICT access, skills, and leadership (collated
from the literature)

<table>
<thead>
<tr>
<th>BARRIERS</th>
<th>RECOMMENDATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability of infrastructure</td>
<td>Expand infrastructure to underserved/unserived communities</td>
</tr>
<tr>
<td></td>
<td>Support original research and the collection, tracking, analysis and sharing of sex-disaggregated data</td>
</tr>
<tr>
<td>Financial constraints</td>
<td>Improve affordability</td>
</tr>
<tr>
<td></td>
<td>Remove gender-based barriers to acquiring business capital</td>
</tr>
<tr>
<td></td>
<td>Support original research and the collection, tracking, analysis and sharing of sex-disaggregated data</td>
</tr>
<tr>
<td>Ability and aptitude (perceived and real; endogenous and exogenous)</td>
<td>Invest in digital literacy capacity-building</td>
</tr>
<tr>
<td></td>
<td>Address gender stereotyping of STEM</td>
</tr>
<tr>
<td></td>
<td>Invest in entrepreneurship capacity-building</td>
</tr>
<tr>
<td></td>
<td>Support original research and the collection, tracking, analysis and sharing of sex-disaggregated data</td>
</tr>
<tr>
<td>Interest and perceived relevance</td>
<td>Provide relevant content and services</td>
</tr>
<tr>
<td></td>
<td>Increase awareness/demonstrate potential and relevance of ICTs and ICT careers</td>
</tr>
<tr>
<td></td>
<td>Address gender stereotyping of STEM</td>
</tr>
<tr>
<td></td>
<td>Support original research and the collection, tracking, analysis and sharing of sex-disaggregated data</td>
</tr>
<tr>
<td>Safety and security</td>
<td>Develop social, technical and regulatory measures to eliminate safety and security threats in public, educational and workplace settings</td>
</tr>
<tr>
<td></td>
<td>Support original research and the collection, tracking, analysis and sharing of sex-disaggregated data</td>
</tr>
<tr>
<td>Socio-cultural and Institutional contexts</td>
<td>Combat stereotypes, biases and discriminatory norms at individual, institutional and societal levels (e.g., increase media awareness/sensitization, establish and enforce legislation, promote gender sensitive learning approaches and environments, spotlight role models, foster work/life balance, diversity policies &amp; programs, gender lens investing)</td>
</tr>
<tr>
<td></td>
<td>Collaborate with stakeholders (e.g. consult and involve women and men, share good practices and lessons)</td>
</tr>
<tr>
<td></td>
<td>Support original research and the collection, tracking, analysis and sharing of sex-disaggregated data</td>
</tr>
</tbody>
</table>
All businesses stand to benefit from gender equality. The Women’s Empowerment Principles (WEPs) platform supports the private sector — regardless of size, sector or geography — to advance gender equality and women’s empowerment in the workplace, marketplace, and community, and to contribute to achieving the Sustainable Development Goals. The WEPs provide a gender lens through which businesses can analyze their current initiatives, benchmarks, and reporting practices, and then tailor or establish policies and practices to realise gender equality and women’s empowerment. Support for the seven Principles has gathered global momentum: more than 2,000 companies worldwide are now WEPs champions.

**Women’s Empowerment Principles**

**Principle 1:** Establish high-level corporate leadership for gender equality.

**Principle 2:** Treat all women and men fairly at work — respect and support human rights and nondiscrimination.

**Principle 3:** Ensure the health, safety, and well-being of all women and men workers.

**Principle 4:** Promote education, training, and professional development for women.

**Principle 5:** Implement enterprise development, supply chain, and marketing practices that empower women.

**Principle 6:** Promote equality through community initiatives and advocacy.

**Principle 7:** Measure and publicly report on progress to achieve gender equality.

---

**Case Study 5.2**

**Gender digital inequality from the Life Course perspective**

Author: Moon Choi (KAIST Graduate School of Science and Technology Policy)

The current state of gender digital inequality is the outcome of accumulated oppressions that women, who used to be girls, have faced throughout the course of their lives. For the last decade, research and discourse on gender digital inequality has advanced slowly but steadily; still, it lacks theoretical perspectives which could provide insight into the mechanisms of gender digital inequality as well as critical intervention points to reduce it. The concept of “life course” is one of the primary theoretical frameworks in the field of gerontology and human development — and it can be applied to enhance understanding gender digital inequality.

Individuals belong to a cohort based on their birth years, in historical context and time (Elder, 1998). The life course perspective emphasises the structural influences of cohort, history, culture, and location in relation to individuals’ life experiences and pathways while attempting to bridge sociological and psychological constructs (Hooyman & Kiyak, 2011; Sertstien, 2006). For example, a girl born in a developing country during the twenty-first century has quite different gender norms, attitudes toward technology, and choices for her education, major, career etc., compared to a woman who was born in the same country during the early half of the twentieth century, or a girl born in the same year but in a developed country. Gender socialisation means “learning gender” (Moen, 2016); members of different cohorts and societies learn gender differently, which influences how they view their lives and make decisions about their future.

Early life experiences and decisions, often constructed by society, affect future life experiences; advantages and disadvantages tend to be accumulated over the life course and maximised in old age (Dannefer, 2003). The gender digital divide needs to be understood from this life course perspective. Women’s decisions on education and career arise from early life experiences and social constructs by cohort. For example, strong gender identity and stereotypes have been reported to be associated with negative attitudes toward mathematics among female college students (Nosek, Banaji, & Greenwald, 2002), becoming a constraint on moving into careers in science and engineering (Moen, 2016). Also, after starting a family, woman often becomes the primary caregiver for children and other family members, responsibilities that may conflict with full-time employment in demanding positions, limiting career options and increasing women’s vulnerability to poverty.

The life course perspective would suggest that enacting seemingly simple solutions, such as increasing access to the internet and digital devices among girls and women, cannot work effectively without fundamental changes in prevalent gender norms and culture. Current and future cohorts of both girls and boys should not learn gender, while both women and men need to unlearn gender, especially around boys should not learn gender, while both women and men need to unlearn gender, especially around technology, and choices for her education, major, career etc., compared to a woman who was born in the same country during the early half of the twentieth century, or a girl born in the same year but in a developed country. Gender socialisation means “learning gender” (Moen, 2016); members of different cohorts and societies learn gender differently, which influences how they view their lives and make decisions about their future.

The gender digital divide needs to be understood from this life course perspective. Women’s decisions on education and career arise from early life experiences and social constructs by cohort. For example, strong gender identity and stereotypes have been reported to be associated with negative attitudes toward mathematics among female college students (Nosek, Banaji, & Greenwald, 2002), becoming a constraint on moving into careers in science and engineering (Moen, 2016). Also, after starting a family, woman often becomes the primary caregiver for children and other family members, responsibilities that may conflict with full-time employment in demanding positions, limiting career options and increasing women’s vulnerability to poverty.
5.5.1 / RECOMMENDATIONS FOR ICT ACCESS

Expand digital infrastructure.
This includes not only improving connectivity options through basic infrastructure (especially in rural areas), but also exploring models of service provision that are more attuned to the lifestyles and concerns of women (Alampay, 2006; Sambuli, Brandusescu, & Buhvird, 2018).

Improve affordability.
There is now greater understanding and visibility of ICT affordability issues in different parts of the world, because of improved data collection and measurement tools such as ITU’s ICT Price Basket indicator. Much of A4A’s work is focused on how to drive down cost and access to the internet, with a goal of bringing down the cost of 1GB of mobile broadband to equal 2% or less of average monthly income. This increased attention to affordability issues over recent years has already galvanised action on the need to bring down the cost of ICTs as a strategy to widen ICT access.

Improve basic digital literacy.
There is a growing recognition that in increasingly “connected” world, digital skills matter (van Deursen and van Dijk, 2010); Robinson et al., 2015). An ongoing conversation surrounds the questions of what exactly constitute digital skills, and what aspects of digital skills are particularly important to bring women online. Due to the speed of change in the technological landscape, the emergence of new ICTs continuously redefines the type of skills that are considered basic and relevant.

Promote education in general.
Closing the gender digital divide should not end at equipping women and girls with basic digital and literacy skills. Promoting education in general is advisable; research shows that access to higher education narrows the gender gap in internet access (World Wide Web Foundation, 2015).

Provide relevant content.
Insufficient attention has been paid to promoting the production and provision of digital content that is relevant to the lives of women (van der Spuy & Souter, 2018). This also encompasses presenting content in the (local) language that women understand (Davaki, 2018). Irregular data collection and inadequate qualitative assessments that are context-specific and sensitive to local conditions.

Improve online safety and security.
To deal with cyber-VAWG, the Broadband Commission (2015) has recommended the following best practices:

a. Sensitisation. Prevent cyber VAWG through changes in social attitudes, by means of public education and training of enforcement agency staff on cyber VAWG.

b. Safeguards. Promote safeguards for online safety and equality on the internet for women and girls through the development of technical solutions and through promotion of due diligence and duty-to-report systems, with the industry maintaining responsible internet infrastructure and customer care practices.

c. Sanctions. Develop laws, regulations, and governance mechanisms; enforce compliance through effective punitive consequences for perpetrators; and consult on cyber civil rights agenda.

Improve offline safety and security.
As noted by Davaki, online violence against women and girls tends to reflect offline arrangements, including patriarchal forces which are uneasy about women’s empowerment through ICT use and Internet access, repressive groups particularly targeting women, either through intimidation or negative campaigning, state authorities that might be retaining user data legally or illegally or aggressive and sexist hate speech feeding on traditional gender stereotypes. (Davaki, 2018, p. 22.)

Eliminating these offline threats will facilitate women’s access to and use of digital technologies.

Combat social norms that disadvantage women.
A crucial dimension of narrowing the gender digital gap is to address the underlying economic, social, and cultural barriers that prevent women from accessing ICTs and meaningfully participating in the digital economy. The solutions to gender digital inequalities “cannot be concerned with digital policies alone”; it is also critical to attend to structural inequalities from a rights-based perspective (van der Spuy & Souter, 2018).

Collaborate with stakeholders.
There is a growing recognition that gender digital divides can only be closed with the concerted effort of all stakeholders, from academia to policy makers and the private sector and non-governmental organisations. Through the SDGs, the UN provides a rallying point for all stakeholders, with the inclusion of specific SDG targets that impact women’s access to ICTs. The Broadband Commission (2013) has also helped raise the profile of the issue of gender digital divide by calling attention to this problem and calling for gender equality in access to broadband by 2020, as part of its broadband advocacy agenda.

A list of recommendations from the Broadband Commission’s Working Group on the Digital Gender Divide (2017) usefully spells out a wide range of actions that stakeholders can take (Figure 5.1). Their four recommendation areas are: (1) support the collection, tracking, and analysis of sex-disaggregated data on internet access and use; (2) integrate gender perspectives into relevant strategies, policies, plans, and budgets; (3) address barriers related to affordability, skills, and safety; and (4) support stakeholders to collaborate more effectively.

Figure 5.1 Summary of Broadband Commission Recommendations to Close the Gender Digital Divide

- Collect, analyze, and track data
- Research women’s access to and use of the internet
- Publish and share data and research
- Establish gender equality targets for internet and broadband access and use
- Assess strategies, policies, and plans for gender equality considerations
- Consult and involve women as well as relevant local communities and experts
- Improve understanding of affordability issues
- Innovate to reduce the cost of devices and services
- Improve network coverage, capacity, and quality
- Provide public access facilities
- Research and understand the threats
- Increase awareness of threats and how they can be addressed or reduced
- Develop safety applications and services
- Strengthen protection measures and reporting procedures
- Understand women’s needs
- Invest in education and capacity building initiatives
- Develop skills and confidence
- Support educators
- Support and promote female role models
- Build awareness
- Develop relevant content and services
- Consult and engage women
- Develop and share tools, guidelines, case studies and other materials
- Support and encourage multi-stakeholder cooperation

5.5.2 / RECOMMENDATIONS FOR ICT SKILLS

Provide equal opportunities to develop ability and aptitude.

In general, there is a need for more accessible digital skills and STEM learning opportunities targeting girls and women, both in and out of the classroom (Microsoft, 2017; UNESCO, 2017). Along with greater exposure to STEM education, teachers and parents can help girls to build their confidence by evaluating their actual abilities in STEM studies, helping them correct their biased self-perceptions, and encouraging their performance and achievement, as well as inspiring and envisioning what they can achieve through future careers in STEM (OECD, 2015). It is also important to ensure sufficient provision of incentives, such as scholarships or awards, in areas where girls are significantly underrepresented (UNESCO, 2017).

Train teachers in gender-responsive pedagogies. Capacity building is needed to improve teachers’ ability to implement gender-responsive STEM pedagogies (Accenture, 2017; UNESCO, 2017). Teachers with good knowledge and understanding in gender-sensitive pedagogy can play a critical role in encouraging more girls to pursue STEM careers, while deconstructing gender stereotypes in STEM education. In fact, studies have found that female students show less self-doubt in their STEM identities when instructors employ specific gender-responsive pedagogical methods, such as student-centered teaching methods and female peer-group activities in classes (Ro & Knight, 2016).

Promote interest and perceived relevance. It is widely suggested that early intervention is crucial in tackling gender imbalance in STEM education and in motivating more girls to be interested in learning STEM and advanced digital skills (Accenture, 2015; Microsoft, 2017; UNESCO, 2017). Approaches include: instituting computing education as an optional educational thinking in primary or secondary education; and introducing innovative technologies, creativity, and hands-on experiences involving educational systems, industry, and government, to deliver a consistent message in a sustained way across the country (Accenture, 2017; UNESCO, 2017). At the global level, it is necessary to enable global dialogue as well as a knowledge-sharing platform, to discuss and disseminate good practices and lessons learned.

Collect and share research and sex-disaggregated data. The gender equality in digital skills can only be fully understood and compared, if we have equal opportunities, feel supported, and are able to pursue their goals and objectives in the learning environment (SWI, 2016). Suggested approaches include: hiring more well-trained female teachers (UNESCO, 2017); organised, well-funded efforts to change academic culture under strong leadership (Steward, Malley, & Herzog, 2016); and schools working to eliminate stereotypes and biases in their STEM curriculum or learning environment, while emphasising the importance of STEM to all students and highlighting women’s achievement as STEM researchers and professionals (UNESCO, 2017). It is also recommended that schools expand education on media literacy, to cultivate critical thinking and gender-responsive knowledge that will help students recognise gender stereotypes in the media. For younger students, it is also recommended that parents are supported to educate themselves about STEM subjects and career perspectives, in order to counter common misconceptions about STEM (Accenture, 2017; UNESCO, 2017). Lastly, educational institutions should try to ensure a safe and inclusive STEM learning environment that is free from discriminatory social and cultural norms (Accenture, 2017).

Develop gender-responsive national policy on digital skills. As education is central to any nation’s social policy, it is important to mainstream gender equality not only in STEM education policy but also across sectors such as education, social welfare, and labour (UNESCO, 2017). Governments should prioritise public investment in fostering gender-responsive STEM and digital skills education, while incentivising the private sector to support gender equality – particularly promoting women’s participation in STEM studies and careers (Broadband Commission, 2017).

Collaborate with stakeholders. No single entity can resolve gender digital inequality. At national level, it is recommended to create collaborative efforts involving educational systems, industry, and government, to deliver a consistent message in a sustained way across the country (Accenture, 2017; UNESCO, 2017). At the global level, it is necessary to enable global dialogue as well as a knowledge-sharing platform, to discuss and disseminate good practices and lessons learned.

Improve recruitment and advancement practices to remove conscious and unconscious bias. Promote more creative job design, expand candidate evaluation criteria, and develop external partnerships to generate a more diverse talent pipeline (Ashcraft et al., 2016; Corbett & Hill, 2015; Dryden, 2013; MacDougall et al., 2017; Molina et al., 2015; National Academy of Sciences, National Academy of Engineering, and Institute of Medicine, 2007; State Street Global Advisors, 2018; Thomas et al., 2016; WISE, n.d.).

Promote change in organisational culture to be more inclusive and less discriminatory. Recommended actions include: removing systemic barriers, increasing transparency of administrative processes, addressing discrimination and harassment, and forming diversity and inclusion committees. Measures might reach as far as establishing limits on CEO pay to narrow the gender pay gap at executive levels (Adler, 2016; Cardator & Hill, 2018; Davis-Ali, 2017; Hunt, Leyton, & Prince, 2015; ILO, 2016; MacDougall et al., 2017; National Academy of Sciences, National Academy of Engineering, and Institute of Medicine, 2007; WISE, n.d.).

Establish professional development initiatives to overcome other marginalised groups. Provide training, mentorship, and networking programs (Davis-Ali, 2017; Hewlett & Sherbin, 2014; Hunt et al., 2015; MacDougall et al., 2017; Molina et al., 2015; WISE, n.d.).

Foster greater work/life balance for all employees. Promote less masculine-oriented definitions of the ideal worker; enable flexible work arrangements for workers with domestic care obligations, as well as better childcare benefits and family leave options (Ecklund & Lincoln, 2016; MacDougall et al., 2017; Molina et al., 2015; WISE, n.d.).

Ensure accountability. Take measures to collect, monitor, and openly share gender-related data, and to monitor and evaluate the performance of policies and initiatives targeting women and other marginalised groups.

5.5.3 / RECOMMENDATIONS FOR ICT LEADERSHIP

Address social norms, stereotypes, and socio-economic constraints that hold women back and discourage girls from considering STEM careers. Equip young girls with the skills and motivation to make informed choices about work in STEM careers; promote alternative pathways to STEM careers; change the image of computing and engineering in the media; and address the unevenness of historical transformations in gender roles, by promoting male participation in female-dominated fields (Broadbeam, 2017; Ashcraft, McLain, & Eger, 2016; Banchefsky & Park, 2018; Blau, Brunndum, & Liu, 2013; Bruhn, Greene, Balachandra, & Davis, 2014; Corbett & Hill, 2015; Erosa, Fuster, Kamkouvrou, & Rogerson, 2017; ILO, 2017a; Miller, Nolla, Eagly, & Utal, 2018; Molina, Lin, & Wood, 2015). In the process, it is important to act in an inclusive manner so as not to alienate the male population or exacerbate backlash. For example, Lean In (2018) reports that, in the wake of the Me Too movement, male managers may increasingly be pulling away from engaging with female colleagues (mentoring, working, or socialising).

Leverage the power of shareholders and investors to compel corporations to improve their gender diversity status. Exercise shareholder voting power as it has been done by State Street Global Advisors (2018). Develop gender lens investment products, such as the SSGA Gender Diversity Index, Thomson Reuters Diversity & Inclusion Index, EDGECertification, EqualLeap Global Gender Equality 100 Leaders Net Total Return Index, Lyxor Gender Equality ETF, and Evolve Gender Diversity Index.
**5.6 / CONCLUSION**


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ILO. (2017d). 156 157


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KEY FINDINGS

- There is a severe lack of official sex-disaggregated data on most ICT-related topics.
- Most indicators are conceptually unclear, lack an agreed methodology, and are not regularly collected by most countries in any region or development category (less than 50% of countries, for most indicators).
- Africa, Asia and Oceania have the lowest availability of sex-disaggregated ICT data.
- Barriers to collection of sex-disaggregated data include: low data collection and analysis capacity of national statistics offices; diversity of potential issues and indicators; and lack of conceptual and definitional clarity.

6.1 / INTRODUCTION

There is a severe lack of official sex-disaggregated and gender data on most ICT-related topics, even though such data is essential for gender researchers to capture and analyse societal differences between men and women (G20, 2018; UNECE, 2010, p. 1). Considering the centrality of ICTs in modern society, sex-disaggregated data is critical for meaningful dialogue and policymaking on gender equality. Within the United Nations and other global organisations, this challenge is receiving heightened attention, and some initiatives have been generated to address it. Examples of these are the UN’s Evidence and Data for Gender Equality (EDGE) project (launched in 2013), the World Bank’s Gender Data Portal (re-launched in 2016), GSMA’s (2018b) toolkit researching women’s internet access and use, and USAID’s Gender and ICT Survey Toolkit (Highet et al., 2018). The first two target gender indicators in general, while the latter two focus on ICT data.

Over the years, advances have been made in promoting collection of sex-disaggregated data on basic ICT access. The UN has developed four ICT access measures — proportion of adults with an account at a bank or other financial institution or with a mobile-money service provider; proportion of individuals using the internet; proportion of individuals who own a mobile telephone; proportion of households with access to mass media — which are included in its Minimum Set of Gender Indicators (UNSD, 2018). The Minimum Set of Gender Indicators categorises the prescribed indicators into three tiers, based on three criteria: conceptual clarity, established methodology, and regularity of data collection (Figure 6.1). This chapter assesses the ICT access, skills, and leadership indicators covered in this report in light of these UN criteria, summarising the extent of data collection in different world regions. Appendix A presents three detailed country profiles, based on the indicators covered in this report.
Based on the UN data tiers and the availability of academic studies, most of the indicators relevant to gender digital equality fall into Tier 2 or 3 (Table 6.1). Notably, even some of the indicators classified by the UN as Tier 1 might be better classified as Tier 2 since, as demonstrated below, few countries are reporting those indicators. Data on African countries is particularly lacking (Case Study 6.1). Research knowledge is mostly fair or poor, as much of the existing scholarly work takes the form of narrowly-scopeďresearch concentrated in a few North American and European countries. The rest of this chapter focuses on the availability of official statistics.

Table 6.1
State of data and knowledge on gender digital inequality

<table>
<thead>
<tr>
<th>Access</th>
<th>Skills</th>
<th>Leadership</th>
<th>Dark side</th>
<th>Barriers &amp; Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>OFFICIAL STATISTICS</td>
<td>Tier 1/2</td>
<td>Tier 2/3</td>
<td>Tier 3</td>
<td>Tier 3</td>
</tr>
<tr>
<td>RESEARCH KNOWLEDGE</td>
<td>Good/Fair</td>
<td>Fair/Poor</td>
<td>Fair/Poor</td>
<td>Fair/Poor</td>
</tr>
</tbody>
</table>

Several studies in Africa identify lack of access to Information and Communication Technology (ICT) as a key element in women’s marginalisation (Africa Development Bank, 2015; World Wide Web Foundation, 2016; Intel, 2018). The International Telecommunications Union reports that the gender digital divide in Africa stood at 23% in 2016, meaning that women were 23% less likely than men to be online. The benefits of ICTs have thus been unevenly distributed, and women have been locked out of opportunities for jobs, growth, education, financial inclusion, and civic advocacy, among others. Despite the potential of ICTs to catalyse women’s empowerment, as recognised in the UN Sustainable Development Goals (specifically goal 5B), the scarcity of gender data on this topic makes it difficult to fully justify the inclusion of gender issues in ICT policies, strategies, and initiatives, particularly in developing countries. This global problem is even more pronounced in Africa, where we have very little information about the situation of women and ICTs: their mobile phone and internet access and use, ICT employment, decision making, entrepreneurship, and ICT skills, and ICT policies. Sex-disaggregated data and gender indicators on ICTs are unavailable and unexplored.

Many African National Statistical Offices do not collect national ICT statistics with consistency and regularity, and rarely is the data disaggregated by sex. Telecommunication companies and national regulators provide most data on ICTs in these countries (not sex-disaggregated), mainly on connectivity. Development partners, private sector, and NGOs also provide some limited data. Data is unavailable on such gender digital divide indicators as content, education, entrepreneurship, employment, decision-making, skills, and policy.

The UN World Summit on the Information Society has affirmed the need for such data, prompting some initiatives. In Kenya, the Kenya National Bureau of Statistics publishes some key indicators measuring gender equality in ICTs: mobile phone, mobile money, and internet penetration rates. Still missing are data in other areas such as ICT employment, entrepreneurship, policy, leadership, and education.

Relevant data is often not disaggregated by sex. In Rwanda, the Ministry of Information Technology & Communications annual ICT sector profile lacks data on women and girls’ access and use of technology. This points to the need for gender sensitisation training beyond the national statistics offices to other government agencies and all institutions that provide and manage national data. Development partners and multilateral partnerships can assist in this area; civil society organisations, particularly gender equality advocates, can pressure policy makers and national statistical offices to produce and publish accurate, relevant, and accessible sex-disaggregated data. Key areas include: access and usage, content, employment, ICT occupations, entrepreneurship, education, consideration of gender issues in national ICT policy, representation in decision-making, and the relative impact of ICT on women and men.

Realistically, it might take some time before sufficient progress is seen in this area. A first step would be collecting all available national ICT data in the context of citizen-generated data (despite its insufficiency or heterogeneity), as a basis for ongoing policy discussions initiated between civil society organisations and national statistical offices. In the medium-term, individual-level ICT questions (gender-identified) can be incorporated as a module into already existing national data collection mechanisms, such as census or labour force surveys.

Reliable, transparent and comprehensive data on how women and men engage with ICT is crucial for a better understanding of the digital divide and for governments and development partners to design and implement policies for inclusive ICT for development. Sweeping generalisations based on observation and anecdotal evidence are of limited value. “Without data, there is no visibility; without visibility, there is no priority.” Bridging the data gap on gender and ICTs is essential to bring the full benefits of the information society to both men and women, critical for the socio-economic development of Africa.

Case Study 6.1
ICT, Gender and Data in Africa
Author: Gloria Muhoro
(African Development Bank)

Several studies in Africa identify lack of access to Information and Communication Technology (ICT) as a key element in women’s marginalisation (Africa Development Bank, 2015; World Wide Web Foundation, 2016; Intel, 2018). The International Telecommunications Union reports that the gender digital divide in Africa stood at 23% in 2016, meaning that women were 23% less likely than men to be online. The benefits of ICTs have thus been unevenly distributed, and women have been locked out of opportunities for jobs, growth, education, financial inclusion, and civic advocacy, among others. Despite the potential of ICTs to catalyse women’s empowerment, as recognised in the UN Sustainable Development Goals (specifically goal 5B), the scarcity of gender data on this topic makes it difficult to fully justify the inclusion of gender issues in ICT policies, strategies, and initiatives, particularly in developing countries. This global problem is even more pronounced in Africa, where we have very little information about the situation of women and ICTs: their mobile phone and internet access and use, ICT employment, decision making, entrepreneurship, and ICT skills, and ICT policies. Sex-disaggregated data and gender indicators on ICTs are unavailable and unexplored.

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6.2 / AVAILABILITY OF SEX-DISAGGREGATED DATA ON ICT ACCESS

6.2.1 / OVERVIEW

Based on the ITU World Telecommunication and ICT Indicators database, most countries currently do not collect or share sex-disaggregated data on ICT access and basic digital skills. The proportion of countries with data on basic access ranges from 17% (mobile phones) to 46% (internet access). For the eight digital literacy-related skills, the highest number of countries reporting any of the skills is 50 (i.e., 26% of countries worldwide); for certain skills, the number is as low as 17 countries. Data on financial inclusion are more readily available: the World Bank’s Global Findex contains data on between 142 and 144 countries for most indicators. Overall, European countries have the best data availability and African countries the least. Table 6.2 summarises the state of sex-disaggregated data on ICT access. (See Chapter 1 for a discussion of gender equality in ICT access.)

Table 6.2
Status of conceptualisation and collection of sex-disaggregated data on ICT access

<table>
<thead>
<tr>
<th>FIELD</th>
<th>Source</th>
<th>Tier 1</th>
<th>Tier 2</th>
<th>Tier 3</th>
<th>Number of reporting countries</th>
<th>Notes on tier classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Used a mobile phone or the internet to access a financial account</td>
<td>World Bank Findex</td>
<td>✔</td>
<td>✗</td>
<td>✗</td>
<td>144 (74%)</td>
<td>Classified by UN</td>
</tr>
<tr>
<td>Used the internet to pay bills or buy something online</td>
<td>World Bank Findex</td>
<td>✔</td>
<td>✗</td>
<td>✗</td>
<td>144 (74%)</td>
<td>Classified by author. Indicator produced from World Bank demand-side surveys. Consistently collected in last two rounds of FINDEX (2014 / 2017)</td>
</tr>
<tr>
<td>Made or received digital payments in the past year</td>
<td>World Bank Findex</td>
<td>✔</td>
<td>✗</td>
<td>✗</td>
<td>144 (74%)</td>
<td>Classified by author. Indicator produced from World Bank demand-side surveys. Consistently collected on the last two rounds of FINDEX (2014 / 2017)</td>
</tr>
<tr>
<td>Individuals using the internet</td>
<td>ITU</td>
<td>✔</td>
<td>✗</td>
<td>✗</td>
<td>90 (46%)</td>
<td>Classified by UN</td>
</tr>
<tr>
<td>Individuals using a computer</td>
<td>ITU</td>
<td>✔</td>
<td>✗</td>
<td>✗</td>
<td>78 (40%)</td>
<td>Classified by UN</td>
</tr>
<tr>
<td>Used a mobile money service in the past year</td>
<td>ITU</td>
<td>✔</td>
<td>✗</td>
<td>✗</td>
<td>77 (39%)</td>
<td>Classified by UN</td>
</tr>
<tr>
<td>Individuals owning a mobile phone</td>
<td>ITU</td>
<td>✔</td>
<td>✗</td>
<td>✗</td>
<td>40 (21%)</td>
<td>Classified by UN</td>
</tr>
<tr>
<td>Individuals using a mobile phone</td>
<td>ITU</td>
<td>✔</td>
<td>✗</td>
<td>✗</td>
<td>24 (17%)</td>
<td>Classified by UN</td>
</tr>
</tbody>
</table>

6.2.2 / REGIONAL SUMMARY

6.2.2.1 / Basic access

Over the years, advances have been made in defining relevant indicators to measure basic ICT access. The UN Inter-Agency and Expert Group on Gender Statistics has included internet and mobile phone use as part of the UN Minimum Set of Gender Indicators (Figure 6.2).

The inclusion of these indicators provides an impetus for UN member countries to systematically and regularly collect this data. However, although both indicators are classified as Tier 1, the 2017 edition of the ITU World Telecommunication/ICT Indicators database shows that several member countries do not collect this data (Table 6.3). Even for countries where data is available, the absence of longitudinal data inhibits identification of trends. Moreover, different organisations use different methodologies to collect data (or calculate estimates in the absence of official data). As a result, different organisations show inconsistent estimates of the gender digital divide, which may impact the way policy targets are framed (A4AI, 2018).
Beyond ITU, no other organisations regularly collate sex-disaggregated data on basic ICT access at a global scale. However, other organisations attempt to fill the data gap by collecting data at a smaller scale. For example, data in the Mobile Gender Gap Report 2018 came from the GSMA Intelligence Consumer Survey 2017, a nationally representative survey of 23 low- and middle-income countries that covers over 73% of the adult population in those countries. This is one of the more visible demand-side data collection and aggregation efforts in recent years; however, access to that data is currently limited to what is presented in the report. Other sources of data include EUROSTAT, OECD, GSMA, and the World Values Survey.

Research institutions such as LIRNEAsia, Research ICT Africa (RIA), and Dialogo Regional sobre Sociedad de la Informacion (DIRSI) have also pioneered data collection on basic access and other aspects of ICT use in developing countries, using demand-side, nationally representative samples. (See Part II Chapter 2 for a discussion of the gender digital gap in the Global South). These initiatives, however, are limited in scale and geographical focus. More recently, researchers are exploring innovative ways to address data gaps, such as collecting data from non-traditional sources (Case Study 6.2).

### Table 6.3
Number of countries sharing sex-disaggregated data on selected basic access indicators

<table>
<thead>
<tr>
<th></th>
<th>AFRICA</th>
<th>AMERICAS</th>
<th>ASIA</th>
<th>EUROPE</th>
<th>OCEANIA</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individuals using the internet</td>
<td>9</td>
<td>16</td>
<td>27</td>
<td>37</td>
<td>1</td>
<td>90</td>
</tr>
<tr>
<td>Individuals using a computer</td>
<td>6</td>
<td>13</td>
<td>25</td>
<td>34</td>
<td>0</td>
<td>78</td>
</tr>
<tr>
<td>Individuals owning a mobile phone</td>
<td>6</td>
<td>7</td>
<td>19</td>
<td>8</td>
<td>0</td>
<td>40</td>
</tr>
<tr>
<td>Individuals using a mobile phone</td>
<td>4</td>
<td>11</td>
<td>15</td>
<td>4</td>
<td>0</td>
<td>34</td>
</tr>
</tbody>
</table>


As outlined in a recently published study in World Development, we leveraged Facebook’s advertisement audience estimates (available from the platform’s marketing API) to generate measures of gender gaps in internet and mobile phone access in a global perspective (Fatehkia, Kashyap, & Weber, 2018). These Facebook advertising audience estimates are publicly-accessible, allowing advertisers, or any user with a Facebook account, to query aggregate numbers of Facebook users by various geographic and demographic attributes such as age, gender, and device type. By providing aggregate data across different attributes for the platform’s over 2 billion users, the data serve as a kind of digital census of Facebook users that can be valuable repurposed for social research.

We used the Facebook data to generate a “Facebook Gender Gap Index”, an indicator of the ratio of female to male Facebook users in a given country. While the Facebook Gender Gap Index does not represent internet access per se, we found it to be highly correlated with official statistics on internet gender gaps from the International Telecommunications Union or ITU and mobile phone gender gaps (from the GSMA), for countries where data are available. The Facebook Gender Gap Index captured gender inequalities in internet access in less developed countries, where access to the internet is most unequal by gender.

We used these Facebook indicators to predict internet and mobile gender gaps found in official statistics, and then compared the performance of models using the Facebook indicators with two other types of models: 1) models using offline variables linked to a country’s development (e.g., GDP per capita) or to the broader gender divide (e.g., gender gaps in literacy); and 2) models combining online Facebook variables with offline ones. For internet gender gaps, we found that models using Facebook data did better than those using offline indicators alone. As shown in Figure 6.3 panel (b), using Facebook data, we were able to significantly expand geographical coverage to internet and mobile gender gap indicators compared to available statistics in the ITU database (as shown in Figure 1 panel (a), with the biggest gains for less developed countries. Higher values in the figure show greater levels of gender equality, with 1 indicating complete parity.

With help from our Data2X grant, our team has developed an online platform (www.digitalgendergaps.org) where we will release regularly updated measures of gender gaps in internet and mobile phone access across the world based on the approach described above. Ad audience estimates, like the ones we have described above, are available from most large web and social media platforms (e.g. Twitter, Google), and in ongoing work we are exploring the potential of applying our general approach to capture other forms of gender inequality, such as in education, digital literacy, and occupations.
Taking Stock: Data and Evidence on Gender Digital Equality

6.2.2.2 / Use of digital financial services

The World Bank’s Global Findex covers a number of digital financial inclusion indicators across all world regions (Table 6.4). The only exception is use of mobile money, that data is mostly limited to developing countries, where mobile money is more widely used.

Table 6.4
Number of countries covered in Global Findex indicators

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Used a mobile phone or the internet to access</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>144</td>
</tr>
<tr>
<td>an account</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Used the internet to pay bills or buy</td>
<td>37</td>
<td>40</td>
<td>41</td>
<td>39</td>
<td>39</td>
<td></td>
<td></td>
<td>142</td>
</tr>
<tr>
<td>something online</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Made or received digital payments in the</td>
<td>37</td>
<td>40</td>
<td>41</td>
<td>39</td>
<td>39</td>
<td></td>
<td></td>
<td>142</td>
</tr>
<tr>
<td>past year</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Used a mobile money service in the past year</td>
<td>34</td>
<td>40</td>
<td>41</td>
<td>39</td>
<td>39</td>
<td></td>
<td></td>
<td>144</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


6.3 / AVAILABILITY OF SEX-DISAGGREGATED DATA ON ICT SKILLS

6.3.1 / OVERVIEW

As with basic digital literacy, there is a lack of internationally comparable data that comprehensively measures advanced digital skills. ITU’s indicator on the proportion of a population that can write a computer programme has data for only 49 countries. OECD’s Survey on Adult Skills includes a test-based measure of ICT skills for problem-solving, but the data is limited to 36 (mostly European) OECD countries. In general, high-level digital skills are estimated via a proxy of qualifications indicating formal education or training in ICT or STEM specialisations, mainly from the UNESCO Institute of Statistics (UIS). Data is particularly lacking on alternative pathways to advanced digital skills. Following the trend for data on ICT access, Europe has the most data coverage, followed by Asia; data from Africa is sparse. Table 6.5 summarises the state of data on ICT skills. (See Chapter 2 for discussion of gender equality in ICT skills.)
Table 6.5  
Status of conceptualisation and collection of sex-disaggregated data on ICT skills

<table>
<thead>
<tr>
<th>INDICATOR</th>
<th>Source</th>
<th>Tier 1</th>
<th>Tier 2</th>
<th>Tier 3</th>
<th>Number of reporting countries</th>
<th>Note on tier classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary education enrolment, Female</td>
<td>Source: World Bank Global Findex Database, 2017.</td>
<td></td>
<td></td>
<td></td>
<td>167 (66%)</td>
<td>Classified by UN</td>
</tr>
<tr>
<td>Secondary education enrolment, Female</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>149 (74%)</td>
<td>Classified by UN</td>
</tr>
</tbody>
</table>
| TVET education enrolment, Female              |                                             |        |        |        | 125 (64%)                     | Classified by author. Similar to others defined by UN.
| Tertiary education enrolment, Female          |                                             |        |        |        | 123 (65%)                     | Classified by author. Similar to others defined by UN.
| Female graduates from STEM programmes in tertiary education |                                             |        |        |        | 97 (50%)                      | Classified by author. Similar to others defined by UN.
| Female graduates from ICT programmes in tertiary education |                                             |        |        |        | 96 (49%)                      | Classified by author. Similar to others defined by UN.
| Student performance in STEM (PISA 2015)      |                                             |        |        |        | 72 (37%)                      | Limited to participating countries. |
| Student self concept in STEM (TIMMS 2015)    |                                             |        |        |        | 65 (33%)                      | Not regularly collected     |
| Literacy: Transferring files between a computer and other devices | ITU                                           |        |        |        | 50 (26%)                      | Classified by UN            |
| ITU ICT skills on programming                 | ITU                                         |        |        |        | 49 (25%)                      | Classified by UN            |
| ITU: Creating or moving a file or folder      | ITU                                         |        |        |        | 49 (25%)                      | Classified by UN            |
| ITU: Creating electronic presentations with presentation software | ITU                                         |        |        |        | 49 (25%)                      | Classified by UN            |
| Literacy: Writing a computer program using a specialized programming language | ITU                                         |        |        |        | 49 (25%)                      | Classified by UN            |
| OECD survey on Adult Skills (ICT-based problem solving) | OECD                                      |        |        |        | 44 (22%)                      | Data for OECD countries only. |
| OECD Survey on Adult Skills (ICT-based problem solving) | OECD                                      |        |        |        | 43 (22%)                      | Data for OECD countries only. |
| OECD Survey on Adult Skills (ICT-based problem solving) | OECD                                      |        |        |        | 42 (22%)                      | Data for OECD countries only. |
| OECD Survey on Adult Skills (ICT-based problem solving) | OECD                                      |        |        |        | 36 (18%)                      | Data for OECD countries only. |
| OECD Survey on Adult Skills (ICT-based problem solving) | OECD                                      |        |        |        | 35 (18%)                      | Data for OECD countries only. |
| OECD Survey on Adult Skills (ICT-based problem solving) | OECD                                      |        |        |        | 28 (14%)                      | Data for OECD countries only. |
| OECD Survey on Adult Skills (ICT-based problem solving) | OECD                                      |        |        |        | 20 (10%)                      | Data for OECD countries only. |
| OECD Survey on Adult Skills (ICT-based problem solving) | OECD                                      |        |        |        | 17 (9%)                       | Data for OECD countries only. |
| OECD Survey on Adult Skills (ICT-based problem solving) | OECD                                      |        |        |        | N/A                           | No known global data repository. |


Table 6.6  
Number of countries covered in ITU sex-disaggregated data on basic digital skills

<table>
<thead>
<tr>
<th>INDICATOR</th>
<th>Source</th>
<th>Tier 1</th>
<th>Tier 2</th>
<th>Tier 3</th>
<th>Number of reporting countries</th>
<th>Note on tier classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copying or moving a file or folder</td>
<td>ITU</td>
<td></td>
<td></td>
<td></td>
<td>50 (26%)</td>
<td>Classified by UN</td>
</tr>
<tr>
<td>Using copy and paste tools to duplicate or move information within a document</td>
<td>ITU</td>
<td></td>
<td></td>
<td></td>
<td>49 (25%)</td>
<td>Classified by UN</td>
</tr>
<tr>
<td>Sending e-mails with attached files</td>
<td>ITU</td>
<td></td>
<td></td>
<td></td>
<td>72 (37%)</td>
<td>Limited to participating countries.</td>
</tr>
<tr>
<td>Using basic arithmetic formula in a spreadsheet</td>
<td>ITU</td>
<td></td>
<td></td>
<td></td>
<td>65 (33%)</td>
<td>Not regularly collected</td>
</tr>
<tr>
<td>Connecting and installing new devices</td>
<td>ITU</td>
<td></td>
<td></td>
<td></td>
<td>65 (33%)</td>
<td>Not regularly collected</td>
</tr>
<tr>
<td>Finding, downloading, installing and configuring software</td>
<td>ITU</td>
<td></td>
<td></td>
<td></td>
<td>65 (33%)</td>
<td>Not regularly collected</td>
</tr>
<tr>
<td>OECD Survey on Adult Skills (ICT-based problem solving)</td>
<td>OECD</td>
<td></td>
<td></td>
<td></td>
<td>36 (18%)</td>
<td>Data for OECD countries only.</td>
</tr>
<tr>
<td>OECD Survey on Adult Skills (ICT-based problem solving)</td>
<td>OECD</td>
<td></td>
<td></td>
<td></td>
<td>35 (18%)</td>
<td>Data for OECD countries only.</td>
</tr>
<tr>
<td>OECD Survey on Adult Skills (ICT-based problem solving)</td>
<td>OECD</td>
<td></td>
<td></td>
<td></td>
<td>28 (14%)</td>
<td>Data for OECD countries only.</td>
</tr>
<tr>
<td>OECD Survey on Adult Skills (ICT-based problem solving)</td>
<td>OECD</td>
<td></td>
<td></td>
<td></td>
<td>20 (10%)</td>
<td>Data for OECD countries only.</td>
</tr>
<tr>
<td>OECD Survey on Adult Skills (ICT-based problem solving)</td>
<td>OECD</td>
<td></td>
<td></td>
<td></td>
<td>17 (9%)</td>
<td>Data for OECD countries only.</td>
</tr>
<tr>
<td>OECD Survey on Adult Skills (ICT-based problem solving)</td>
<td>OECD</td>
<td></td>
<td></td>
<td></td>
<td>N/A</td>
<td>No known global data repository.</td>
</tr>
</tbody>
</table>


6.3.2 / REGIONAL SUMMARY

6.3.2.1 / Basic digital literacy

Over the years, advances have been made in defining basic digital literacy. Despite being the main data repository for ICT data, the ITU’s indicators measuring basic digital literacy suffer from lack of coverage. As seen in Table 6.6, few countries (especially in Africa and Asia) shared relevant data for the period 2014–2016.
6.3.2.2 / Advanced skills

As discussed in Chapter 2, digital skills are often measured by self-reported surveys on the range of ICT activities performed by users. Beyond basic skills, there is a lack of internationally comparable data measuring a comprehensive set of advanced digital skills — especially for Africa, the Americas and Oceania. For example, of the 49 countries reporting the number of people who can write a computer program, only three are in Africa, two are in Latin America, and none are in the Oceania region (Table 6.8).

Table 6.7
Countries with sex-disaggregated data on all eight ITU digital skills

<table>
<thead>
<tr>
<th>Region</th>
<th>Country</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa</td>
<td>Egypt</td>
<td>2015</td>
</tr>
<tr>
<td></td>
<td>Morocco</td>
<td>2016</td>
</tr>
<tr>
<td></td>
<td>Zimbabwe</td>
<td>2014</td>
</tr>
<tr>
<td>Americas</td>
<td>Brazil</td>
<td>2016</td>
</tr>
<tr>
<td></td>
<td>Jamaica</td>
<td>2015</td>
</tr>
<tr>
<td></td>
<td>Bahrain</td>
<td>2016</td>
</tr>
<tr>
<td></td>
<td>Brunei</td>
<td>2016</td>
</tr>
<tr>
<td></td>
<td>Georgia</td>
<td>2016</td>
</tr>
<tr>
<td></td>
<td>Iran</td>
<td>2015</td>
</tr>
<tr>
<td></td>
<td>Singapore</td>
<td>2017</td>
</tr>
<tr>
<td></td>
<td>Kazakhstan</td>
<td>2016</td>
</tr>
<tr>
<td></td>
<td>Qatar</td>
<td>2015</td>
</tr>
</tbody>
</table>


6.3.2.3 / STEM Education

The UNESCO Institute of Statistics (UIS) produces annual globally-comparable data on education, collected from national ministries of education. UIS emphasises the importance of gender equality in education and STEM education, as evidenced in its recent programme on STEM and Gender Advancement (SAGA, https://en.unesco.org/saga). Most UIS data on enrolments and graduates are broken down by gender as well as field of study, including some specific STEM or ICT-related majors.

While the coverage of UIS sex-disaggregated data on school enrolment is relatively comprehensive, the number of reporting countries gradually decreases; most report on primary education (167) and least on tertiary education (125). The data coverage is even less complete for female students’ majors in higher education. Combining both 2015 and 2016 data, only 96 out of 195 countries reported the female share of students graduating with an ICT specialisation (Table 6.9). Furthermore, it is difficult to assess the data quality and accuracy for reporting countries.

Table 6.8
Number of countries covered in ITU and OECD data on advanced ICT skills

<table>
<thead>
<tr>
<th>Region</th>
<th>AFRICA</th>
<th>AMERICAS</th>
<th>ASIA</th>
<th>EUROPE</th>
<th>OCEANIA</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>ITU ICT skills</td>
<td>3</td>
<td>2</td>
<td>11</td>
<td>33</td>
<td>0</td>
<td>49</td>
</tr>
<tr>
<td>OECD Survey</td>
<td>0</td>
<td>6</td>
<td>7</td>
<td>21</td>
<td>2</td>
<td>36</td>
</tr>
<tr>
<td>on Adult Skills</td>
<td>(ICT-based problem-solving)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 6.9
Status of sex-disaggregated data on general and ICT education, no. of countries reporting

<table>
<thead>
<tr>
<th>Stage</th>
<th>AFRICA</th>
<th>AMERICAS</th>
<th>ASIA</th>
<th>EUROPE</th>
<th>OCEANIA</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary education enrolment, Female (2015)</td>
<td>39</td>
<td>33</td>
<td>42</td>
<td>43</td>
<td>10</td>
<td>167</td>
</tr>
<tr>
<td>Secondary education enrolment, Female (2015)</td>
<td>31</td>
<td>33</td>
<td>34</td>
<td>43</td>
<td>8</td>
<td>149</td>
</tr>
<tr>
<td>TVET education enrolment, Female (2015)</td>
<td>26</td>
<td>22</td>
<td>32</td>
<td>41</td>
<td>4</td>
<td>125</td>
</tr>
<tr>
<td>Tertiary education enrolment, Female (2015)</td>
<td>25</td>
<td>26</td>
<td>31</td>
<td>37</td>
<td>2</td>
<td>123</td>
</tr>
<tr>
<td>Female graduates from ICT programmes in tertiary education (2015/2016)</td>
<td>17</td>
<td>19</td>
<td>28</td>
<td>31</td>
<td>1</td>
<td>96</td>
</tr>
<tr>
<td>Female graduates from STEM programmes in tertiary education (2015/2016)</td>
<td>18</td>
<td>19</td>
<td>28</td>
<td>31</td>
<td>1</td>
<td>97</td>
</tr>
</tbody>
</table>

Case Study 6.3
Tracking data on female programmers in Argentina

Introduction. The non-profit organisation Chicas en Tecnología has been developing a range of programmes to bridge the gender digital gap by fostering knowledge and enthusiasm of young women in science, engineering, and technology. We are also creating a database to gather information on the professional profile of the population to inform public policymaking, collaborating with stakeholders who can provide (or facilitate access to) relevant data.

Methodology. Over a four-month period we collected information on new enrolments, re-enrolments, and graduations in 73 programming courses of studies between 2010 and 2015, at 84 public and private universities and university institutes. Surveys were done to gather profiles of women working in programming in Argentina’s public organisations and major companies in the programming field. The Argentine Department of Production’s 111 Mil Plan and Aprendé Programando, both governmental initiatives, were also analyzed. Buenos Aires City and national governmental organisations provided data about the country’s universities, the university institutes and the two public programs chosen. In some cases, the educational institutions were contacted directly. A media advisory and dissemination strategy for social networks was implemented in order to encourage participation of companies and institutions. The data-tracking was carried out in association with Medalla.

Main findings
1. Although women outnumber men overall in new enrolments, the share of female enrolments in programming courses of study never exceeded 17%. Between 2010 and 2014, five men were enrolled for every woman, and in 2015 (the year with the most female enrolments in Argentine universities), the male-to-female ratio increased to six to one.
2. The programs with the strongest presence of women were University Associate Technical Degree in Web Programming (38.5%) and University Associate Technical Degree in IT (35.3%). The programs with the lowest female presence was University Associate Technical Degree in Video-Game Development (5.5%).
3. The greatest number of females graduated in Information Systems Engineering (1,027, or 23%), followed by University Associate Degree of Systems Analyst (362, or 8%) and IT Engineering (321, or 7%).
4. A high percentage of companies refused to open data on gender distribution, but they all wanted to know the results of the survey. Among the 40% who shared data, only 13 had their technical positions held by women. In 13 of the 78 organisations, men held more than 90% of technical positions, and four had no women in technical jobs. Most women work in Software Development profiles, and very few in Software Quality profiles.
5. There has been a significant increase in governmental strategic actions and promotion of studies in technological areas.

Challenges
- Some institutions lacked specific guidelines for public requests.
- Data had to be matched with established categories.
- Sex-disaggregated data for some years and institutions was not available, especially for new programmes.
- Different programme naming conventions, as well as variations in the graduate profile and teaching approach, make comparison difficult.
- Some documents, e.g., pdf files, were impossible to analyse as they could not be manipulated or modified. Aprendé Programando initiative was not included in the final report, because the City Government did not provide the data in an open format.

Recommendations
- Analyze the 111 Mil Plan activities and participants’ motivations, to discover why the enrolments are almost double that of new female enrolments in programming-related courses.
- Compare female enrolments in programming courses to those in other fields.
- Analyze sex-disaggregated data on Master and Ph.D. degrees in Argentina to compare with undergraduate enrollments.
- Find out if any governmental statistics system has sex-disaggregated data on faculty of associate and undergraduate programmes.
- Introduce legislation that requires companies to provide (or facilitate access to) relevant data.
- Find out if any governmental statistics system has sex-disaggregated data on faculty of associate and undergraduate programmes.
- Introduce legislation that requires companies to provide (or facilitate access to) relevant data.
- Analyze the 111 Mil Plan activities and participants’ motivations, to discover why the enrolments are almost double that of new female enrolments in programming-related courses.
- Compare female enrolments in programming courses to those in other fields.

Table 6.10
Examples of different classification of STEM-related fields in higher education

<table>
<thead>
<tr>
<th>UI</th>
<th>OECD</th>
<th>EUROSTAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural sciences, mathematics and statistics</td>
<td>Science</td>
<td>Science, mathematics and computing</td>
</tr>
<tr>
<td>Information and communication technologies</td>
<td>Physical science</td>
<td>Life science</td>
</tr>
<tr>
<td>Engineering, manufacturing and construction</td>
<td>Mathematics and statistics</td>
<td>Physics science</td>
</tr>
<tr>
<td>Engineeirng, manufacturing and construction</td>
<td>Computing</td>
<td>Mathematics and statistics</td>
</tr>
<tr>
<td>Engineering and engineering trades</td>
<td>Engineering and manufacturing and construction</td>
<td>Engineering and manufacturing and construction</td>
</tr>
<tr>
<td>Manufacturing and processing</td>
<td>Engineering and engineering trades</td>
<td>Engineering and engineering trades</td>
</tr>
<tr>
<td>Architecture and building</td>
<td>Manufacturing and processing</td>
<td>Manufacturing and processing</td>
</tr>
<tr>
<td></td>
<td>Architecture and building</td>
<td>Architecture and building</td>
</tr>
</tbody>
</table>

6.3.2.4 / Student performance and learning experiences

Most of the international data on ICT education focuses on enrolment or graduation levels. There is a lack of globally-comparable data on quality of education — student performance, learning experiences, motivation, aspiration, or discrimination. Assessing these measures would involve using various psychometric measures. PISA (Programme for International Student Assessment) and TIMSS (Trends in International Mathematics and Science Study) provide data on student performance and learning experiences at the secondary education level. Although the PISA is governed by the OECD, its participant countries include non-OECD economies; in 2015, over half a million students participated, from 72 countries representing several regions (Table 6.11). TIMSS is an international assessment of mathematics and science at the fourth and eighth grades that has been conducted every four years since 1995. In 2015, 57 countries participated, with relatively higher representation for Europe and Asia while other regions had low participation.

Table 6.11 Number of countries covered in PISA and TIMSS surveys*

<table>
<thead>
<tr>
<th></th>
<th>Africa</th>
<th>Americas</th>
<th>Asia</th>
<th>Europe</th>
<th>Oceania</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>PISA 2015</td>
<td>3</td>
<td>12</td>
<td>19</td>
<td>36</td>
<td>2</td>
<td>72</td>
</tr>
<tr>
<td>TIMSS 2015</td>
<td>4</td>
<td>3</td>
<td>23</td>
<td>26</td>
<td>1</td>
<td>57</td>
</tr>
</tbody>
</table>

*Surveys on student learning experiences sex-disaggregated data.

6.4 / AVAILABILITY OF SEX-DISAGGREGATED DATA ON ICT LEADERSHIP

6.4.1 / OVERVIEW

As discussed in Chapter 3 on leadership, both practical and conceptual issues complicate collection of gender-disaggregated, industry-specific data on ICT. The primary source of global occupational data, the International Labour Organisation (ILO), includes some breakdowns by gender, sector, and occupation, its classification systems — as well as the quantities and types of data available — obscure the actual levels of gender participation in the ICT industry. Furthermore, some major countries such as the United States and Canada are generally not covered in the ILO databases. Some other global and regional organisations, such as the World Bank, UNESCO, OECD, and the Inter-Parliamentary Union, are alternative sources for some of the relevant data.

However, for several of the pertinent issues covered in this report, there are no official internationally comparable statistics. For example, while the ILO has good data coverage on female employment by skill level, this is not broken down by industry. Reports such as McKinsey’s annual Women in the Workplace tend to have limited industry breakdown at best, and usually do not have an international focus. Table 6.12 summarises the state of data availability on issues related to women in ICT leadership. (See Chapter 3 for discussion of gender equality in ICT leadership.)

Table 6.12 Status of conceptualisation and collection of sex-disaggregated data on ICT leadership

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Source</th>
<th>Tier 1</th>
<th>Tier 2</th>
<th>Tier 3</th>
<th>Number of Reporting Countries</th>
<th>Note on Tier Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proportion of seats held by women in national parliaments, 2018</td>
<td>IPU</td>
<td>✓</td>
<td>-</td>
<td>-</td>
<td>193 (99%)</td>
<td>Classified by UN.</td>
</tr>
<tr>
<td>Proportion of females in occupation skill level, 2017</td>
<td>ILO</td>
<td>✓</td>
<td>-</td>
<td>-</td>
<td>188 (97%)</td>
<td>Classified by author. Similar to others classified by UN.</td>
</tr>
<tr>
<td>Bank or mobile account ownership</td>
<td>WB</td>
<td>✓</td>
<td>-</td>
<td>-</td>
<td>144 (74%)</td>
<td>Classified by UN.</td>
</tr>
<tr>
<td>Saved at financial institution</td>
<td>WB</td>
<td>✓</td>
<td>-</td>
<td>-</td>
<td>144 (74%)</td>
<td>Classified by author. Similar to others classified by UN.</td>
</tr>
<tr>
<td>Borrowed from financial institution</td>
<td>WB</td>
<td>✓</td>
<td>-</td>
<td>-</td>
<td>144 (74%)</td>
<td>Classified by author. Similar to others classified by UN.</td>
</tr>
<tr>
<td>Firms with female participation in ownership</td>
<td>WB</td>
<td>-</td>
<td>-</td>
<td>✓</td>
<td>119 (61%)</td>
<td>Classified by UN.</td>
</tr>
<tr>
<td>Proportion of women in managerial positions, 2016</td>
<td>ILO</td>
<td>✓</td>
<td>-</td>
<td>-</td>
<td>82 (42%)</td>
<td>Classified by UN.</td>
</tr>
<tr>
<td>Proportion of females in telecommunication industry, 2016</td>
<td>ILO</td>
<td>✓</td>
<td>-</td>
<td>-</td>
<td>60 (31%)</td>
<td>Classified by author. Similar to others classified by UN.</td>
</tr>
<tr>
<td>Proportion of female ICT professionals, 2016</td>
<td>ILO</td>
<td>✓</td>
<td>-</td>
<td>-</td>
<td>59 (30%)</td>
<td>Classified by UN.</td>
</tr>
<tr>
<td>Proportion of female chief executives, senior officials &amp; legislators, 2016</td>
<td>ILO</td>
<td>✓</td>
<td>-</td>
<td>-</td>
<td>53 (27%)</td>
<td>Classified by author. Similar to others classified by UN.</td>
</tr>
<tr>
<td>Proportion of female electrical and electronic trades workers, 2016</td>
<td>ILO</td>
<td>✓</td>
<td>-</td>
<td>-</td>
<td>52 (27%)</td>
<td>Classified by author. Similar to others classified by UN.</td>
</tr>
<tr>
<td>Proportion of female engineering &amp; technology researchers, 2015</td>
<td>UNESCO</td>
<td>✓</td>
<td>-</td>
<td>-</td>
<td>51 (26%)</td>
<td>Classified by author. Similar to others classified by UN.</td>
</tr>
<tr>
<td>Access to business training</td>
<td>OECD</td>
<td>-</td>
<td>-</td>
<td>✓</td>
<td>25 (13%)</td>
<td>Classified by UN.</td>
</tr>
<tr>
<td>Proportion of female STEM faculty</td>
<td>ITU</td>
<td>-</td>
<td>-</td>
<td>✓</td>
<td>N/A</td>
<td>Classified by author. No global repository.</td>
</tr>
<tr>
<td>Proportion of female business school faculty</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>✓</td>
<td>N/A</td>
<td>Classified by author. No global repository.</td>
</tr>
<tr>
<td>Proportion of female software developers</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>✓</td>
<td>N/A</td>
<td>Classified by author. No global repository.</td>
</tr>
<tr>
<td>Proportion of males and females leaving ICT industry</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>✓</td>
<td>N/A</td>
<td>Classified by author. No global repository.</td>
</tr>
<tr>
<td>Proportion of female managers, telecom companies</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>✓</td>
<td>N/A</td>
<td>Classified by author. No global repository.</td>
</tr>
<tr>
<td>Proportion of female members and heads in Academies of Science</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>✓</td>
<td>N/A</td>
<td>Classified by author. No global repository.</td>
</tr>
<tr>
<td>Proportion of females, ICT company boards</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>✓</td>
<td>N/A</td>
<td>Classified by author. No global repository.</td>
</tr>
<tr>
<td>Access to venture capital</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>✓</td>
<td>N/A</td>
<td>Classified by author. No global repository.</td>
</tr>
<tr>
<td>Proportion female heads of ICT regulatory agencies</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>✓</td>
<td>N/A</td>
<td>Classified by author. No global repository.</td>
</tr>
</tbody>
</table>
6.4.2 / REGIONAL SUMMARY

6.4.2.1 / Employment

For the few ICT occupation indicators in ILO datasets, European countries tend to have the most data (Table 6.13). In North America, the U.S. and Canada track their own data quite extensively. For example, the U.S. National Science Foundation and the Bureau of Labour Statistics compile detailed occupational data, often disaggregated by sex. Reasons for data scarcity are similar to those for other topics: institutional capacity, lack of interest, definitions of ICT occupations, and lack of a common methodology. One notable effort to address this data challenge is the UC Berkeley Women in Technology Initiative to encourage technology companies to adopt and collect a set of common indicators tracking women’s entry into and pathways through ICT jobs.

Table 6.13
Status of sex-disaggregated, internationally comparable data on ICT employment (no. of reporting countries)

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>AFRICA</th>
<th>AMERICAS</th>
<th>ASIA</th>
<th>EUROPE</th>
<th>OCEANIA</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employment by occupation skill level, 2017</td>
<td>53</td>
<td>33</td>
<td>51</td>
<td>40</td>
<td>11</td>
<td>188</td>
</tr>
<tr>
<td>Employees in telecommunications industry, 2016</td>
<td>4</td>
<td>10</td>
<td>9</td>
<td>34</td>
<td>3</td>
<td>60</td>
</tr>
<tr>
<td>Electrical and electronic trades workers, 2016</td>
<td>2</td>
<td>10</td>
<td>8</td>
<td>32</td>
<td>1</td>
<td>53</td>
</tr>
<tr>
<td>Engineering &amp; technology researchers, 2015</td>
<td>3</td>
<td>6</td>
<td>9</td>
<td>31</td>
<td>2</td>
<td>51</td>
</tr>
<tr>
<td>Total management, 2016</td>
<td>3</td>
<td>2</td>
<td>15</td>
<td>5</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Senior &amp; middle management, 2016</td>
<td>6</td>
<td>17</td>
<td>19</td>
<td>38</td>
<td>2</td>
<td>82</td>
</tr>
<tr>
<td>Chief executives, senior officials &amp; legislators, 2016</td>
<td>3</td>
<td>11</td>
<td>8</td>
<td>35</td>
<td>2</td>
<td>59</td>
</tr>
<tr>
<td>STEM faculty: members and heads of departments of science, business school faculty</td>
<td>2</td>
<td>7</td>
<td>9</td>
<td>32</td>
<td>2</td>
<td>52</td>
</tr>
<tr>
<td>Employees leaving ICT industry due to discrimination</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Telecom company managers</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Proportion of females, ICT company boards</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

At the heart of the difficulty of tracking women’s participation in the ICT industry is the continually evolving nature of the industry, the diversity of occupations that could be classified as ICT jobs, the use of different measurement and classification approaches, and the lack of a central repository with comprehensive, internationally comparable data on this topic. Without a clearer view of the range of possible ICT occupations within and outside the ICT industry, and without common measurement and classification standards, it is difficult to come to definitive conclusions about the degree of female marginalisation in ICT employment. Furthermore, in most parts of the world it is nearly impossible to understand how gender equality in ICT leadership is changing (for better or for worse), because there is limited trend data.

6.4.2.2 / Entrepreneurship

None of the entrepreneurship-related data presented in this report is specific to the ICT industry. Even general entrepreneurship data is limited or non-existent for most countries (Table 6.14). In seeking insights on women’s ownership of ICT firms, or on their access to business and finance opportunities in ICT, at present one can only make extrapolations from data on entrepreneurship in general. The Global Entrepreneurship Monitor (GEM), which has some analyses by gender as well as by ICT industry, does not break down by gender within the ICT industry. It also does not cover all countries: the last three GEM reports included 60 or fewer countries (Global Entrepreneurship Research Association, 2016, 2017, 2018, https://www.gemconsortium.org).

Table 6.14
Status of sex-disaggregated data on ICT entrepreneurship

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>AFRICA</th>
<th>AMERICAS</th>
<th>ASIA</th>
<th>EUROPE</th>
<th>OCEANIA</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access to and use of financial services (bank/mobile account)</td>
<td>47</td>
<td>25</td>
<td>46</td>
<td>39</td>
<td>2</td>
<td>159</td>
</tr>
<tr>
<td>Firms with female participation in ownership</td>
<td>33</td>
<td>30</td>
<td>32</td>
<td>22</td>
<td>2</td>
<td>119</td>
</tr>
<tr>
<td>ICT entrepreneurs</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Access to business training</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Access to venture capital</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>


6.4.2.3 / Policymaking

The Inter-Parliamentary Union (IPU) is one of the main repositories of regularly updated statistics on women’s participation in national governance. Almost all countries are represented in their datasets, covering the number of seats women hold in parliamentary bodies (Table 6.15). No agency currently monitors women’s participation in ICT-related regulatory and policy making institutions.
### Table 6.15
Status of sex-disaggregated data on ICT policymaking

<table>
<thead>
<tr>
<th>INDICATOR</th>
<th>AFRICA</th>
<th>AMERICAS</th>
<th>ASIA</th>
<th>EUROPE</th>
<th>OCEANIA</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seats held in national parliaments, 2018</td>
<td>54</td>
<td>46</td>
<td>48</td>
<td>47</td>
<td>19</td>
<td>214</td>
</tr>
<tr>
<td>Heads of ICT regulatory agency, 2018</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Inter-Parliamentary Union (2018), ipu.org.

### 6.5 / AVAILABILITY OF SEX-DISAGGREGATED DATA ON THE DARK SIDE OF ICTS

#### 6.5.1 / OVERVIEW

Globally, data is not systematically collected on most gender issues related to the dark side of the digital age. The majority of indicators identified so far are conceptually unclear, lack an established methodology, or are not regularly collected by countries. There is also limited rigorous qualitative or quantitative research on a wide range of issues and contexts, such as negative and unintended consequences of gender-based initiatives. Table 6.16 summarises the state of data on the dark side of ICT access, skills, and leadership. (See Chapter 4 for a discussion of the dark side of ICTs.)

### Table 6.16
Status of sex-disaggregated data on the dark side of ICTs

<table>
<thead>
<tr>
<th>INDICATOR</th>
<th>Source</th>
<th>Tier 1</th>
<th>Tier 2</th>
<th>Tier 3</th>
<th>Number of reporting countries</th>
<th>Note on tier classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-discrimination clause monitors gender*</td>
<td>World Bank</td>
<td>✓</td>
<td>-</td>
<td>-</td>
<td>113 (99%)</td>
<td>Classified by UNIL</td>
</tr>
<tr>
<td>Gender non-discrimination policies for employment (promotion or detention, vocational training, equal pay)*</td>
<td>World Bank</td>
<td>-</td>
<td>✓</td>
<td>-</td>
<td>113 (99%)</td>
<td>Classified by UNIL</td>
</tr>
<tr>
<td>Paid leave policies for mothers of infants (availability, maximum replacement wage)*</td>
<td>World Bank / World Policy Analysis Center</td>
<td>✓</td>
<td>-</td>
<td>-</td>
<td>113 (99%)</td>
<td>Classified by UNIL</td>
</tr>
<tr>
<td>Mothers of infants guaranteed breastfeeding breaks at work or paid breastfeeding options*</td>
<td>World Bank / World Policy Analysis Center</td>
<td>✓</td>
<td>-</td>
<td>-</td>
<td>113 (99%)</td>
<td>Classified by author. Similar to others classified by UNIL</td>
</tr>
<tr>
<td>Legislation prohibiting sexual harassment in public places, education &amp; employment**</td>
<td>World Bank</td>
<td>-</td>
<td>✓</td>
<td>-</td>
<td>189 (97%)</td>
<td>Classified by UNIL</td>
</tr>
<tr>
<td>Proportion of women subjected to physical and or sexual violence by a current or former intimate partner</td>
<td>UNFAW / UN Women</td>
<td>-</td>
<td>✓</td>
<td>-</td>
<td>89 (45%)</td>
<td>Classified by UNIL</td>
</tr>
<tr>
<td>Mean hours of work</td>
<td>ILO</td>
<td>-</td>
<td>✓</td>
<td>-</td>
<td>66 (30%)</td>
<td>Classified by author. Similar to others classified by UNIL</td>
</tr>
<tr>
<td>Proportion of time spent on unpaid domestic and care work</td>
<td>ILO</td>
<td>-</td>
<td>✓</td>
<td>-</td>
<td>52 (27%)</td>
<td>Classified by UNIL</td>
</tr>
<tr>
<td>Proportion of women subjected to sexual violence by persons other than an intimate partner</td>
<td>UNFAW / UN Women</td>
<td>-</td>
<td>✓</td>
<td>-</td>
<td>50 (26%)</td>
<td>Classified by UNIL</td>
</tr>
<tr>
<td>Average hourly earnings: managers, professionals, technicians &amp; associate professionals</td>
<td>ILO</td>
<td>-</td>
<td>✓</td>
<td>-</td>
<td>17 (9%)</td>
<td>Classified by UNIL</td>
</tr>
<tr>
<td>Experience workplace discrimination or harassment</td>
<td>-</td>
<td>-</td>
<td>✓</td>
<td>-</td>
<td>N/A</td>
<td>Classified by author. Published in his global repository.</td>
</tr>
<tr>
<td>Employees leaving ICT industry due to discrimination</td>
<td>-</td>
<td>-</td>
<td>✓</td>
<td>-</td>
<td>N/A</td>
<td>Classified by author. Published in his global repository.</td>
</tr>
</tbody>
</table>

* In this case, the number of countries for which data is available on whether the country has legislation on the issue.
** World Bank

#### 6.5.2 / REGIONAL SUMMARY

#### 6.5.2.1 / General discrimination and gender-based violence

The broader environment of physical (IP and non-IP) VAWG can serve as possible proxy indicators of the extent of the dark side of ICTs. In general, data on the existence of pertinent legislative protection is more available than data on the actual incidence of discrimination or violence (Table 6.17).
For non-IP violence, the most recent data available for any country is from 2014; for some countries, the most recent data is more than a decade old (from as far back as 2000; Table 6.18). For both intimate and non-IP violence indicators, only one country has reported more than one survey on violence against women (UNSTAT, 2018).

According to UNSTAT (2018), the availability of comparable data remains a challenge for several reasons: different survey methodologies and survey question formulations; uneven data collection efforts; different definitions of partner or spousal violence; lack of an internationally-agreed standard; and different categorisation of sexual violence by non-partners and forms of violence. Efforts to solve this problem include the creation of an Inter-Agency Group on Violence against Women Data, with a Technical Advisory Group (established jointly by WHO, UN Women, UNICEF, UNSD, and UNFPA), to establish a mechanism for compiling harmonised country level data (UNSTAT, 2018).

According to UNSTAT (2018), the availability of comparable data remains a challenge for several reasons: different survey methodologies and survey question formulations; uneven data collection efforts; different definitions of partner or spousal violence; lack of an internationally-agreed standard; and different categorisation of sexual violence by non-partners and forms of violence. Efforts to solve this problem include the creation of an Inter-Agency Group on Violence against Women Data, with a Technical Advisory Group (established jointly by WHO, UN Women, UNICEF, UNSD, and UNFPA), to establish a mechanism for compiling harmonised country level data (UNSTAT, 2018).

Table 6.18
SDG indicators related to violence against women and girls

<table>
<thead>
<tr>
<th>INDICATOR</th>
<th>Number of reporting countries</th>
<th>Coverage Period</th>
<th>Number of countries with at least 2 data points in the last 5 years (2013-2018)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proportion of women subjected to physical and/or sexual violence by a current or former intimate partner, in the last 12 months</td>
<td>89</td>
<td>2005-2016</td>
<td>1</td>
</tr>
<tr>
<td>Proportion of women subjected to sexual violence by persons other than an intimate partner, since aged 15</td>
<td>50</td>
<td>2006-2014</td>
<td>0</td>
</tr>
</tbody>
</table>


6.5.2.2 / Cyber violence against women and girls

Accounting for instances of technology-enabled gender-based violence (GBV) is complicated; currently, no single measure adequately captures its intricacies. Codifying and translating the various notions of cyber VAWG into measurable indicators remains a major challenge, as such data are not yet systematically collected and shared. While existing tools such as the Cyber Psychological Abuse Scale and the Revised Cyber Bullying Inventory provide tangible methods, they are limited in the sense that they measure specific cases of technology-enabled GBV and have been tested mostly in developed-country settings (Hinson et al., 2017).

According to UNSTAT (2018), the availability of comparable data remains a challenge for several reasons: different survey methodologies and survey question formulations; uneven data collection efforts; different definitions of partner or spousal violence; lack of an internationally-agreed standard; and different categorisation of sexual violence by non-partners and forms of violence. Efforts to solve this problem include the creation of an Inter-Agency Group on Violence against Women Data, with a Technical Advisory Group (established jointly by WHO, UN Women, UNICEF, UNSD, and UNFPA), to establish a mechanism for compiling harmonised country level data (UNSTAT, 2018).

According to UNSTAT (2018), the availability of comparable data remains a challenge for several reasons: different survey methodologies and survey question formulations; uneven data collection efforts; different definitions of partner or spousal violence; lack of an internationally-agreed standard; and different categorisation of sexual violence by non-partners and forms of violence. Efforts to solve this problem include the creation of an Inter-Agency Group on Violence against Women Data, with a Technical Advisory Group (established jointly by WHO, UN Women, UNICEF, UNSD, and UNFPA), to establish a mechanism for compiling harmonised country level data (UNSTAT, 2018).
6.6 / POTENTIAL OF BIG DATA

The last decade has seen an exponential increase in the amount of digital data produced and captured. "Big data" is an umbrella term used to define large amounts of data generated as a by-product of our interaction with information-sensing devices and services, including mobile phones and social media. The large quantity of data produced, coupled with new approaches to analyzing these datasets, provide opportunities to reexamine social issues such as gender digital divides (Case Study 6.2, above). A 2018 report by UN Women, Gender Equality and Big Data, outlines a range of ways big data techniques are being used globally, highlighting successes and challenges entailed in the use of big data to improve the lives of women and girls. In this regard, organisations have started offering incentives to promote innovative thinking around the use of big data to fill gender data gaps. For example, Data 2x has awarded grants to projects that use mobile phone data to measure gender digital divides and assess financial inclusion. The use of big data is not without risks and limitations. Issues related to privacy as well as access to key datasets are challenges that need to be addressed. In most cases, big data repositories are owned by private organisations, such as telecom operators and banks, that may be constrained in the type of data they can or are willing to share. Even when the data itself is free, the analytical tools and expertise needed to derive insights from the data could make the effort prohibitively expensive (UN Women, 2018).

Another problem with using big data to understand gender issues is that it ignores women who are not online, not using mobile phones, or not generating the online trails or features that can be captured by existing methodologies. Case Study 6.4 details some limitations of gender disambiguation methodologies.

Case Study 6.4
Gender in the Global Research Landscape Gender Disambiguation Methodology
Authors: Sarah Huggett (Elsevier)

Analysing critical issues related to gender disparity and bias require high-quality global data sources and analytical expertise. Elsevier (2017) has implemented an evidence-based examination of gender-relevant research worldwide in our report, "Gender in the Global Research Landscape" (https://www.elsevier.com/research-intelligence/campaigns/gender-17). As a proxy for researchers, we compiled authors of relevant publications (as indexed in Scopus®), Elsevier’s indexing and abstracting database covering over 22,500 journals (https://www.elsevier.com/solutions/scopus). In addition to indexing scholarly output, Scopus indexes authors with an associated unique identifier. This identifier groups together all the documents published by an author, matching alternate spellings and variations of the author’s name and distinguishing between authors with the same name by using data elements associated with their publications.

We combined Scopus data with other data sources to identify gender and country. We gather each author’s list of papers in his or her first year of publication in Scopus, and then derive their country of origin based on the affiliations listed in their papers. (Author profiles without a first name, or with equal numbers of papers in two or more countries, are excluded from the gender disambiguation analysis.)

Genderise.io uses data from social media platforms to provide lists of first names as well as the number of people with this first name that are (self-reportedly) women or men in a given country. We use these lists to calculate the probability that each author’s first name is feminine or masculine in the author’s country of origin. An author’s name needs to have appeared at least five times in the Genderise.io data and the probability that the name associates with a specific gender needs to be at least 85% for us to assign a gender to an author.

We utilise a second data source, NamSor™ Applied Onomastics, that uses sociolinguistic characteristics to mine Big Data sources with its name recognition software. It assigns a gender probability for a given name depending on the individual’s location.

The use of Genderize.io and NamSor tends to work well for authors from Western countries or with Latin or Anglophone names. However, these methodologies are not sufficient for robustly determining the gender of names of authors of African, Arabic, or Asian descent. So, we use a third source for gender disambiguation of author names from Japan: a set of the most common masculine and feminine names from Wikipedia, also used by Larivière et al. (2013).

Gender disambiguation based on author’s first name and country of origin presents challenges, especially for names originally written in non-Roman alphabets or languages using different character sets. The issue is particularly prominent for tonal languages such as Chinese; as the tone is lost in the transliteration, it becomes impossible to distinguish between masculine and feminine names.
There is a serious lack of official statistics on most topics related to gender equality in ICT access, skills, and leadership. This data deficiency exists for most countries and is worst for the developing world. Coverage is best for ICT access, but even here we find large gaps. Where data are available, quality, reliability, and comparability are often issues of concern. Furthermore, an absence of longitudinal data inhibits insights into trends. Factors limiting the collection and usefulness of data include low data-gathering and analysis capacity of both public and private entities in most countries, as well as a diversity of potential indicators, definitions, and data collection methodologies that constrain international comparability.

The paucity of adequate data impedes policy makers from identifying good practices, benchmarking programme effectiveness, and making evidence-based decisions. Not surprisingly, therefore, most recommendations on closing gender digital divides stress the need to collect gender-disaggregated data and improve measurement tools. Such data needs to be routinely collected, analysed, and disseminated. Both supply-side and demand-side data are important in bridging knowledge gaps about the information lives of women. Demand-side data (such as GSMA’s 2018a Global Consumer Survey and the “After Access” surveys, discussed in Part II Chapter 2) provide insights on users’ characteristics, preferences, and habits. However, collecting global demand-side data especially at a global scale is an expensive exercise that is often spearheaded by private sector players, with their own commercial motivations and proprietary interest in keeping the data they collect confidential.

In addition, in-depth research is needed to surface and illuminate issues that may be unique to women (e.g., breastfeeding at work) or that may have invisible gender-based dimensions (e.g., owning a phone versus having control over use of the phone). These types of insights will be best generated through carefully designed studies drawing on multiple research disciplines. Efforts should be directed not only towards identifying and standardising indicators that can capture diverse aspects of ICT access, but also making the data collected openly available.

REFERENCES


INTRODUCTION

The digital gender divide manifests in different ways. Across different countries, varying local institutional constraints and endowments including culture, legal framework, and resources help shape the ways women and girls are disadvantaged in their access and use of digital technologies or their meaningful participation in the digital economy. In a way, no two gender digital divides look alike.

While the main report looks at the digital gender divide at the global scale, this appendix views the issues at the country level. What does gender digital inequality look like in different countries?

Three countries from three different geographical regions (Africa, the Americas, and Asia Pacific) were selected to illustrate how gender digital divides play out in various contexts. Aside from geographical diversity, one of the main considerations in selecting a country to profile was to select a country where women’s political commitment to address the problem such as the Indonesian society despite a strong top-down approach. The issue cuts across education.

This gender divide goes beyond ICT access, skills, and leadership issues. The issue cuts across the Indonesian society despite a strong top-down political commitment to address the problem such as by establishing a full ministry in charge of women’s empowerment.

Among the three countries profiled in this report, Rwanda ranks the highest in the Gender Gap Report of the World Economic Forum ranking 4th out of 144 countries. However, indicators relevant to ICT access and skills still show substantial gap in women’s access vis-à-vis men. Women lag substantially behind men in education attainment which would affect women’s participation in the country’s nascent ICT sector.

By examining local data and resources where available, these country profiles provide a broad overview of gender digital inequality across a broad spectrum of cases: where substantial progress has been made in addressing gender digital divides (Argentina); where the issue persists despite a dynamic ICT market (Indonesia); and where the problem remains substantial despite having high gender equality in other areas (Rwanda). To be sure, these examples are but some of the many forms that the problem of gender digital inequality can take. However, as the data tables below show, there is insufficient official sex-disaggregated data to fully demonstrate the state of gender digital inequality in all three countries.

ARGENTINA

CONTEXT

From as early as 1985, with Argentina’s accession to CEDAW, the country has made continuous efforts towards achieving gender equality. Numerous policies and programs have since been implemented, including gender quotas in labour unions and the creation of the National Women’s Council. With regard to women in ICTs, there exist various academic institutions and civil society organisations that conduct research and encourage women’s participation in the field. These include the Argentine Network of Gender, Science and Technology, and the Center of Studies on Science, Technology and Higher Education. These government policies and public-private collaboration have had positive results. In the 2017 Gender Gap Report of the World Economic Forum, Argentina ranked 34th out of 144 countries in gender parity. It has performed well on some measures of gender parity: ranking 1st in the area of women’s health and survival, 21st in political empowerment, and 44th in educational attainment. However, the country ranked 111th in women’s economic participation.

ACCESS

Argentina is one of the few countries in the world where the digital gender divide in basic access is relatively marginal. According to the latest available data from ITU, there are more women (80%) than men (79%) using a mobile. While more men than women use the computer and internet, the difference is only 2%.

Even in aspects of meaningful use, women’s access to and use of complex ICT services are comparable to men’s. In 2017, Argentina was one of only four countries in the world where there were more women than men owning a bank account (including mobile money accounts), according to data from the Global Findex survey. Based on the same dataset, overall, more women than men have reportedly made or received digital payments in the past year.

Even in aspects of meaningful use, women’s access to and use of complex ICT services are comparable to men’s. In 2017, Argentina was one of only four countries in the world where there were more women than men owning a bank account (including mobile money accounts), according to data from the Global Findex survey. Based on the same dataset, overall, more women than men have reportedly made or received digital payments in the past year.

LEADERSHIP

On the political front, women’s participation and representation has increased steeply over the years with a female president being elected and reelected between 2007 and 2015. Argentina became a pioneer in women’s political participation by instituting a quota system in 1991 which required 30% of all candidates for elections to be women. In 2018, 40% of seats in Argentina’s national parliament were held by women, ranking 17th globally. However, more work needs to be done to ensure that women are more fully engaged in running the public sector.

In decision-making positions, specifically in the public sector at national science and technology institutions and in higher education, women’s representation is lower than men. In 2013, women made up 36% of the Science, Technology, and Productive Innovation Commission of the lower house of parliament. In the same year, the proportion of women in the Ministry of Science, Technology and Innovation (MINCyT) for all categories of staff was at 52%. But women only accounted for one third of staff working in the management and coordination of MINCyT in the National Scientific and Technical Research Council in 2013, there were only 2 females out of 8 board members. In higher education decision-making positions, there were only 8 female rectors among Argentina’s 53 national universities in 2014. Similarly, in the same year, there were 47 male vice-rectors and only 9 were female.

Women’s participation in the economy is low relative to men with the labour force participation rate for women at only 56% for women compared to 82% for men in 2017. Nonetheless, there are sectors where the proportion of women workers is relatively high. For example, in high-skills occupations, 49% of workers are women. However, overall, women are less represented in management positions with only 31% female managers in top management positions (2013), 36% categorised as chief executive, senior officials, and legislators (2014), and 39% in senior and middle management positions (2015).

CONCLUSION

Overall, Argentina has done well in narrowing the digital gender divide in access and skills but not in leadership. The digital gender divide in basic access, and even some aspects of meaningful use where data are available, is getting narrower or even approaching parity. For STEM training, the problem is more related to the overall low level of people studying STEM subjects and pursuing higher education rather than a gender divide. While Argentina was the first country in the world to introduce a quota law ensuring 30% of candidates standing for election are women, women continue to make meaningful participation in the nation’s political life, with little representation in decision making processes in the public sector. Similarly, in the private sector, there are far fewer women represented in senior management roles compared to men.
of accessing digital content in the country. In 2017, mobile subscribers per 100 inhabitants stood at 174. Despite this, there is a gender gap in mobile phone ownership. Only 52% of women owned a mobile phone compared to 64% for men in 2016. There were also fewer women accessing the internet and using a computer.

One aspect of meaningful use where data are available is in the field of digital financial services. Based on data from the World Bank Findex (2017), Indonesia is one of only four countries in the world where there are more women than men owning a bank account (including mobile money account). There are also more women than men who have made or received digital payments in the past.

**SKILLS**

Access to education and low digital literacy have been cited as key barriers that exacerbate the gender digital divide in Indonesia. Unfortunately, ITU does not have gender-disaggregated data on basic ICT skills for the country. Nonetheless, this problem of low digital literacy and skills being addressed by the government through formal educational channels. The national education curriculum includes specific objectives for a subject on basic computing skills and the primary and secondary levels to improve. Women lag behind men across primary, secondary, and tertiary educational attainment. In fields related to STEM and ICT, the number of female tertiary graduates in these areas also falls behind male graduates. Of the total graduates in tertiary STEM programme in 2014, only 38% were women. In the field of ICT and engineering/manufacturing and construction, the percentage share of women graduates stood at 36% in 2014. The reverse is true in health and welfare programs where there are more women graduates than men.

In Indonesia, there is political commitment to promote the integration of ICT in education. The national policy and national plan include strategies to integrate ICTs in education at the primary and secondary levels. Outside traditional educational routes, non-government and for-profit organisations have been active in urban areas in promoting alternative pathways to ICT skills upgrading through coding boot camps, she-hacks (or hackathons exclusive to women) among others.

**CONCLUSION**

The state of the gender digital divide across access, skills, and leadership in Indonesia remains an ongoing concern. Incomplete data on meaningful access prevent us from drawing a holistic picture of the state of the gender digital divide beyond basic access. Top-down embrace of policies related to women empowerment has not resulted to the desired outcome, some of greater gender parity. Structural issues including digital literacy, access to education and economic opportunities are some of the underlying issues that are seen as contributing to the gender digital divide.

**REFERENCES**


**Databases consulted:**
- ILOSTAT
- ITU Statistics
- UNESCO UIS
- World Bank Women, Business and the Law 2018
RWANDA CONTEXT

Rwanda has made efforts in recent years to attain gender equality through implementation of numerous policies and commitments at different levels of society. At the international level, Rwanda is committed to the Convention on the Elimination of All Forms of Discrimination against Women and has adopted the Beijing Platform for Action. On a national level, the Ministry of Gender and Family Promotion was established in 2003 to promote gender equality throughout the development process of the country. In 2010, the National Gender Policy was initiated which requires each government ministry to have a gender sector policy and strategic plan. At both the national and local levels, the National Women’s Council (an organ under the Ministry of Gender and Family Promotion) facilitates forums and development activities for women’s empowerment.

In addition, there are Faith Based Organisations at the community and family level that create dialogues for healthy gender relations. These efforts have resulted in positive outcomes leading to Rwanda ranking 4th out of 144 countries in the 2017 Global Gender Gap Report. Despite these efforts, there are still significant gender digital divides in Rwanda.

ACCESS

While the ITU does not have gender disaggregated data on access and use of ICTs in Rwanda, we can glean the state of gender digital divides in the country using data from the Integrated Household and Living Condition Survey (EICV) 4 administered by the National Institute of Statistics of Rwanda in 2015. In general, women lag behind men in basic access. In 2015, female-headed households had lower access to ICT assets such as mobile phones (51% versus 68% for male-headed households) and computers (2% versus 3%). The percentage of households whose members had access to the internet was also lower for female-headed household (8% as compared to 10% for male-headed households).

The EICV 4 data also notes that the percentage of the population aged 15 years and above that is computer literate is lower for females (7%) as compared to males (10%). In terms of meaningful access, 33% of females made or received digital payments in the past year which is much lower than male respondents (49%). Barriers to basic and meaningful ICT access include cultural norms that assign women traditional gender roles, such as responsibility for household chores and child care activities. This results in women not having enough free time to access or use ICTs.

In terms of leadership, women are well represented in the public sector but not in the economic sphere. Rwanda currently leads the world with the highest number of women elected to parliament. As of June 2018, the lower house consisted of 65% women and the upper house 38% women. However, the proportion of women in government ministerial positions was lower than men at 40% in 2016. There were also more women governors in Rwanda as of 2016 (60% women governors) but only 17% of mayors were women.

Leadership positions are under-represented in economic leadership positions. The economy of Rwanda is primarily agriculture-based, and this is where majority (79%) of female workers over the age of 16 are found. In 2014, only 14% of total management positions were held by women. About 40% of positions in high skills occupations were held by women. Based on the 2016 National Gender Statistics Report of Rwanda, only 0.1% of female workers work in the information and communication sector and 0.2% work in professional, scientific and technical activities (compared to 0.3 and 0.6% respectively for men). The report also shows that in 2014 there were only 18 female managers of information and communication establishments, compared to 375 male managers. The number of female managers of professional, scientific and technical establishments was less than half that of males (308 compared to 654).

CONCLUSION

The problem of basic access in Rwanda is true for both men and women but is more acute for women. In general, Rwanda has fared well in narrowing gender gaps in educational attainment especially at the primary and secondary levels. However, challenges remain at the tertiary level where there are less women enrolled in tertiary programs and especially in STEM related programs. Women are visible and well represented in the political sphere but not in economic activities. The low participation of women in ICT-related economic activities is related to the general composition of the economy – the main national industries are agriculture, forestry, and fishing. To ensure appropriate policymaking and interventions, more official statistics and rigorous research are needed on the state of female access to ICTs and participation in the digital economy.

REFERENCES


## Table A.1
Mobile and internet access, by country

<table>
<thead>
<tr>
<th>INDICATOR</th>
<th>DATA SOURCE</th>
<th>Argentina</th>
<th>Indonesia</th>
<th>Rwanda</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic Access (ITU indicators, 2017)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fixed-telephone subscriptions per 100 inhabitants</td>
<td>ITU</td>
<td>21.5</td>
<td>4.2</td>
<td>0.1</td>
</tr>
<tr>
<td>Mobile-cellular subscriptions per 100 inhabitants</td>
<td>ITU</td>
<td>139.8</td>
<td>173.8</td>
<td>72.2</td>
</tr>
<tr>
<td>Using a mobile phone (%), Female (Male) 2016</td>
<td>ITU</td>
<td>80 (79)</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Owning a mobile phone (%), Female (Male) 2016</td>
<td>ITU</td>
<td>N/A</td>
<td>52 (64)</td>
<td>N/A</td>
</tr>
<tr>
<td>Fixed-broadband subscriptions per 100 inhabitants</td>
<td>ITU</td>
<td>15.2</td>
<td>1.2</td>
<td>0</td>
</tr>
<tr>
<td>Mobile-broadband subscriptions per 100 inhabitants</td>
<td>ITU</td>
<td>78</td>
<td>95.6</td>
<td>35</td>
</tr>
<tr>
<td>Households with a computer (%)</td>
<td>ITU</td>
<td>66</td>
<td>19.1</td>
<td>4.5</td>
</tr>
<tr>
<td>Households with internet access at home (%)</td>
<td>ITU</td>
<td>71.8</td>
<td>47.2</td>
<td>9.3</td>
</tr>
<tr>
<td>Individuos using the internet (%), Female (Male) 2016</td>
<td>ITU</td>
<td>70 (72)</td>
<td>24 (28)</td>
<td>20</td>
</tr>
<tr>
<td>Individuos using the computer (%), Female (Male) 2016</td>
<td>ITU</td>
<td>46 (48)</td>
<td>16 (48)</td>
<td>N/A</td>
</tr>
</tbody>
</table>

### Meaningful Access 2017

<table>
<thead>
<tr>
<th>INDICATOR</th>
<th>DATA SOURCE</th>
<th>Argentina</th>
<th>Indonesia</th>
<th>Rwanda</th>
</tr>
</thead>
<tbody>
<tr>
<td>Used the internet to pay bills or to buy something online in the past year (% age 15+: male/female %)</td>
<td>World Bank</td>
<td>19 (21/16)</td>
<td>11 (9/13)</td>
<td>5 (6/3)</td>
</tr>
<tr>
<td>Used a mobile phone or the internet to access an account (% age 15+: male/female)</td>
<td>World Bank</td>
<td>10 (14/8)</td>
<td>8 (7/8)</td>
<td>29 (34/24)</td>
</tr>
<tr>
<td>Made or received digital payments in the past year (% age 15+)</td>
<td>World Bank</td>
<td>40 (38/42)</td>
<td>35 (34/35)</td>
<td>39 (45/33)</td>
</tr>
</tbody>
</table>

## Violence against Women

<table>
<thead>
<tr>
<th>INDICATOR</th>
<th>DATA SOURCE</th>
<th>Argentina</th>
<th>Indonesia</th>
<th>Rwanda</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is there domestic violence (covering physical, sexual, emotional and economic) legislation?</td>
<td>World Bank</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Do protection orders for domestic violence exist?</td>
<td>World Bank</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Is there legislation that specifically addresses sexual harassment?</td>
<td>World Bank</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>Is there sexual harassment legislation in public places?</td>
<td>World Bank</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>Are there civil remedies for sexual harassment in employment?</td>
<td>World Bank</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>Subjected to a current/former intimate partner (%)</td>
<td>UN Women</td>
<td>N/A</td>
<td>N/A</td>
<td>20.4</td>
</tr>
</tbody>
</table>
Table A.3
Women in employment, entrepreneurship, and policymaking, by country

<table>
<thead>
<tr>
<th>INDICATOR</th>
<th>DATA SOURCE</th>
<th>Argentina</th>
<th>Indonesia</th>
<th>Rwanda</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proportion of females in high-skil occupations, 2017</td>
<td>ILO</td>
<td>48.9%</td>
<td>45.7%</td>
<td>40%</td>
</tr>
<tr>
<td>Proportion of females in Telecommunications industry, 2016</td>
<td>ILO</td>
<td>N/A</td>
<td>27.8%</td>
<td>N/A</td>
</tr>
<tr>
<td>Proportion of female ICT Professionals</td>
<td>ILO</td>
<td>21.4% (2014)</td>
<td>5.3% (2015)</td>
<td>N/A</td>
</tr>
<tr>
<td>Proportion of female Electrical and Electronic Trades Workers, 2016</td>
<td>ILO</td>
<td>N/A</td>
<td>12.2%</td>
<td>N/A</td>
</tr>
<tr>
<td>Proportion of female business school faculty</td>
<td>UNESCO Institute for Statistics</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Proportion of female managers - Total management</td>
<td>ILO</td>
<td>38.6% (2016)</td>
<td>21.5% (2015)</td>
<td>N/A</td>
</tr>
<tr>
<td>Proportion of female managers - Senior &amp; middle management</td>
<td>ILO</td>
<td>38.6% (2016)</td>
<td>21.5% (2015)</td>
<td>N/A</td>
</tr>
<tr>
<td>Proportion of female managers - Chief executives, senior officials &amp; legislators</td>
<td>ILO</td>
<td>29.7% (2014)</td>
<td>15.4% (2016)</td>
<td>N/A</td>
</tr>
<tr>
<td>Proportion of female managers - Telecom, other ICT companies</td>
<td>ILO</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Proportion of female members and heads - Academies of Science</td>
<td>ILO</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Gender pay gap: managers, professionals, technicians &amp; associate professionals</td>
<td>ILO</td>
<td>23.7% (2013)</td>
<td>9.2%</td>
<td>N/A</td>
</tr>
<tr>
<td>Proportion of time spent on unpaid domestic and care work (female/male)</td>
<td>ILO</td>
<td>23.7%</td>
<td>8.2% (2013)</td>
<td>N/A</td>
</tr>
<tr>
<td>Non-discrimination clause mentions gender</td>
<td>WB Women, Business &amp; the Law (WB WBL) 2018</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Maternity leave, paid breastfeeding options at work (women/first 6 months)</td>
<td>WB WBL 2018</td>
<td>42/60</td>
<td>58/60</td>
<td>N/A</td>
</tr>
<tr>
<td>Equal pay for equal work policy</td>
<td>WB WBL 2018</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Experience workplace discrimination/harassment</td>
<td>WB WBL 2018</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Entrepreneurship

<table>
<thead>
<tr>
<th>INDICATOR</th>
<th>DATA SOURCE</th>
<th>World Bank</th>
<th>OECD</th>
<th>WB Global Index 2017</th>
<th>WB Global Index 2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Firm with female participation in ownership</td>
<td>World Bank</td>
<td>38%</td>
<td>22%</td>
<td>42.70%</td>
<td></td>
</tr>
<tr>
<td>Access to business training</td>
<td>OECD</td>
<td>N/A</td>
<td>N/A</td>
<td>51.6%</td>
<td>46%</td>
</tr>
<tr>
<td>Bank/micro account ownership, 2017 (female/male)</td>
<td>WB Global Index 2017</td>
<td>50.8%</td>
<td>56.5%</td>
<td>55.4%</td>
<td>55.7%</td>
</tr>
<tr>
<td>Saved at financial institution, 2017 (female/male)</td>
<td>WB Global Index 2017</td>
<td>4.9%</td>
<td>9.6%</td>
<td>22.3%</td>
<td>20.7%</td>
</tr>
<tr>
<td>Borrowed from financial institution (female/male), 2017</td>
<td>WB Global Index 2017</td>
<td>7.6%</td>
<td>7%</td>
<td>16.8%</td>
<td>17.6%</td>
</tr>
<tr>
<td>Access to venture capital</td>
<td>WB Global Index 2017</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Policymaking

<table>
<thead>
<tr>
<th>INDICATOR</th>
<th>DATA SOURCE</th>
<th>Inter Parliamentary Union</th>
<th>UN-INTERPOL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proportion of seats held by women in national parliament</td>
<td>Inter Parliamentary Union</td>
<td>40%</td>
<td>20%</td>
</tr>
<tr>
<td>Heads of ICT ministries/regulatory agencies (female/male)</td>
<td>UN-INTERPOL</td>
<td>1 female, 0 male</td>
<td>0/2</td>
</tr>
</tbody>
</table>

Note: Red indicates less than 50% of men/women reporting ability to perform specific digital skill. Purple indicates more than 50% of men/women reporting ability to perform specific digital skill.

Table B.2 Asia
Basic ICT Access Indicators, Most Recent Year (2014–2016)

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>Using a computer</th>
<th>Using the internet</th>
<th>Individuals using a mobile cellular telephone</th>
<th>Owning a mobile phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Azerbaijan</td>
<td>F% 75</td>
<td>M% 82</td>
<td>F% 70</td>
<td>M% 77</td>
</tr>
<tr>
<td>Bahrain</td>
<td>F% 73</td>
<td>M% 70</td>
<td>F% 99</td>
<td>M% 98</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>F% 4</td>
<td>M% 7</td>
<td>F% 77</td>
<td>M% 85</td>
</tr>
<tr>
<td>Brunei Darussalam</td>
<td>F% 58</td>
<td>M% 50</td>
<td>F% 99</td>
<td>M% 99</td>
</tr>
<tr>
<td>Cambodia</td>
<td>F% 27</td>
<td>M% 27</td>
<td>F% 32</td>
<td>M% 32</td>
</tr>
<tr>
<td>Cyprus</td>
<td>F% 68</td>
<td>M% 72</td>
<td>F% 73</td>
<td>M% 73</td>
</tr>
<tr>
<td>Georgia</td>
<td>F% 59</td>
<td>M% 58</td>
<td>F% 57</td>
<td>M% 60</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>F% 80</td>
<td>M% 83</td>
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Note: Red indicates less than 50% of men/women reporting ability to perform specific digital skill. Purple indicates more than 50% of men/women reporting ability to perform specific digital skill.

Table B.3 Europe
Basic ICT Access Indicators, Most Recent Year (2014–2016)

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Note: Red indicates less than 50% of men/women reporting ability to perform specific digital skill. Purple indicates more than 50% of men/women reporting ability to perform specific digital skill.
## Table C.1

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Note: Red – less than 50% of men/women reporting ability to perform specific digital skill. Purple – more than 50% of men/women reporting ability to perform skill.

Data Source: WITD Database, 2017.

## Table C.2

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<td>49.9</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Switzerland</td>
<td>70.7</td>
<td>67.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Macedonia</td>
<td>41.7</td>
<td>38.9</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>United Kingdom</td>
<td>66.4</td>
<td>56.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Red – less than 50% of men/women reporting ability to perform specific digital skill. Purple – more than 50% of men/women reporting ability to perform skill.

Data Source: WITD Database, 2017.
APPENDIX D:
SAMPLE ILO SECTOR
AND OCCUPATION
CLASSIFICATIONS

International Standard Industrial Classification of All
Economic Activities (ISIC), Rev.4

C – Manufacturing (23 subcategories including):
• 26 - Manufacture of computer, electronic and optical
  products
• 27 - Manufacture of electrical equipment
• 33 - Repair and installation of machinery and equipment
• H - Transportation and storage
• 49 - Land transport and transport via pipelines
• 50 - Water transport
• 51 - Air transport
• 52 - Warehousing and support activities for transportation
• 53 - Postal and courier activities

M - Professional, scientific and technical activities
• 67 - Legal and accounting activities
• 70 - Activities of head offices; management consultancy
  activities
• 71 - Architectural and engineering activities; technical
  testing and analysis
• 72 - Scientific research and development
• 73 - Advertising and market research
• 74 - Other professional, scientific and technical activities
• 75 - Veterinary activities

J - Information and communication
• 58 - Publishing activities
• 59 - Motion picture, video and television programme
  production, sound recording and music publishing
  activities
• 60 - Programming and broadcasting activities
• 61 - Telecommunications
• 62 - Computer programming, consultancy and related
  activities
• 63 - Information service activities

R - Arts, entertainment and recreation
• 90 - Creative, arts and entertainment activities
• 91 - Libraries, archives, museums and other cultural
  activities
• 92 - Gambling and betting activities
• 93 - Sports activities and amusement and recreation
  activities

S - Other service activities
• 94 - Activities of membership organizations
• 95 - Repair of computers and personal and household
  goods
• 96 - Other personal service activities


International Standard Classification of Occupations
(ISCO 08), major & sub-major groups

1 Managers
• 11 - Chief Executives, Senior Officials & Legislators
• 12 - Administrative & Commercial Managers
• 13 - Production & Specialized Services Managers
• 14 - Hospitality, Retail and Other Services Managers

2 Professionals
• 21 - Science and Engineering Professionals
• 22 - Health Professionals
• 23 - Teaching Professionals
• 24 - Business and Administration Professionals
• 25 - Information and Communications Technology Professionals
• 26 - Legal, Social and Cultural Professionals

3 Technicians and Associate Professionals
• 31 - Science and Engineering Associate Professionals
• 32 - Health Associate Professionals
• 33 - Business and Administration Associate Professionals
• 34 - Legal, Social, Cultural and Related Associate Professionals
• 35 - Information and Communications Technicians

4 Clerical Support Workers
• 41 - General and Keyboard Clerks
• 42 - Customer Services Clerks
• 43 - Numerical and Material Recording Clerks

5 Services and Sales Workers
• 51 - Personal Services Workers
• 52 - Sales Workers
• 53 - Personal Care Workers
• 54 - Protective Services Workers

6 Skilled Agricultural, Forestry and Fishery Workers
• 61 - Market-oriented Skilled Agricultural Workers
• 62 - Market-oriented Skilled Forestry, Fishery and Hunting
  Workers

7 Craft and Related Trades Workers
• 72 - Metal, Machinery and Related Trades Workers
• 73 - Handcraft and Printing Workers
• 74 - Electrical and Electronic Trades Workers

8 Plant and Machine Operators and Assemblers
• 81 - Stationary Plant and Machine Operators
• 82 - Assemblers
• 83 - Drivers and Mobile Plant Operators

9 Elementary Occupations

10 Armed Forces Occupations
INTRODUCTION

Part Two deals thematically with three key elements in achieving goals of the EQUALS partnership: People, Skills and Pathways.

People. The emphasis on people first underlines the importance of viewing technology in its social context. Technology does not exist in a vacuum but is embedded in society: technology has social impact, and it functions in social contexts and is shaped by social factors. The People section examines how technology impacts society through inclusion or exclusion of people in various groups — on the basis of gender (in all its varieties), age, disability, and geographical location. The papers in this section cover a range of factors: gender variance in relation to technology; North vs. South differences in the gender digital gap; the participation and use of technology by female children, youth and women with disabilities; and the potential for women’s empowerment in rural areas through access to ICTs.

Skills. The skills needed for full participation in technology are wide and varied. To secure privacy and security in modern society, women need at least basic digital and security skills. At a higher level, women need to be involved in designing systems and tools for privacy and security that address their situation and needs. Papers in this section focus on key questions. Are educational institutions doing the job in closing STEM education gaps? Are differential skill levels and cognitive abilities responsible for the gender wage gap in technology? And whether all jobs in the technology industry enhance technology skills and provide advancement possibilities for women, as illustrated in the case of call centre employment.

Pathways. EQUALS is dedicated to achieving global gender equality in the processes and benefits of technology, especially in information and communication technologies and STEM. What are the ways to achieve this result? What courses of action are needed? This section examines some of the paths that have been suggested towards gender equality in technology, asking whether their promises have been fulfilled and what remains to be done to achieve them. The authors examine the empowerment of women in the technology workforce, the participation of women in knowledge and technology transfer, and the prognosis for gender equality in the rapidly expanding field of Artificial Intelligence.
Taking Stock: Data and Evidence on Gender Digital Equality

PART TWO

UNIVERSITY OF NEW HAMPSHIRE

UNIVERSITY) AND REMY FROST

TINA BEYENE (CALIFORNIA STATE

AUTHORS:

DIGITAL

GENDER

VARIANCE

GENDER

1

1

208 209

Image 314x-1 to 596x843

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•

•

KEY FINDINGS

• Policy and research on gender and ICT generally focus on women understood as a binary category: male/female, excluding consideration of transgender people, gender identity, and sexual preference. Consequently, most approaches to women and ICT do not capture the relationship of gender and sexual minorities to ICTs.

• The spread of internet access and social media permit gender and sexual minorities authentically to express their gender within their communities, without the stress of medically and/or socially transitioning or pressures of “coming out”. Smart phones and mobile apps facilitate fast, affordable, and culturally relevant dissemination of crucial services such as eHealth interventions to gender and sexual minorities.

• Recent moves by the largest social media platforms allowing users to customise their gender have made social media more accessible to gender and sexual minorities. However, social media platforms still sell to advertisers user information that is coded along binary gender categories.

• Technology-driven surveillance and cyberbullying of gender and sexual minorities is increasing. These tactics are now common occurrences worldwide, leading to workplace discrimination, physical attacks, blackmail, arrest, detention, torture, sexual assault, and murder of gender and sexual minorities.

INTRODUCTION

Scholars of gender and technology have extensively examined the gender digital divide, highlighting the marginalisation of women and girls in the tech field and the potential of ICTs to empower them (Buskens & Webb, 2016; Hafkin & Huyer, 2006; Lopes & Ballur, 2018; Sanarsen, Faulkner, & Room, 2011; Treinen & Van der Elst, 2018). Overwhelmingly, these studies of the gender digital divide conceptualise gender as binary system of biological “male” and “female” sexes and further assume a division between masculinity and femininity that neatly aligns with male/female, gender identity, and sexual identity. These divisions are used to frame research, policy, and activism in ways that occlude gender and sexual minorities — are often used interchangeably, although there are complex histories and theories behind each of these designations. For a full discussion of these political histories see Stryker (2008 and 2017) and Halberstam (2018).

ABSTRACT

Gender is a broad and fluid social construct that is not limited to the conventional male/female dichotomy that commonly informs gender analysis in ICT. Despite two decades of lesbian, gay, bisexual, transgender, queer, and intersex (LGBTQI) scholarship that has shown how gender and sexuality are lived along a wide spectrum — with great variation across regions, age groups, times, spiritual traditions, and cultural practices — the framing of gender and ICT overwhelmingly focuses on women, understood in binary terms. Hence, data is scant on access, inclusion, and innovation of gender and sexual minorities in the ICT sector. Despite the lack of accurate data, gender and sexual minorities innovatively employ computer language coding, gaming, social media, and mobile apps as empowerment tools, using them to raise awareness about discrimination and violence and to build social and political communities. But the spread of ICTs also raises concerns of safety for gender and sexual minorities, who face harassment and violence via technology-based surveillance tactics. Because of the extreme discrimination, violence, and surveillance they face, gender and sexual minorities have a unique set of needs for ensuring their success in employment in the ICT sector, including issues of healthcare, equitable work spaces, safety, visibility, and mentorship. This chapter reviews the intersection between gender and sexual minorities and ICTs, examining the opportunities for access and use and assessing the pitfalls involved. It ends with suggestions for further research and programming to promote gender and sexual equality in ICT.

AUTHORS:

TINA BEYENE (CALIFORNIA STATE UNIVERSITY) AND REMY FROST (UNIVERSITY OF NEW HAMPSHIRE)
Emerging Legal Frameworks for Gender and Sexual Rights

Recent activism by gender and sexual minorities has led to important changes in the public policy realm, including legislation that has initiated positive actions on behalf of gender and sexual minorities. The most important initiative was the 2016 resolution by the Office of the United Nations High Commissioner for Human Rights (OHCHR) denouncing “violence and discrimination based on sexual orientation, and gender identity” and appointing an independent expert on discrimination and violence against sexual and gender minorities (United Nations General Assembly, 2016). The OHCHR’s online Free and Equal Campaign, raising awareness about human rights violations affecting the LGBTIQ community, has to-date generated 2.3 billion social media feeds. Many United Nations agencies have also called for an end to requiring transgender people to undergo surgery and sterilisation against their will (National Center for Transgender Equality, 2016). The UN Women, along with OutRight International, has similarly advocated for the abolition of LGBTIQ voices at all levels of programmatic intervention to end gender-based violence (Mlambo-Ngcuka, 2017). Regional initiatives such as the 2016 resolution by the Office of the United Nations High Commissioner for Human Rights, which targets to end gender-based violence (Mlambo-Ngcuka, 2017). Regional initiatives such as the 2016 resolution by the Office of the United Nations High Commissioner for Human Rights, which targets to end gender-based violence (Mlambo-Ngcuka, 2017).

GENDER AND SEXUAL DISCRIMINATION: THE LEAKY EDUCATION–WORKPLACE PIPELINE

While data is scarce on workplace discrimination against gender and sexual minorities in ICTs, general patterns reveal that the challenges that LGBTIQ employees face in the workplace are often different from what are experienced outside of the workplace. LGBTIQ employees experience workplace discrimination including cyberbullying, workplace hostility, and harassment by colleagues, including monitoring their personal social media accounts, spreading rumors and creating a hostile work and living environment (Raffree, 2015). Such vigilantism prevents LGBTIQ workers from safely building communities against threats of physical violence and aggressive policing. Violations were especially intense in parts of the world with rampant legal and cultural discrimination against LGBT people and where hostile governments control the internet.

Employment discrimination is closely related to education discrimination. In many regions of the world, transgender students are pushed out of school by harassment and discrimination. The United Nations High Commissioner for Human Rights (2015) reports that 77% of surveyed individuals who were out or perceived as transgender in their school-age years had left school as a result of abuse, including verbal harassment, restriction on dressing according to their gender identity, harassment, and physical/sexual assault (James et al., 2016). In college or vocational school, 29% of people who were out or perceived as transgender also reported verbal, physical, or sexual harassment (James et al., 2016).

Nor do advanced degrees guarantee fair treatment: in South Africa, transgender women with advanced degrees reported working in positions far below their qualifications, due to workplace discrimination on the basis of gender identity (UNDP et al., 2016). A United Nations Educational, Scientific and Cultural Organization (UNESCO) survey of students in Thailand found that more than half of LGBTIQ respondents had been bullied in the previous month, and more than 30% had experienced physical abuse; similar statistics are reported in other countries (UNESCO, 2016). The implication for the ICT sector is clear: there is a “leaky pipeline” for gender and sexual minorities who are forced to drop out of school, limiting their access to technology and vocational skills.

In short, “legal gender recognition [is] a prerequisite to fair employment” (Office of the United Nations High Commissioner for Human Rights, 2015, p. 42). It is imperative for states, ICT sector policy makers, employers and educators to prioritise the rights of gender and sexual minorities to fair and equal education and employment.

The Rise of Cyber Threats Against Gender and Sexual Minorities

With the rise of the internet, social phones, and social media, technology-enhanced threats against LGBTIQ people have become commonplace (Cluningham, 2013). Anti-LGBTIQ groups, individuals, and states use technology-based surveillance tactics to identify people online in order to prosecute them, harm them offline, and exclude them from political and social life. Common tactics include doxing, phishing (via software such as Trojan spyware and Fin Spy software), metadata mining, and requesting users’ personal profile information from host sites or internet services (Cluningham, 2013). Social media platforms such as
Facebook, Twitter and Skype have been transformed into tools for exposing the identities, networks, and location of non-conforming individuals to enable physical attacks, cyber-harassment, threats, lies, and sexual assault (Clunaghi, 2013, p. 125). Individual harassers — as well as repressive governments — also deploy these platforms for “cyberwar,” the illicit practice of luring gender and sexual minorities for a supposed liaison and then exposing, extorting, and attacking them (Clunaghi, 2013). Most infamously, in the early 2000s, the Egyptian government cracked down on LGBTQI communities by luring them on dating sites (Clunaghi, 2013).

While hostile parties use technology-enabled violations against sexual and gender minorities, LGBTQI activists deploy ICTs to combat cyber threats. Activist groups such as Tactical Technology Collective (Tactical Tech) and Frontline Defenders have responded to the growing cybersecurity threats to LGBTQI communities by providing training to human rights workers on digital safety. They teach strategies such as removing work-related collaborations from social media sites and deleting metadata from files (especially photographs, which can include GPS location information). These groups also provide popular security training manuals in various languages.

ICTs are also used by human rights activists to document the rampant extent of new and old digital human rights violations around the world. Between 2008 and 2014 alone, the Trans Murder Monitoring Project recorded 1612 murders of gender-variant/transgender people in 62 countries (Transgender Europe, n.d.). Transgender people also face much higher rates of intimate partner violence than other groups (UNDP et al., 2016). Open-source software programmes such as Martus and OpenEvsys allow LGBTQI groups to securely record and report violations in real-time. Martin is a program used in Uganda to document 782 cases of human-rights violations against transgender people; it has also helped individuals who face risk of computer confiscation by police (30). OpenEvsys has been useful for the Transgender Europe project’s efforts to track transphobia. Another possible ICT tool recommended by UNDP for adoption by gender and sexual minorities is Ushahidi, an open-source programme compatible with smart phone that is used by women’s rights activists to generate Crowdmap, a digital map that allows users to record and share threats and attacks in real-time (31). As UNDP notes, programmes like Martus and OpenEvsys do not require sophisticated technical know-how, making them ideal tools for community organisations (UNDP et al., 2016).

While e-health interventions are promising, as UNDP points out, health information on the web for gender minorities remains scarce, and (when available) is mostly in English (UNDP et al., 2016). Moreover, in many parts of the world, low literacy rates is a barrier for gender minorities’ use of ICTs for health services and information (UNDP et al., 2016), reflecting the faceless inaccessibility of gender/sexual discrimination in education and highlighting the need for a multi-pronged anti-discrimination strategy.

**Computer Games and Virtual Reality**

The internet in particular has emerged as a “preliminary, complementary, and/or alternative” site of gender transition, community development, and empowerment of these marginalised populations (Marciano, 2014). The world of internet games and virtual reality (VR) have been especially instrumental for non-conforming individuals (including transgender, gender non-binary, and questioning), allowing them to express different gender identities without pressure to transition medically and/or socially (Costello, 2014). In the 1990s, role-playing games (RPGs) provided new spaces for gender non-conforming players to socially and culturally authenticate their gender expression (Costello, 2014; Cross, 2012; Griffiths, Arcelus, & Browne, 2016). These applications particularly enable anonymity and neutrality, by eliminating vocal pitch, appearance, and other indicators of users’ gender (Turkle, 1997). This include multi-user dungeons/dungeons, a multiplayer real-time virtual world that integrates role-playing game mechanics, online chat and so on; and Internet Relay Chats (IRCs), a chatting system that uses rules and conventions and client-server software. RPGs also allow more tangible trans and non-binary expression, especially for individuals who may not be able to physically transition or who are reluctant to transition out of fear of harassment, discrimination, and/or violence (Turkle, 1997). Popular games such as Second Life or Sim World offer millions of players the option to choose a gender avatar that differs from their assigned and/or lived gender and to explore new embodiments. It is important to note that many virtual worlds still construct gender as binary, limiting users’ choices to “male” and “female” avatars. However, as scholar and gamer Kathleen Angel notes, RPGs such as World of Warcraft allow for “creative resistance” and self-formation within a framework that was never intended by the game developers to accommodate such modes of expression (Cross, 2012). Indeed, after developers and other pronoun sets of IRCs and MUDs and popularised them across servers (Danet, 1998).

**Social Media**

Recent moves by the largest social media platforms to expand their gender marker options have opened up unprecedented opportunity for gender minorities. Facebook, Google+ and Twitter all now allow users to customise their gender or choose from a wide range of gender identities. Facebook’s user registration interface now lets users identify their pronouns or gender identity options. Twitter and LinkedIn do not mandate new users to supply information about their gender, and many other platforms now also give users control over their preferred pronouns. These design decisions increase access and inclusion for non-binary users, and they may also be instrumental in expanding general awareness of the broader gender spectrum, potentially beyond the digital world and into the physical.

While social media companies’ foray into a wider gender spectrum does open up prospects for self-determination of gender and sexual minorities, these companies also perpetuate gender binaries by selling gender data — and doing so in ill-considered
ways. Social media platforms that have broadened gender concepts in certain platforms (such as the public-facing profile pages and news feeds) are shown to rewire in other spaces, such as adverisement sign-up pages, without users’ awareness (Bivens & Haimson, 2016). Hence, the millions of users who use social media platforms before gender customisation options were available still inhabit the original gender-binary categories, because marketers frequently tailor advertisement along gender binary lines, which may violate users’ sense of themselves (Bivens & Haimson, 2016). For instance, Twitter allows a Linky system and other advertising partners to algorithmically extract users’ gender-based information (Bivens & Haimson, 2016, p. 7), while Facebook forces users to make public personal information, such as legal name, profile picture, and gender. Such requirements may make it more difficult for people to freely, creatively, and comfortably express their gender. Hence, while it is important to note the potential such social media practices hold to accelerate social and political change, it is equally important to underscore “the capacity for software to misgender users under the surface” (Bivens & Haimson, 2016, p. 5) and to safeguard against such possibilities.

Gathering data about gender and sexual minorities matters because good data demonstrates the existence of gender and sexual minorities, which many repressive government and cultural groups deny (Williams Institute, 2014), helps destigmatise the existence of gender and sexual minorities, which matters because good data demonstrates the protection of the rights of gender and sexual minorities. To expand under-served gender and sexual minorities’ access and use of ICTs, such as internet and mobile apps, address the unique needs of these individuals who are also members of other under-represented groups.

To protect gender and sexual minorities as ICT users, under-represented groups, encourage ICT-related institutions and agencies to include gender and sexual minorities in the shaping of gender equality frameworks at all levels. To end technology-driven security threats, raise awareness of the threats experienced by gender and sexual minorities communities throughout the ICT sector — with employers, healthcare providers, educational institutions, and human rights activists, among others. This effort could include: integrating digital security practices into the ICT environment of specific communities at risk; supporting capacity building of groups combating cyber threats in LGBTQI communities; providing cyber safety training manuals in various languages and geared toward technology users with varying literacy levels; and encouraging social media providers to adopt cybersecurity measures to prevent their technologies being used to perpetrate crimes.

To decrease workplace discrimination, train key ICT sector employers about the complexity of gender and sexual minorities’ experiences. Encourage them to implement preferred gender pronoun use in the workplace, provide adequate health care (including gender-affirming surgery and mental health care), ensure the availability of non-discriminatory facilities, and adopt cybersecurity measures that protect the rights of LGBTQI workers.

To expand the wellbeing of gender and sexual minorities via mobile technologies, mobile phone operators (and their associations, such as GSMA) should reach out to serve the LGBTQI communities and protect their privacy.

To ensure the gender concepts in ICT do not mischaracterise people’s self-understanding of their gender or reinforce discrimination, encourage ICT-related institutions and agencies to include gender and sexual minorities in the shaping of gender equality frameworks at all levels.

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To end violence and discrimination based on sexual orientation and gender identity, integrate gender and sexual minorities in the framing of the global gender digital divide, and promote the resulting framework via high-profile campaigns tailored for the ICT sector.

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INTRODUCTION

Central to the call for digital equality are claims that the internet has the potential to be a driver of accelerated progress towards the achievement of the Sustainable Development Goals (SDGs) contained in the UN’s 2030 Agenda for Sustainable Development. It is important to understand how these benefits are distributed between men and women, and why there appears to be significant unevenness in their adoption at a global and national level. Yet our ability to assess where we stand currently in relation to access and use of the internet, and to measure progress toward achieving SDG targets related to information and communication technologies (ICTs), is constrained by the dearth of reliable data. Data collection is particularly problematic in pre-paid mobile markets: supplier data does not capture the number of unique subscribers, nor does it show users’ demographic characteristics. This research aims to address these data challenges through quantitative and qualitative analysis of ICT access and use across the Global South, and by examining the barriers to online access and the limitations on optimal use. Findings are derived from the After Access 2017 household and individual survey, a nationally representative survey of ICT access and use undertaken by DIRSI, LIRNEasia, and IRA, across 17 countries in the Global South. Households were selected from the national sampling frame using simple random sampling. First, the head of the household was interviewed to obtain household indicators. Next, an individual (15 years or older) was randomly selected from each household to be interviewed about their mobile access and usage. The findings highlight the significant demand-side challenges to achieving SDG ICT goals, including cost of devices and services, low education and associated income levels, digital literacy gaps, and limited availability of local and relevant content. Modelling the data further identifies the factors behind digital inequality that may be masked by aggregated descriptive indicators, and suggests areas of policy intervention to address gender inequality.

KEY FINDINGS

The extent of mobile phone ownership and the gender gap aligns broadly — though not perfectly — with GNI per capita. The richest of the surveyed countries show the lowest gender gap. India, Pakistan and Bangladesh show the largest gender gap in mobile phone ownership and among the largest in internet use. There are notable exceptions to this pattern. Colombia, with lower overall mobile penetration, has gender parity in mobile ownership; and in South Africa, with high income disparity, more women than men own mobile phones.

In Africa, education and income are the main determinants of access to the internet. Women are generally less educated, less employed and have lower incomes than men.

In Asia, disaggregating women by income or wealth illustrates the importance of understanding they are not a homogenous group (just as men are not). In Latin America, the main factors affecting the gender gap include both observable characteristics (age, occupation and household characteristics) and non-observable factors that should be taken into account, in country-specific policy interventions.

ABSTRACT

Central to the call for digital equality are claims that the internet has the potential to be a driver of accelerated progress towards the achievement of the Sustainable Development Goals (SDGs) contained in the UN’s 2030 Agenda for Sustainable Development. It is important to understand how these benefits are distributed between men and women, and why there appears to be significant unevenness in their adoption at a global and national level. Yet our ability to assess where we stand currently in relation to access and use of the internet, and to measure progress toward achieving SDG targets related to information and communication technologies (ICTs), is constrained by the dearth of reliable data. Data collection is particularly problematic in pre-paid mobile markets: supplier data does not capture the number of unique subscribers, nor does it show users’ demographic characteristics. This research aims to address these data challenges through quantitative and qualitative analysis of ICT access and use across the Global South, and by examining the barriers to online access and the limitations on optimal use. Findings are derived from the After Access 2017 household and individual survey, a nationally representative survey of ICT access and use undertaken by DIRSI, LIRNEasia, and IRA, across 17 countries in the Global South. Households were selected from the national sampling frame using simple random sampling. First, the head of the household was interviewed to obtain household indicators. Next, an individual (15 years or older) was randomly selected from each household to be interviewed about their mobile access and usage. The findings highlight the significant demand-side challenges to achieving SDG ICT goals, including cost of devices and services, low education and associated income levels, digital literacy gaps, and limited availability of local and relevant content. Modelling the data further identifies the factors behind digital inequality that may be masked by aggregated descriptive indicators, and suggests areas of policy intervention to address gender inequality.

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ABSTRACT

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Taking Stock: Data and Evidence on Gender Digital Equality

PART TWO

Taking Stock: Data and Evidence on Gender Digital Equality

PART TWO

Before dealing with the challenges of trying to measure digital inequality at the global level, including the “gender digital divide,” it is important to consider the relevance of equality in access and use of the internet to social and economic inclusion in the contemporary world. Claims regarding the potential benefits that ICTs offer women are not yet widely supported by evidence, and it remains important to understand why these benefits are not evenly distributed between men and women. It is equally important to understand the negative implications of ICTs for women — including, for instance, the impact of surveillance or online abuse on women’s rights (e.g., Cummings & O’Neil, 2015, p. 22; Garcia & Manikan, 2014; Bickers & Webb, 2016).

A more holistic understanding is also key to better comprehending the indirect effects of improved internet access on women’s wider communities, including impacts on those who remain unconnected. Empirical evidence supports the notion that social and welfare investments in women have positive multiplier effects on wellbeing, family incomes, broader communities, and society at large (Todaro, 2003, cited in Gillwald, 2009). Ending discrimination against women and girls is, therefore, not only a human rights issue but is also central to harnessing all available human resources for sustainable economic growth and development.

RESEARCH CHALLENGES

The limited research available, especially in the Global South, on the access disparities between men and women has contradictory implications. Some qualitative studies support stereotypes that women are more averse to technology than men, while others show that women embrace digital communication under certain circumstances (Cummings & O’Neil, 2015, p. 9) and others that men and women respond differently to mobile marketing. However, quantitative research often raises more questions than it answers. The qualitative research on the subject, which has such an important role to play in answering gender questions that quantitative research methods cannot, often fails to move beyond anecdotal accounts, and often raises more questions than it answers. To develop a comprehensive evidence base for policy formulation, both qualitative and quantitative methods are required.

Since gender is constructed differently across time and regional location, and because it is impossible to distinguish clearly gender effects from race, class, culture and religion, gender specialists have argued that it cannot be understood as a discrete, quantifiable indicator or even as a separate area of social science. But, as Tepe-Belfrage and Steans point out, “in order to speak to policy makers and to inform and influence discussion and “gender-making-its” it is often necessary to produce rigorous gender differentiated data which will elucidate myriad gender inequalities” (Steans & Tepe-Belfrage, 2016, p. 2).

While acknowledging the dangers of treating a binary construction such as male/female as a “coherent and stable category of analysis”, the goal of research-to-policy influence requires us to find sufficiently reflective approaches that do not rely on the crude forms of gender essentialism, often evident in policy and practice, that treat women’s and men’s attributes as universally associated with gender. In recognition of the possibility of the existence of intersectional identity, this research has attempted to grapple with the challenge of accurate data collection, including gender-disaggregated data, for the purpose of informing policy interventions in developing and emerging economies.

In Asia and the Pacific, LIRNEasia has surveyed access and ownership among lower income populations in several countries, tracking changes over time. The gaps are especially large in South Asian countries, compared to the Southeast Asian countries studied. Significant reliance on shared phones was observed among women in South Asia, reflecting the gap in ownership. By 2011, the little internet use observed in South Asian countries was predominantly that of men (LIRNEasia, 2011; Zainudeen et al., 2010).

Similarly, gender differences in use and — importantly — in use, in prepaid mobile environments. The questionnaire has several questions that track some of the core indicators that have been collected in surveys in Africa, Asia and Latin America for over a decade. It also includes questions on income, education and expenditure that allow for data modelling to identify the real factors contributing to gender inequality, in a way that descriptive statistics cannot.

METHODOLOGY

The After Access® Survey (2017) of household and individual ICT access and use was conducted using enumeration areas (EAs) of national census sample frames as primary sampling units. The sampling was performed in four steps for households and in five steps for individuals. The national census sampling frames were split into urban and rural EAs, and EAs were stratified to be representative of the population using probability proportional to size. Two listings were compiled for each EA, serving as sample frames for the simple random selections. Households were then sampled using simple random sampling. An individual 15 years or older (which could be a visitor staying for the night) was then randomly selected and interviewed from each household.

The desired level of accuracy for the survey was set to a confidence level of 95% and an absolute precision (relative margin of error) of 5%. The population proportion P was set conservatively to 0.5, which yields the largest sample size (Jwanga & Lemeshow, 1991). Two weights were constructed for households and individuals, based on the inverse selection

For a fuller account of methodology see https://researchictafrica.net/2017/08/04/beyond-access-surveys-questionnaires-methodology-and-timeframe/
Overall, the five Latin American countries surveyed, together with South Africa, are the richest among the countries surveyed and they show the lowest gender gap (Figure 2.2). In contrast, the poorer African countries show high gender disparity in mobile and particularly internet use. However, these disparities are lower than in some higher income Asian countries, where we see some of the greatest disparities in income. The GNI per capita in India and Bangladesh is more in line with that of Ghana and Kenya, but both countries, together with Tanzania, which is also among the poorest countries surveyed, have much lower gender disparities than the Asian countries surveyed.

Figure 2.2 shows an overall negative correlation between the level of mobile phone penetration and the gender gap in mobile ownership, with some exceptions. Although Colombia has lower mobile than other Latin American countries, it has gender parity in mobile ownership. South Africa, with GNI similar to the Latin American countries — despite having one of the highest income disparities in the world — has more women than men who own mobile phones.

Of all the countries surveyed, India, Rwanda, and Pakistan show the highest gaps between men and women in mobile phone ownership (Figure 2.2). Rwanda and Bangladesh show the highest gender gap in internet use, followed by India, Mozambique, and Nigeria, which has by far the largest population in Africa (comparable to that of Bangladesh) (Figure 2.3). These populous nations thus account for a large number of unconnected women in the Global South, with gender gaps greater than in some of the least developed countries in Africa. The highest gender variance in African mobile ownership is in Rwanda and Mozambique. The internet gender gaps in Rwanda and Mozambique are double those of other developing African countries.

Besides South Africa, of the African and Asian countries surveyed, the only country within range of the Latin American countries is Kenya, with a relatively low mobile phone gender gap of 10% and mobile phone penetration in line with the lower- and middle-income countries of Latin America. Ghana — with a similar GNI per capita in 2016 to Kenya — follows, with a gender gap of 16%. Nigeria, with a GNI per capita twice that of Kenya or Ghana, has a mobile gender gap of 18% and penetration similar to Cambodia.

Cambodia has the lowest GNI per capita (and penetration rate) of the countries surveyed in Asia, roughly in line with Ghana and Kenya. Nevertheless, Cambodia’s gender gap for mobile phone ownership is just 20%, by far the lowest of the Asian countries surveyed — 15 percentage points below Pakistan and Bangladesh, and 25 percentage points below India. With the highest GNI per capita of nearly $2000 in 2016, India has a staggering gender gap: 46% in mobile phone ownership, and 57% in internet access.

Unless otherwise noted, currencies are shown in USD.
The use of mobile phones for mobile money transactions is minimal or negligible in most of the countries surveyed, and the associated gender gap varies widely in those countries where mobile money is used (Figure 2.4). In Latin America, Paraguay stands out, with over half of both men and women using mobile money. Asia makes the least use of mobile money: even in Pakistan, the Asian country with highest mobile money. Asia makes the least use of mobile money: even in Pakistan, the Asian country with highest mobile money use, only 13% of men and 12% of women use this service. Much has been written about mobile money use, but as penetration levels increase overall, the disparities between men and women reduce, with more women using mobile money in the lower-income categories, and the gender gap in mobile money use becomes minimal or negligible. In Emergent internet markets, however, where penetration levels are low, the gap between men’s and women’s use of the internet is high; lower-income countries have the lowest penetration rates and the largest gender gaps. Lower-income countries have the lowest penetration rates and the largest gender gaps. Living in urban areas is also associated with greater internet access than in rural areas (where, in some countries, women tend to be concentrated). Women living in urban areas are more likely to have better access to the internet than either men or women of a similar education and income living in rural areas.

AFRICA

Data for the seven African countries surveyed shows substantial gender disparities in ICT access and use, mostly in favour of men. However, the primary determinants of mobile phone ownership and internet access are in fact education and income. Because women are disproportionately concentrated among the uneducated and unemployed, they generally have lower ownership of mobile phones, but as penetration levels increase overall, the disparities between men and women are reduced, with more women using mobile phones in South Africa owning mobile phones than men. In emergent internet markets, however, where penetration rates are low, the gap between men’s and women’s use of the internet is high; lower-income countries have the lowest penetration rates and the largest gender gaps. Living in urban areas is also associated with greater internet access than in rural areas (where, in some countries, women tend to be concentrated). Women living in urban areas are more likely to have better access to the internet than either men or women of a similar education and income living in rural areas.

South Africa, with one of the highest GNIs in Africa, has the highest internet penetration and the lowest gender gap of the countries surveyed. Nigeria — now considered the largest economy in Africa, and with a population four times that of South Africa — has 25% less internet penetration than South Africa, and the internet gap between men and women is the second highest in the African countries surveyed (46%, in favour of men). Kenya has the highest mobile phone penetration (approaching 90%) and a mobile gap of only 10% between men and women. It has much lower internet penetration, however, at 25% — similar to Ghana; both countries also have notably large internet gender gaps (31% and 34%). Interestingly, the internet gender gap in Tanzania is comparable to that of Kenya and Ghana, despite their more developed and dynamic economies (from an ICT perspective) — and much lower than that of the other lower-income, lower-ICT countries, Mozambique and Rwanda, which show the highest gender gap in Africa. Despite being renowned for its prioritisation of ICT and supply-side interventions, Rwanda nevertheless has a pronounced gender gap in both mobile phone ownership and internet penetration.

In South Africa, despite a considerably higher internet penetration rate (nearly 50%), the gender gap has grown, from a minimal level in 2012 to 12% (in favour of men) in 2017. In contrast, in the nearly saturated mobile phone market, the gender gap has shifted in favour of women. In the lower income categories, however, there is not much variance between the sexes, which supports the conclusion that among the poor there are no differences between men and women in terms of affordability.

Though internet use is still relatively low in most countries, there has been an increase from 2012 to 2017. For less developed countries — Rwanda, Tanzania, and Mozambique, where internet use was less than 3% in 2008 for both sexes — internet use now ranges between about 5% and 20%. In South Africa, where internet uptake is highest for both men and women in comparison to the other countries, the use of internet among women increased at a faster pace than that of men, as lower income people, predominantly women, came online. While internet use among men in South Africa almost doubled from 2008 to 2012 and then again from 2012 to 2017, for women it more than doubled over the same periods.

BARRIERS TO INTERNET ACCESS

In Africa, the cost of devices is the primary barrier for those who are not connected, while for those who are connected the reason for low usage is the price of data services. These continue to be the biggest challenges from a policy perspective. In many countries, however, particularly in the predominantly rural populations, access to electricity is a greater challenge than access to mobile coverage.

Both men and women adopt multiple strategies to access the internet. The greater use of free public wi-fi...
Guided by the descriptive statistics discussed above, the study further analyses the data using binary regression techniques. The logistic regression models developed allow us to investigate the factors affecting ICT access and use and to establish the direction of inequalities. The study models the probability of ICT access and use by plotting the binary variables, mobile phone ownership and internet use, against selected demographic and socioeconomic variables.

For six of the countries studied, the sex of respondents shows a significant and negative correlation with mobile phone ownership. In South Africa, however, the relationship is significant and positive, indicating that women there are more likely to own a mobile phone than men, unlike in the other countries surveyed. The significance of the relationship (in either direction) implies that the sex of the person influences the probability of an individual owning a mobile phone.

As in the 2008 and 2012 studies, this study shows that higher levels of income and education are correlated with ownership of a mobile phone. Education in particular maintains a positive and significant correlation throughout. Location and age are also significant influencers of mobile phone ownership; those living in rural areas are less likely to own a mobile phone than those in urban areas, and in most countries younger people are more likely to own a mobile phone.

The analysis shows that in rural South Africa, higher income does not necessarily translate into increased mobile phone ownership, indicating the strong influence of other factors such as urban or rural location, and (related) proximity to infrastructure. A female individual is more likely than a male to own a mobile phone, supporting the initial descriptive findings. In Kenya, however, while a woman is generally less likely than a man to own a mobile phone, in urban areas women are more likely to own a mobile phone than men.

The regression analysis shows that sex, income, education, and location are all significant determinants of whether people use the internet. Women show lower use of the internet, which supports the descriptive findings that women show lower internet use in all seven countries surveyed. People with higher levels of income and education are more likely to be online than those with lower income and education levels. Also, those in rural areas are less likely to be connected. These may be contributing factors to the gender disparities in internet use, as women are more likely to be poorer, less educated, and rural.

### INTERSECTING FACTORS

The disparity is not always in favour of men, especially when the disaggregation is location-specific. Table 2.2, which aggregates urban and rural data across all countries surveyed, shows that women in urban areas access and use ICTs more than men in rural areas. This indicates that the gender gap is affected by other factors such as location. Where women are at the intersection of multiple factors of inequality, they are the most disadvantaged: rural women are worse off than either urban women or rural men.

Knowledge of the internet is lowest among women in rural areas, where less than 35% of women indicate that they know what the internet is.

Interestingly, there is also a difference in ICT access and use among women in different locations. Women in urban areas are exposed to and use ICTs more than women in rural areas. The difference is more than double across all indicators except for mobile phone ownership.

#### Table 2.1

Main reasons cited for not using the internet

<table>
<thead>
<tr>
<th>Country/ gender</th>
<th>Do not know what the internet is</th>
<th>No device (computer/ smartphone)</th>
<th>No Internet/ not useful</th>
<th>Do not know how to use it</th>
<th>Not available in my area (no mobile coverage)</th>
<th>Too expensive</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rural</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rwanda M</td>
<td>11.5</td>
<td>34.7</td>
<td>7</td>
<td>1.3</td>
<td>0</td>
<td>34.4</td>
</tr>
<tr>
<td>Rwanda F</td>
<td>6.1</td>
<td>51.7</td>
<td>0.5</td>
<td>4.1</td>
<td>0</td>
<td>31.4</td>
</tr>
<tr>
<td>Tanzania M</td>
<td>1.3</td>
<td>62.8</td>
<td>16.5</td>
<td>12.2</td>
<td>0.6</td>
<td>3.4</td>
</tr>
<tr>
<td>Tanzania F</td>
<td>0.3</td>
<td>64.4</td>
<td>13.9</td>
<td>12.9</td>
<td>0</td>
<td>1.2</td>
</tr>
<tr>
<td>Kenya M</td>
<td>15.9</td>
<td>24.7</td>
<td>29.4</td>
<td>13.6</td>
<td>2.8</td>
<td>4.6</td>
</tr>
<tr>
<td>Kenya F</td>
<td>35.3</td>
<td>18.9</td>
<td>23.5</td>
<td>10.2</td>
<td>1.9</td>
<td>3.4</td>
</tr>
<tr>
<td>South Africa M</td>
<td>0</td>
<td>38.9</td>
<td>15.1</td>
<td>11.7</td>
<td>2.4</td>
<td>11.1</td>
</tr>
<tr>
<td>South Africa F</td>
<td>0</td>
<td>38.9</td>
<td>16.1</td>
<td>11.1</td>
<td>3</td>
<td>17.8</td>
</tr>
<tr>
<td>Mozambique M</td>
<td>0</td>
<td>74.4</td>
<td>2.9</td>
<td>14.8</td>
<td>0.6</td>
<td>0.1</td>
</tr>
<tr>
<td>Mozambique F</td>
<td>0</td>
<td>77.4</td>
<td>3</td>
<td>13.4</td>
<td>0</td>
<td>1.2</td>
</tr>
<tr>
<td>Ghana M</td>
<td>44.1</td>
<td>19.2</td>
<td>8</td>
<td>12.7</td>
<td>4.2</td>
<td>2.9</td>
</tr>
<tr>
<td>Ghana F</td>
<td>42.9</td>
<td>23.8</td>
<td>10.2</td>
<td>15</td>
<td>0.8</td>
<td>1.6</td>
</tr>
<tr>
<td>Nigeria M</td>
<td>33.3</td>
<td>17.4</td>
<td>10.2</td>
<td>22.2</td>
<td>6</td>
<td>3.6</td>
</tr>
<tr>
<td>Nigeria F</td>
<td>44.7</td>
<td>10.2</td>
<td>9.8</td>
<td>21.8</td>
<td>2.8</td>
<td>4.4</td>
</tr>
</tbody>
</table>


#### Table 2.2

Urban-rural gender comparison on ICT access and use

<table>
<thead>
<tr>
<th>QUESTION</th>
<th>RURAL</th>
<th>URBAN</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All</td>
<td>Female</td>
</tr>
<tr>
<td>Do you own a mobile phone?</td>
<td>58.8</td>
<td>64.7</td>
</tr>
<tr>
<td>Is your mobile phone a smartphone?</td>
<td>18.5</td>
<td>21.5</td>
</tr>
<tr>
<td>Do you know what the Internet is?</td>
<td>41</td>
<td>40.2</td>
</tr>
<tr>
<td>Have you ever used the Internet?</td>
<td>16.9</td>
<td>21.5</td>
</tr>
<tr>
<td>Do you use social media?</td>
<td>15.4</td>
<td>19.7</td>
</tr>
</tbody>
</table>


42 This may reflect inability to use a mobile device or lack of a good signal (in very remote areas; there is over 95% 3G coverage in South Africa).
In summary, modelling shows that the main determinants of this digital gap between men and women are education and income. These two factors are, in turn, likely to be determined by cultural and social factors, which are more likely to be captured through qualitative research. In 2017, when Research ICT Africa ran focus groups — as a pre-test for the After Access surveys and to explore gender matters arising from the 2012 survey — some of these “softer” issues also emerged.

For instance, a woman in the village, even if she wanted to use a cyber (café), she will not do that. Imagine being in the cyber at 7 pm and you are expected to be at home cooking, taking care of cows, etc. Even if you have a child abroad and you want to communicate with them, it becomes very difficult.

— Peri-urban female internet user, Kenya (Chair, 2017, p. 34)

Though internet use is still relatively low in most countries in Africa, there has been a significant leap from 2008 to 2017. Women, however, still lag behind men in the use of the internet, and this is mainly as a result of their relatively low levels of education and income.

### Table 2.3

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>Mean years of schooling</th>
<th>Estimated GNI per capita (2015, PPP, 2011 international $)</th>
<th>Labour force participation, 15 - 64 years population (2017, ILO modelled estimate)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Women</td>
<td>Men</td>
<td>Women</td>
</tr>
<tr>
<td>India</td>
<td>64.7</td>
<td>8.2</td>
<td>2184</td>
</tr>
<tr>
<td>Pakistan</td>
<td>21.3</td>
<td>5.5</td>
<td>1498</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>49.2</td>
<td>5.6</td>
<td>2379</td>
</tr>
<tr>
<td>Cambodia</td>
<td>21.5</td>
<td>5.5</td>
<td>2650</td>
</tr>
<tr>
<td>Myanmar</td>
<td>19.7</td>
<td>4.9</td>
<td>4182</td>
</tr>
</tbody>
</table>


Note: *Income of employed individuals.

Analysis of nationally representative survey data also shows how education and income inequalities contribute to mobile phone non-ownership among women. A binary logistic regression model was used, where mobile adoption is modelled as the dependent variable, taking a value of 1 for adopters and 0 for non-adopters; the results give the change in the odds (directly related to the probability) of mobile adoption attributable to a unit increment of the independent variable. The model (detailed in Perampalam et al., 2016) showed that the completion of secondary and tertiary education is a significant predictor of mobile phone adoption.

For Myanmar, the completion of secondary education is associated with a 55% increase in the odds of mobile adoption, while the completion of tertiary education, though limited to a small percentage of the population, is associated with a 378% increase in the odds of adoption. Similarly, being employed is associated with an 84% increase in the odds of mobile phone adoption.

However, the same binary logistic regression model showed the complicated and intertwined nature of mobile access with gender, income, and cultural factors. The gender disparity persisted even after accounting for all the independent variables that show a statistically significant impact on mobile phone adoption (such as secondary and tertiary education, proportion of friends with mobile phones) and others that are direct or indirect indicators of wealth (such as employment status, monthly household expenditure, TV and electricity in the household, and age). After controlling for all these factors, being a woman in Myanmar still reduces the chance of mobile phone ownership by fully 42%. This finding was surprising, since women hold important status in Myanmar society, in comparison to its South Asian neighbours (see, among others, Sein, 1972; Ikuya, 2005; 2006; Kawanami, 2007). Ethnographic observations detailed in Zainudeen and Galpa (2016) showed that women are the “chief financial officers” of the family, receiving money from employed family members and allocating and managing the budget. A woman decides when her family has sufficient funds to purchase a phone. Yet, because these women have little technical knowledge and few opportunities to obtain it, the are not involved in the decision of which phone to purchase. Furthermore, when the phone is purchased, it then “travels” with the person who works or studies outside the home. So, even if a woman is working from home as well as managing the family finances, she is unlikely to have access to the phone for significant hours each day.

The gender gap lies at the intersection of other forms of marginalisation: gender, income, education, urban/ rural, and cultural identity. Therefore we cannot treat men and women as homogenous social groups. When our survey data is disaggregated by income, the chasms become apparent between “rich” women (those earning above the national mean income) and “poor” women (those earning below the national mean income). When non-users were asked about...
For women accessing the internet, gender also impacts their online experience — how much time they spend online and what content they access. As a follow-up to the Myanmar survey, in 2017 we conducted semi-structured interviews with 98 men and women who had been using the internet for at least a year. Both men and women reported that their social media accounts (mainly Facebook) were regularly hacked. In fact, not everyone even knew that Facebook required a valid email address. When asked about this, they often did not know how to solve the problem. As a result, they had to create new accounts and list their gender as male or adopt “male” accounts, even when they had a female account they used to connect with friends and family. More specifically, it was “easier” to engage in sensitive conversations related to religion and politics if one was seen to be a male belonging to the main ethnic group, Bamar. For example, many Kachin women and men, whose Kachin ethnicity can be often identified with their name, had an account in a non-Kachin, Bamar name. So, in fact, Kachin women are harassed online both as women and as Kachin (minority ethnicity) — highlighting that “women” is not a single, uniform category.

From a gender perspective, there are issues to be tackled on multiple fronts in order to achieve equitable and meaningful access for all. The gaps in mobile and internet access seem to be worse in the Asian countries than in Africa and Latin America. Key challenges for women in the Asian countries relate to skills (in turn related to education) and economics. The lack of skills is a particular barrier preventing them from getting online, for those who are online, and women leave them vulnerable to privacy and safety threats. Affordability, as measured by average data prices as a percentage of per capita income, is a particular barrier for “average” women, who often earn less than men, or don’t have their own incomes at all; the situation may be even more worrying if lower income deciles are analysed.

While disparities in education and income may explain a large component of the gender gap in mobile and internet access, the “pure gender effect” still plays a role in determining and conditioning women’s access, as the Myanmar case demonstrates. Deeply embedded in this effect are the social and cultural norms and attitudes that are not measured in the other explanatory variables. What this means is that there are greater and deeper concerns that need to be addressed in these societies: change is needed in the attitudes and perceptions that shape the ways in which women gain access to technology and are able to make use of it.

While attitudes and perceptions are not easy to change in the short term, a good starting point may be to focus on more tractable solutions that can help women to become (and stay) affordably connected, and to provide them with the skill set to make use of the host of services and platforms offered through mobiles and the internet, in a safe and secure way — and perhaps even earning a living from these opportunities.

LATIN AMERICA

Women represent more than 50% of the total Latin American population,44 here, as in many parts of the world, they face a set of barriers that result in unequal conditions for them relative to their male peers. Particularly in this region, women are overrepresented in lower income quintiles, informal labour sectors, and low-payment activities. According to the International Labour Organisation (ILO, 2016), the unemployment rate for women is around twice the level as for men, they receive lower wages in all occupational segments, and they face worse labour conditions.

Although there have been significant advances towards gender equality in accessing the basic levels of education, women remain underrepresented in STEM fields (science, technology, engineering, and mathematics). These differences are more pronounced at the highest levels of academic and professional hierarchies (Castillo et al., 2014; UNESCO, 2015a). Gender disadvantages are also evident in other social and cultural contexts. Women face entrenched discriminatory social norms and persistent structural barriers: early motherhood, gender-based violence, and gendered division of household labour, among others (UNESCO, 2015b).

The ICT field is not an exception. Opportunities to access and use the internet are not evenly distributed between men and women within the sample. Then we briefly describe the quantitative methodology used to identify the factors underlying the ICT gender gap and provide the most important results. We conclude the section by explaining the ICT gender differences.
THE ICT INDEX FOR FIVE LATIN AMERICAN COUNTRIES

The ICT index for the Latin American region consists of two sub-indexes and eight indicators. The first sub-index is related to mobile phone use and includes the following variables: smartphone ownership, mobile use experience, mobile application use, and mobile banking and e-commerce. The indicators in this sub-index are mainly related to the more modern uses of mobile phones; for example, it includes only smartphone ownership (excluding “basic phones” lacking internet access). It also takes into account the use of a wide variety of mobile applications (nine different types).

Similarly, the second sub-index includes internet use and has the following four indicators: internet use, internet use experience, internet devices, and online activities.

Figure 2.6 shows the average values of the ICT index for each country of the Latin American After Access survey, including values by gender; this provides an approximation on the indicators described above. In particular, Argentina and Colombia have the highest average values for the index, which means that both countries have a wider variety and higher intensity of ICT use. These countries show more advanced use in terms of mobile phones (level of ownership and number of applications used), internet, and social media. On the other hand, Paraguay and Guatemala show the lowest levels of use in the region. The overall range is quite narrow, however — between 34.7% and 41.5%.

In terms of gender differences, Peru and Guatemala exhibit the largest disadvantages for women. In both countries, women’s use of mobile phones, internet, and social media is about 18% lower than their male peers, compared to Argentina, Colombia, and Paraguay which show a difference of just 5%. The main objective of this section is to identify the major factors underlying this gender inequality.

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EXPLAINING THE ICT GENDER DIFFERENCES

Adapting the methodology used by Ñopo (2008), analysing gender wage gaps in Peru, we identify the factors behind the differences between men and women in the ICT index for each of the five Latin American countries under analysis. Ñopo’s methodology provides an estimation of the effect of observable characteristics (such as age, occupation, and household characteristics) and the effect that is related to non-observable factors. In the same way, we suggest there are two main components of the gender gap:

1. The explained component. This is the share of the gap that is attributed to differences in observed characteristics (such as education, occupation, and household characteristics).
2. The unexplained component. This is the share of the gap that cannot be attributed to differences in observed characteristics and thus indicates the influence of other factors (such as discrimination, cultural factors, sexism, and racism).

The following observed variables are taken into account: age, education level, the presence of children and youngsters in the household, location, language, socioeconomic level, and occupation. These variables have been documented extensively in the literature as important determinants of ICT use: see, for example, Mendoça et al. (2015), Wang (2015), and Barrantes (2007). Descriptions of the indicators are presented in Table 2.4.

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1. The explained component. This is the share of the gap that is attributed to differences in observed characteristics (such as education, occupation, and household characteristics).
2. The unexplained component. This is the share of the gap that cannot be attributed to differences in observed characteristics and thus indicates the influence of other factors (such as discrimination, cultural factors, sexism, and racism).

The following observed variables are taken into account: age, education level, the presence of children and youngsters in the household, location, language, socioeconomic level, and occupation. These variables have been documented extensively in the literature as important determinants of ICT use: see, for example, Mendoça et al. (2015), Wang (2015), and Barrantes (2007). Descriptions of the indicators are presented in Table 2.4.
Taking Stock: Data and Evidence on Gender Digital Equality

PART TWO

Taking Stock: Data and Evidence on Gender Digital Equality

PART TWO

48 A negative relationship indicates a tendency for the actual gender gap to be less than would be expected based on the predicted gender gap. For example, if women are less educated than men, education would be a factor that contributes to widening the ICT gender gap.

Table 2.5 shows the kind of relationship found between the ICT index and the variables described in Table 2.4. In particular, people in higher socioeconomic and education levels and those who live with children and young adults show advantages regarding mobile, internet, and social media use. In contrast, being an older adult, speaking a local language, and living in a rural location show a negative relationship with the proposed ICT index. Regarding occupation, there are differences in the relationships for each employment category, but the outstanding ones are related to “employer”, showing a positive relationship, and “non-active people” showing a negative relationship.

These results show the strong association between the variables related to digital disadvantages (low educational levels, rural location, or ethnic issues) and those related to social disadvantages in general. As Kularski and Moller (2012) highlight, digital exclusion is caused (and reinforced) by traditional dimensions of inequality, such as socioeconomic level or race. Nevertheless, the digital divide is a complex phenomenon, and social and digital inequalities do not always move together (Bauer, 2016). An interesting example is the presence of children in the household. According to Nigo (2010), having children could imply a significant negative effect for women in terms of wage and labour status. However, regarding technologies, younger people in the household could represent an advantage in terms of the ICT index; in this sense, if women are less educated than men, education would be a factor that contributes to widening the ICT gender gap.

Table 2.4 Determinants of ICT adoption

<table>
<thead>
<tr>
<th>INDICATOR</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>It takes the value of 1 if the respondent is less than 18 years old; 2, if he/she is between 18 and 25; 3, if between 26 and 39; 4, if between 40 and 59; and 5 if he/she is more than 60 years old.</td>
</tr>
<tr>
<td>Education</td>
<td>It takes the value of 1 if the respondent has less than complete secondary education; 2, if he/she has complete secondary education; and 3, if he/she has higher than secondary education.</td>
</tr>
<tr>
<td>Child</td>
<td>It takes the value of 1 if the respondent lives in a rural location, otherwise 0.</td>
</tr>
<tr>
<td>Local Language</td>
<td>It takes the value of 1 if the respondent affirms that the language that he/she speaks in his/her house is a native language, otherwise 0.</td>
</tr>
<tr>
<td>SEC</td>
<td>Socioeconomic Level index in quintiles</td>
</tr>
<tr>
<td>Occupation</td>
<td>It takes the value of 1 if the respondent is unemployed; 2, if he/she is a student; 3, employee; 4, employer; 5, independent; 6, non-active.</td>
</tr>
</tbody>
</table>

Source: Authors’ elaboration based on After Access Survey, 2017.

On the other hand, it is important to highlight that the types of relationships shown in Table 2.5 are relevant to a better understanding of how personal and household characteristics contribute to widening or narrowing the ICT gender gap. For example, being highly educated represents an advantage in terms of the ICT index; in this sense, if women are less educated than men, education would be a factor that contributes to widening the ICT gender gap.

Figure 2.7 shows the contribution of each independent variable to the ICT gender gap. Bars with positive values indicate the percentage increase in the ICT gender gap associated with inclusion of a specific factor. For instance, gendered occupations contribute to increasing the gap by 2.5%; this means that if there were no structural differences in occupation between women and men, the gap would be 7.5% in the five Latin American countries instead of around 10% — the actual average gap (illustrated in Figure 2.6b). A negative sign means that the particular factor reduces the ICT gender gap.

As indicated in Figure 2.7, education, socioeconomic level (SEC), occupation, and the presence of children in the household are factors that contribute to widening the ICT gender gap, disfavouring women. The first three factors are well documented in the literature (Castillo et al., 2014; ILO, 2016; UNESCO, 2015). Women in the region have fewer educational opportunities, belong to lower SECs, and are overrepresented in informal and low-profit labour segments. On the other hand, having children in the household is seen to have little overall impact on the gender gap, because its effect is not one-directional. Children may have an important positive role in increasing technology adoption and use by older household members (Barrantes & Cozzubo, 2017). However, since women are disadvantaged in terms of domestic division of labour, the presence of children in the household significantly increases the demand on women’s time, allowing them less free time (Beltran & Lavado, 2014) — less time for informational development. Overall, the negative effect prevails: the presence of children in the household widens the gap by 0.4%. Finally, the ICT gender gap was reduced by age and rural location and local language.

Table 2.5 Preliminary analysis – Observed effects of independent variables

<table>
<thead>
<tr>
<th>Independent Variable/Dependent variable: The ICT index</th>
<th>Observed effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEC</td>
<td>+</td>
</tr>
<tr>
<td>Education</td>
<td>+</td>
</tr>
<tr>
<td>Age</td>
<td>-</td>
</tr>
<tr>
<td>Occupation: Employers (+); Non-active (-)</td>
<td>+/-</td>
</tr>
<tr>
<td>Local Language</td>
<td>-</td>
</tr>
<tr>
<td>Rural</td>
<td>-</td>
</tr>
<tr>
<td>Children</td>
<td>+</td>
</tr>
</tbody>
</table>

Source: Authors’ analysis. Note: Based on multiple regression analysis using the After Access Survey 2017. In all the cases there is a 99% statistical significance.

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48 A negative relationship indicates a tendency for the actual gender gap to be less than would be expected based on the predicted gender gap. For example, if women are less educated than men, education would be a factor that contributes to widening the ICT gender gap.

Figure 2.8 shows the part of the ICT gender gap that remains unexplained after including the analyzed factors (age, education, children, rural, language, SEC, and occupation). This unexplained component is usually described in the literature as related to factors of culture, stereotype, and sexism, among others. Interestingly, in Argentina, Colombia, and Paraguay, the ICT gender gap is explained entirely by the analyzed factors (education, SEC level, and occupation) and the unexplained component is not statistically significant. Conversely, in Guatemala and Peru, other factors such as gender stereotypes and sexism apparently have an important effect on ICT gender disadvantages, representing more than half of the ICT gender gap. Highlighting these factors could help policymakers design policies for reducing the ICT gender gap most effectively in each country. For example, in Argentina, Colombia, and Paraguay the focus should be on improving the educational and labour opportunities for women, while in Peru and Guatemala, addressing gender stereotypes and sexism is critical.

49 Women who are older or who speak a native language and live in a rural location are generally at a greater disadvantage than men with these characteristics. This comes from a previous regression analysis (see Table 2.3). However, Figure 2.7 shows a decomposition analysis in which both factors negatively influence the ICT gender gap, and this is related to the distribution of the sample and the general population in these countries (CEPAL, 2003).
Although not as stark as this in all countries, the main results show that digital inequality will not disappear even when those currently marginalised from services — disproportionately women, in most countries surveyed — become connected. From a policy perspective, it is clear that demand-side interventions that address not only affordability but also e-literacy and education, are as critical to digital inclusion as supply-side connectivity measures. Moreover, as the Latin-American cases show, there are deeply entrenched factors such as social and cultural norms, including attitudes towards women, that need to be taken into account when analyzing women’s access and use of ICT.

![Figure 2.7](chart.png)

**Figure 2.7**
Independent variable contribution to the explained ICT gender gap

![Figure 2.8](chart.png)

**Figure 2.8**
Confidence Intervals for the unexplained gap by countries (full set of independent variables)

**CONCLUSION AND RECOMMENDATIONS**

Nationally representative surveys of ICT engagement enable the disaggregation of indicators to show the disparities between men and women. In prepaid mobile markets — even with SIM card registration — this is the only way to obtain sex-disaggregated data. Supply-side data based on active SIM cards cannot identify unique subscribers or their gender; moreover, surveys show that individuals have multiple SIMS, as part of their access and affordability strategies. Similarly, descriptive indicators reported at the national level can mask digital inequalities between men and women and can fail to detect the specific factors determining the uneven take-up of ICTs, as well as inequalities that may exist among women and among men. Through a survey, sex-disaggregated data can be linked to other indicators, such as income, education, location, age — all critical for identifying points of policy intervention required to address the ICT gender gap.

In many countries, the data shows that merely by connecting those individuals currently marginalised from services — who are disproportionately women, in most countries surveyed — digital inequality will not be resolved. Demand-side interventions, that enhance not only affordability but also e-literacy and education, are as critical to digital inclusion as are supply-side connectivity improvements. Moreover, as seen in the Asian and Latin American cases, deeply entrenched factors of social and cultural norms and attitudes towards women need to be taken into account when analysing women’s access to and use of ICT.

Although further investigation is needed, it appears that ICT adoption and diffusion through commercial models is associated with high education and income levels of early adopters, showing low levels of gender variance in societies and economies that do not structurally disadvantage the participation of women. As more users come online, greater gender disparities in ICT access and use may reflect gender disparities in relation to education and income (employment); but as prices of devices and services come down and poorer people (disproportionately women) come online,
markets begin to saturate and the figures for men and women tend to equalise. Initiatives to make internet use more affordable and thus lower the income barrier for men and women would reduce the gender gap in internet access.

**RECOMMENDATIONS FOR RESEARCHERS**

The dominant research on ICT and gender is binary in its conceptualisation, reducing gender to the distinction of men and women. It is important to find ways of developing indicators for other gender categories, as well as ways that these can be safely examined, especially where such groups and individuals are marginalised and oversimplified on the grounds of their sexuality. This research priority presents a challenge that the United Nations, as a rights-based body, needs to address, with the support of research communities. Even within the narrow confines of gender as currently defined, there is still a dearth of rigorous quantitative research on digital inequality between men and women. Such research needs to delve beyond descriptive statistics to model the available data, to understand factors of exclusion and to better inform policymakers. Further, many gender research questions cannot be answered by quantitative analysis and instead require qualitative and hybrid research approaches. Deeply entrenched factors, such as social and cultural norms and practices, are best explored through qualitative research and theory. Effectively redressing digital inequality will require transforming the structural inequalities that perpetuate economic and social exclusion and that are mirrored in the digital world. Political economy research that examines relations of power and interests in relation to gender can provide insights into the nature of digital inequality and how it might be structurally addressed.

**REFERENCES**


3

TECHNOLOGIES AND YOUTH: KEY DIMENSIONS FOR INVESTIGATING GENDER DIFFERENCES IN INTERNET ACCESS AND USE

AUTHORS:
TATIANA JEREISSATI, MONICA BARBOVSKI, JAVIERA MACAYA, STEFANIA LAPOLLA CANTONI

ABSTRACT

This chapter underscores the importance of understanding the use of the internet through a gender perspective and acknowledging gender-specific discourses on the uses of information and communication technologies (ICTs), as well as their implications in terms of opportunities and risks for the young population. The growing use of digital technologies by youth highlights the importance of understanding how these transformations affect their lives. ICT use potentially provides a multitude of opportunities, for example, by supporting children's rights, including those pertaining to gender equality. However, internet use also replicates inequalities affecting young people, and it creates new inequalities which may not be adequately portrayed in quantitative research. Gender inequalities affect both the uptake of ICT-related opportunities by girls and boys and the nature and extent of their online risks. In this context, how can researchers identify the inequalities related to the access to and use of ICTs by the young population? How can we identify gender differences in terms of opportunities and risks online? This information is crucial to inform policymaking that aims at bridging the gender digital divide. The Regional Centre for Studies on the Development of the Information Society (Cetic.br), a department of the Brazilian Network Information Centre (NIC.br), developed a qualitative research framework that takes gender as a fundamental cross-cutting dimension for understanding the social implications of digital technologies in the lives of the young population. This research aims at investigating practices of access and use as well as activities of young people online which escape quantitative approaches. The qualitative study was implemented in the urban setting of São Paulo, Brazil, by Cetic.br in 2016. Focus groups were conducted with internet users aged 11–17, as well as mothers, fathers, and teachers, in order to obtain insights into gender-specific issues on the use of ICTs by the young population. Additionally, in-depth interviews were conducted with young people selected according to their self-identified gender identity and/or sexual orientation. This chapter presents preliminary results on the intersection of two important dimensions, online privacy and violence, examining how this population manages their information online and exploring the role of gender in this complex process.

KEY FINDINGS

• Both boys and girls aged 11–17 believe that parents are more restrictive and controlling of girls’ use of the internet. Many attributes this difference to gendered norms of what is appropriate or acceptable for girls. However, limited access to ICT may influence how children find and uptake opportunities.
• Girls have more concerns about their personal information online being more exposed to risky situations; they are also more likely to suffer negative consequences from this than boys.
• The non-consensual disclosure of nude photos appears to be a common practice that affects young people’s lives. This practice is gender-based: girls’ photos are disclosed by boys, without consent. The consequences of such actions are perceived as extremely problematic for girls, with consequences ranging from changing schools to depression and suicide attempts.

INTRODUCTION

New media have been widely embraced by young people for purposes of communication and connection to peers, as well as for self-expression online. In 2017, it was estimated that one in three adolescents under 18 were online worldwide — a fast-rising proportion of internet users (Livingstone et al., 2016). Such rapid growth in youth’s access to the Internet, further enhanced by the spread of mobile Internet devices, has led to increased attention to young people’s uses of digital technologies. In spite of advances in access to digital technologies worldwide (ITU, 2018), digital inequalities and exclusion, especially related to gender, remain of a particular concern51. Gender-related data on ICT are essential to map patterns in access to and use of ICT, to inform national policy and to monitor the advancement of international policy goals of equitable information and knowledge. Unfortunately, the scarcity of sex-disaggregated ICT data, especially for developing countries, may hinder the development of ICT policies that can benefit girls and women (UNCTAD, 2014). This is of particular relevance since gender can influence young people’s access to and use of technology, including how they use devices, what activities and opportunities they are encouraged to pursue by means of ICT use, and the consequent

51 The digital gender divides have been addressed by numerous international initiatives, including the World Summit for the Information Society (WSIS, 2003, 2005), the WSIS +10 Outcome Document (ITU, 2014), and Agenda 2030 adopted by the United Nations (UN, 2015; UN Women, 2015), which focus on ICTs as strategic for improving gender equality and ensuring opportunities of networking, empowerment and participation (SDG 5 - Gender Equality).
This research examines gender-related inequalities and the ways in which gender stereotypes impact young people's experiences of the internet. The research framework was implemented by FLACSO Argentina, in partnership with FLACSO-ECLAC, in Cetic.br, and in collaboration with the Brazilian Network for the Information Society (Cetic.br) and the Brazilian Computer Science Society (SBC). The research was conducted in Brazil and South Africa in 2016, with a sample of 200 young people aged 13-19 years old. The research used qualitative methods, including interviews, focus groups, and online surveys, to explore young people's experiences of the internet and their online practices.

The research findings revealed that young people experience gender-related inequalities in their access to and use of the internet. Young girls are more likely to experience restrictions and limitations on their internet access and use, and are more likely to be policed and monitored online. Young boys, on the other hand, are more likely to experience hyper-masculine behavior and to be rewarded for following gender stereotypes.

The research also found that young people's online experiences are influenced by their gender roles and stereotypes. For example, young girls are more likely to be policed and monitored online, while young boys are more likely to be rewarded for following gender stereotypes. The research concludes that gender-related inequalities in internet access and use are a result of gender stereotypes and expectations, and that these inequalities need to be addressed to ensure equal opportunities for all young people to participate in the digital age.

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Research Questions

How are boys and girls socialised by various agents (family, media, school environment and groups of peers, wider community) regarding what is appropriate to share online, and with whom? How are they encouraged or discouraged regarding managing degrees of disclosure, setting and enforcing boundaries, and maintaining control over their privacy? For example, are boys or girls asked to share their passwords with others in their peer group, or to share pictures on the device or on social media? How do they manage their privacy settings and perceive online risks, and does this vary by gender?

ONLINE VIOLENCE

Young people’s exposure to online risks, the types of risks they encounter, and the connection with face-to-face risks (e.g., violence) are widely discussed and debated. EU Kids Online has formulated some key observations: not all risks result in harm (Hansson, 2010); young people have various degrees of resilience; and young people who are most vulnerable, both online and offline, are most likely to be in danger of harm (Hansson, 2010). The risks related to online violence, such as the dissemination of nude photos without consent and sexual cyber-bullying, are marked by nongoal gender dynamics, with girls usually being more affected by gendered pressures towards sexual behaviour, experiencing more negative consequences and being subjected to more online harassment and stalking. This dimension explores young people’s experiences of sexual online risks, and less in relation to children’s safety online, in alignment with the protection dimension of the 1989 UN Convention on the Rights of the Child (UNCRC, 1989) — mainly concerning sexual online risks, and less in relation to opportunities for gender and sexual expression (Livingstone and Mason, 2015).

This dimension explores young people’s experiences and perceptions of online violence, including harassment, discrimination, and dissemination of nude photos without consent, whether gender-specific or not, as well as its consequences and implications for boys and girls respectively.

Research Questions

Have young people experienced any type of problematic situation online, including harassment, discrimination, verbal violence (including being called names), dissemination of nude photos without consent, or slandering (e.g., being ridiculed online for not conforming to norms regarding physical beauty)? Are the issues they report related to what the impacts for those who experience such situations? Does this differ for boys and girls? Whom do they consider responsible for such problematic situations, and how could they be avoided? How can they deal with these situations when they arise?

IMPLEMENTING THE RESEARCH FRAMEWORK: THE CASE OF YOUNG INTERNET USERS IN SAO PAULO, BRAZIL

Following a pilot phase, the research framework was implemented by Cetic.br in the metropolitan area of São Paulo, Brazil. In this phase, the project was carried out in collaboration with Brazilian Center for Analysis and Planning (CEBRAP), and fieldwork was conducted by the Brazilian Research Institute Ibope Inteligência. Fieldwork consisted of 16 single-sex focus groups26 conducted with internet users aged 11–12, 13–14, and 15–17 years. For these age ranges, consent was sought from both minors and adults to conduct the research. Also, data collection was preceded by a series of consultations with young people and with experts on topics related to gender, internet and media, and young people, from academia, government, and civil society, in order to map out topics to be addressed. Including young people in the design of the research questions conforms to the prerequisite of including young people in decision making processes that affect their lives, in keeping with the UN Convention on the Rights of the Child. Finally, four (out of sixteen) focus groups were comprised exclusively of black young people. In-depth interviews were conducted with young people selected according to their self-identified gender identity and/or sexual orientation, recruited with the help of a local LGBTQ organisation.

Given that children’s online experiences cannot be studied in isolation from their lives in general (Kardasz-Winther, 2017), the sample selection criteria for the focus groups were guided by the intersections of gender, sexual and racial characteristics (according to the official Brazilian distribution, and following the classification established by the Brazilian Institute of Geography and Statistics); and type of school (public or private) — with additional sampling for socio-economic level (SEI)27. Information about religion was also collected, though not used as a sampling variable. A thematic analysis was conducted for this chapter, relevant quotes were translated by the authors, with attention to children’s expressions and use of language.

For the purpose of this chapter, we present preliminary findings focusing on two broad dimensions of interest: (1) perceptions of privacy online, socialisation of privacy, and personal boundaries; and (2) online violence. This will allow a brief discussion on how young people reflect about privacy, how they manage information shared online, and how they deal with the issue of consent. Additionally, we discuss the perceived gender norms related to online privacy and risks — a topic that is deeply connected to experiences of online violence reported by the interviewees.

PRELIMINARY RESULTS: BRIEF DISCUSSION OF ONLINE PRIVACY AND VIOLENCE

The rise of social networking sites and their enthusiastic embrace by young people have posed new challenges regarding how they manage the information they share with different “networked publics” (Ito, 2008). As cultural assumptions and social norms around privacy, sharing, and visibility are revisited in the context of new technologies, youngsters appear to be using innovative mechanisms for dealing with these issues (Marwick & Livingston, 2014).

Privacy has been conceptualised as a process of managing the boundary between an individual and his or her digital self as well as deciding what information to share and who should have access to it (Altman, 1975; Livingstone & Marwick, 2014). In this chapter, we have found it difficult to define in their own words when asked about the meaning of “privacy”, many young Brazilian teenagers described in terms of absence, with particular mention of perceived “invasion of privacy” regarding their online activities. Adults often undermine the agency of the young population, by scrutinising their children’s mobile phones and surveillance their activities online (Livingstone & Livinston, 2014). Moreover, Brazilian findings show that both boys and girls, from different age ranges, perceive parents as more controlling of girls’ use of the internet. Attempts to explain this often suggest that girls are “naturally” more vulnerable, in particular with regard to their safety, in a context where the boundary between online and offline interaction becomes increasingly diffuse. Nevertheless, this practice may affect the unequal uptake of opportunity by boys and girls. My dad always takes my mobile phone, and once I found him reading my conversations and I got very angry because he asks me what’s going on, ‘I’ll tell him. He takes it from my hand, he won’t even let me block it.

If my mom takes my mobile phone to check it and finds a photo or something, it’s okay. I’m a boy, right, boys are like that, she’ll understand, but if it’s my sister, she’s toast.
— 15–17 year-olds, boys, private school

My dad says that he gave my brother more freedom because I will always be daddy’s girl and he will always be more cautious with me than my brother. That is much more likely that something dangerous happens to me than my brother.

— Girl, 11–12, private school

Although a wide variety of problematic online situations were described by young Internet users, including racial discrimination and bullying, a striking and recurrent situation was the non-consensual disclosure of nude photos by a third party, usually after having been sent to a trusted person (such as an ex-partner or friend). This was reported in all focus groups conducted in São Paulo, in all age ranges, and was much more prevalent among girls. Overall, the consequences of these practices were also perceived as extremely problematic for girls; they ranged from having to change schools to depression and suicide attempts.

In my school there is a girl, she sent nude photos to a boy, he posted them and she had to move to another country; the girl’s mom wanted to kill the boy and the girl wanted to kill herself and almost threw herself at the train tracks.

— 11–12 year-old girls, public school

My friend’s [nude photo] was also shared without consent. Her boyfriend printed her photos and put them on the street poles, it was horrible and the police had to be involved.

— 13–14 year-old girls, private school

In face of such situations, a common reaction in the focus groups was to blame the girls for taking and sharing photos of themselves in the first place. Seldom was the perpetrator, who disclosed the photos without consent, accounted responsible.

She is also wrong to send [nudes] (...) because if someone sends it to me and I disclose it, the fault won’t be mine, it will be hers. I think so.

— 13–14 year-old boys, public school

But, deep down, I think [the girls] want [the photo to be disclosed] because if she didn’t, she wouldn’t take the photo.

— 15–17 year-old boys, private school

I’d like to ask her something: was the girl forced to send the boy a photo [or] did she do it because she wanted to? She did it because she wanted to.

— 11–12 year-old girls, private school

and the need for child protection, as well as a discrepancy between how youngsters perceive these situations and what they are taught about them (Livingstone & Mason, 2015). As noted by Ringrose et al. (2013), discourses around sexting tend to reproduce moral norms of victim-blaming in cases of sexual assault (Salter et al., 2013, p. 310), instead of condemning the cultural sexism that endorses unauthorised and coercive distribution of girls’ pictures (Salter et al., 2013, p. 307). Accordingly, these discourses on sexting present girls as sexual subjects to be controlled and their sexuality as something to be surveilled and regulated (Salter et al., 2013).

The preliminary findings of this project highlight the relevance of detailed research that can address the issues of privacy and violence from a gender perspective, and their implications for the young population.

MOVING FORWARD: KEY RECOMMENDATIONS

- Engage key stakeholders in the ICT and gender debate; promote wider raising on the topic, giving voice to children and also involving parents, educators, the media, the private sector, and research institutions.
- Promote more research to obtain timely, robust data on ICT use by children, through a gender perspective, to inform policymakers; use encouraged agreed research frameworks (adapted locally) to allow cross-national comparisons.
- Adopt a mixed-methods approach whenever possible, producing both quantitative and qualitative data.
- Give special attention to data gaps: themes (e.g., privacy and violence); age ranges (e.g., young girls); and geographical scope (Global South, rural areas).
- Mainstream gender in both research and policymaking related to children’s use of ICT; promote evidence-based policymaking in this field.

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This chapter focuses on the relationship between gender and disability, stating that "women and girls with disabilities are subject to multiple discrimination," it asserts that States Parties have an obligation — along with other requirements — to ensure access to information and communication technology (ICT), including the internet, to women with disabilities, on an equal basis with others. Borrowing from feminist legal scholarship, disability rights scholars have adopted the term intersectionality to describe the overlapping forms of discrimination and systematic injustice that affect women with disabilities. Since the 1990s, researchers in human-computer interaction, legal scholars, and industry practitioners have promoted ICT accessibility, striving to remove the barriers that persons with disabilities experience using ICT. Similarly, the UN has argued that under the CRPD, States Parties have an obligation to ensure that technology is usable for persons with disabilities. The UN also endorses universal design, which requires the design of ICT "to be usable by everyone to the greatest extent possible without the need for adaptation or specialised design". Universal design serves as a useful tool in promoting both ICT access and accessibility for women with disabilities, and it provides a useful framework for understanding the overlapping forms of discrimination that women with disabilities experience in accessing and using ICT.

**KEY FINDINGS**

- **States have an obligation to ensure access to ICT, including the internet, to women with disabilities, on an equal basis with others.**
- **Universal design provides a useful tool for promoting both access and accessibility in ICT for women with disabilities; it provides a framework for understanding the overlapping forms of discrimination that women with disabilities experience in accessing and using ICT.**
- **Disability rights scholars have adopted the term intersectionality to describe the overlapping forms of discrimination and systematic injustice that affect women with disabilities.**
- **Since the 1990s, researchers in human-computer interaction, legal scholars, and industry practitioners have promoted ICT accessibility to remove the barriers that persons with disabilities experience using ICT.**
- **Research still needs to fully develop and operationalise universal design, to allow scholars and advocates to integrate an intersectional perspective in ICT. Scholars have yet to investigate in detail the experience of multiple socially marginalised groups in accessing and using ICTs.**
- **While ICT developers have made significant strides towards automatic detection of hate speech online, the implications for persons with intersectional identities have yet to be explored.**
- **Research on ICT accessibility has not yet fully examined the socio-economic and socio-political mechanisms that persons with disabilities experience accessing ICTs, particularly women with disabilities in the Global South. "Accessibility," as generally understood, is accessible for a small fraction of people with disabilities.**

**INTRODUCTION**

The World Health Organisation (WHO) estimates that 15% of the world’s population has experience of long-term disability (WHO, 2011), finding that the prevalence of disability is higher among women than men (WHO, 2016). Moreover, moderate to severe disability affects 6.7% of women with disability — slightly higher than the 6.5% of men with disability — and women with disabilities experience gender discrimination in addition to any disabling barriers (WHO, 2011). Accordingly, the effort to bridge the digital gender divide must take into account the experiences of women with disabilities. The European Union as well as the United Kingdom and other countries have recognised that women face multiple forms of discrimination, and that the rights of women do not exist in isolation from their rights as persons with disabilities. Indeed, women with disabilities may experience exacerbated rights violations, occasioned by their dual identity as women and as persons with a disability. In relation to access to ICT, women with disabilities experience unique barriers to ICT that need to be tackled as a whole rather than separately.

It is beyond the scope of this article to fully investigate the relationship between digital divides, disability, and gender. Digital divides are complex and multidimensional; they may include barriers in using ICT interfaces, barriers in accessing information, and barriers in acquiring digital competencies. Technical standards for designing technology that is accessible specifically to women with disabilities have yet to be developed, either by government or by industry. The specific barriers experienced by persons with disabilities in accessing and using ICT have been well documented in the literature (Dobransky & Hargittai, 2006). Since the emergence of the disability rights movement in the United States in the 1960s, research has provided examples as well as criteria
Some potential design considerations for ICT developers emerge clearly from the hypothetical but realistic situation of women with disabilities trying to access information on the web about domestic abuse. A woman survivor of domestic abuse may experience barriers accessing information about domestic abuse on the web based on gender, disability, and possibly other social identities (racial, ethnic, socio-economic, etc.). First, the act of accessing information about domestic abuse may put the woman in a dangerous or threatening situation, if the web developers have not provided and highlighted easy-to-access, and discreet functionalities to clear the web browser’s search history. Second, accessing information about domestic abuse may trigger feelings of doubt or self-blame, if the content developer’s information on abuse can be presented in ways that promote self-esteem and perceived control. Third, imagery used on the website may contain problematic symbols that convey unintended, culturally inappropriate meanings, if the content developers have not considered the sociocultural backdrop of the user (Rideout, et al., 2016). Fourth, the content of the website may alienate and exclude transgender women or women in a queer relationship, if developers have embedded cisgender and heteronormative design assumptions that diminish or marginalise the experiences of queer and transgender women (Shelton, 2017). Fifth, complex content and features of the website may be inaccessible for persons with cognitive disabilities, if the developers have not ensured that the website adheres to standards for web accessibility such as the Web Content Accessibility Guidelines (WCAG), which prescribe, among other things, the use of clear and understandable language and actions. Sixth, the content of the website may exclude women of a variety of cultural backgrounds due to the use of unfamiliar idioms and cultural references. Seventh, the content of the website may exacerbate issues related to low self-esteem, shame, and prejudice, if developers have not considered the experiences of women with cognitive and psychosocial disabilities who have survived systemic violence (Meer & Combrinck, 2015). Finally, the content of the website may discourage a woman from seeking help if the content is intimidating and difficult to understand. The interaction between this hypothetical user and the design of the website inextricably links the woman’s gender, sociocultural background, disability, and sexual orientation; web developers must consider these factors when designing websites to make the website accessible to women with disabilities.

This chapter has three parts. It presents research on marginalisation and discrimination in the use of ICT, including ICT accessibility for persons with disabilities and the less widely understood impact of intersectionality on ICT access. It then presents relevant research on universal design in ICT and its potential impact on ICT accessibility. Finally, it reviews the existing literature and the need for further research, before presenting recommendations for researchers and policy makers.

MARGINALISATION AND DISCRIMINATION IN ICT

Transnational feminism situates feminism within an international context, providing a useful basis for challenging the boundaries between nation-states and between social and cultural groups (Brenner, 2003). Transnational feminist scholars have argued that satellite and internet technologies have allowed greater volumes of media—especially visually-based imagery—to be promulgated around the world (Fernandes, 2013). These trends have contributed to destabilising structures of power that systematically oppress women, while also reinforcing stereotypical images of women based on their culture and traditions (Fernandes, 2013).

In a related field, research in science and technology studies have shown efforts to combat the decline of women’s participation in the ICT field have hark back to engaging with formative masculine perceptions of the field (Henwood, 2000). Over the last decades, scholars have challenged the prevailing assumption that technology is a gender-neutral domain (Ford & Wajcman, 2011). In practice, technology is defined by a culture of perceived “know-hows” vs. “know-nots”. Because a majority culture defines how individuals interact with ICT and how ICT systems are designed and structured, these development processes and user-experience designs often exclude minority groups.

The experiences of minority groups in social media provide a useful example to illustrate the unintended results of excluding minority groups from ICT development processes and user-experience design. All users, particularly minority groups, are expected to have similar experiences on social media, and research suggests that minority groups may view hate speech as more interlinked with the microcosm (Skjerve et al., 2016). However, research also suggests that minority groups are rendered invisible in online debates, precisely for fear of such repercussions or real-world consequences (Skjerve et al., 2016). In the initial design of many social media platforms, such as Twitter, developers apparently prioritised users’ anonymity overly, safety and security, a decision that has the effect of disenfranchising minority groups. One of the victims of GamerGate, an ongoing campaign of harassment that personally targets women in the video game industry, is Brianna Wu. She described, in a 2015 article, the experience of being a high-profile woman online: “You have to constantly ask yourself if your post will put you or your loved ones in danger” (Wu, 2016). Wu, who ran unsuccessfully for a seat in the U.S. Congress in 2018, continues to work in industries where one’s social media presence and online network have a direct influence on their career. Wu’s experience shows that excluding minority groups from ICT development processes and user-experience design can exacerbate the digital divides that constrain the participation of women and other minority groups in society. Research has yet to provide case studies or empirical evidence examining the overlapping forms of discrimination experienced by women with disabilities in accessing ICT, due to both disability and gender.

ICT ACCESSIBILITY

The development of ICT has produced a global digital divide due to the disparities between countries that possess ICTs and countries that lack them. The UN Convention on the Rights of Persons with Disabilities (2006) describes accessibility as “an evolving concept” that “results from the interaction between persons with impairments and attitudes and environmental factors that constrain their full and effective participation in society on an equal basis with others.” A person with an impairment, i.e., a variation of an individual towards a recognition that is not inherently disabled. While pain and other symptoms of an impairment might act as disabling factors, society’s failure to accommodate a person’s needs that must be considered in development processes and user-experience design can exacerbate the digital divides that constrain the participation of women and other minority groups in society. Research has yet to provide case studies or empirical evidence examining the overlapping forms of discrimination experienced by women with disabilities in accessing ICT, due to both disability and gender. This reflects the shifting conceptualisation of “disability” away from an inherent deficiency on the part of an individual towards a recognition that designers typically embed assumptions of disability and functionality in developing social structures and built environments — assumptions that disadvantage some people (Shakespeare, 2006; Oliver & Barnes, 2012). Javier Romañach and Manuel Lobato, at the 2005 Independent Living Forum in Spain, proposed an international standard that aimed to provide clear criteria and guidance for developers to create web content that is accessible for persons with disabilities. WCAG soon spread internationally, as a practical and legal solution for achieving web accessibility (Giannounis, 2015a). By the late 1990s, interest organisations had begun to involve disability anti-discrimination legislation to take private enterprises to court over websites and ICT features that were inaccessible for persons with disabilities (Giannounis, 2015b).

Research on web accessibility has focused on the outcomes of web accessibility policies, such as WCAG, in specific sectors: public libraries (Yu, 2002; Stewart et al., 2005) and public service organizations had begun to invoke disability anti-discrimination legislation to take private enterprises to court over websites and ICT features that were inaccessible for persons with disabilities (Giannounis, 2015a).
INTERSECTIONALITY

Intersectionality provides a useful basis for examining the overlapping forms of discrimination that women with disabilities experience in accessing ICT. Intersectionality, as both a theory and a methodology, recognises that systems of oppression intersect with each other; thus, the sum of an individual’s identity goes beyond separate components such as ethnicity, race, class, sexuality, age, citizenship status, and gender (Collins & Bilge, 2016; Crenshaw, 1991). This has two main implications. First, no part of a person’s identity can be seen as a lack of power. Second, isolated perspectives and barriers that women with disabilities experience accessing and using ICT, is important to understand and address the barriers that women and minorities with disabilities experience accessing and using ICT.

Antidiscrimination law and policy have provided a useful basis for incentivizing, and coercing, providers of goods and services to ensure access to ICT for persons with disabilities, but these laws do not fully comprehend the barriers that persons with intersectional identities experience accessing ICT (Blanch, 2014). The 2010 Equality Act in the UK has provided protections for persons with multiple protected characteristics, such as disability, race, gender, and sexuality. However, some research has found that the Equality Act has failed to accommodate instances of discrimination that have an intersectional nature (Solanki, 2011). As discussed in the following section, the Norwegian government has taken a different approach, requiring goods and service providers to ensure universal design of ICT (Blind, 2005).

UNIVERSAL DESIGN OF ICT

Universal design typically refers to the design of products and services to be usable by all persons to the greatest extent possible (UN, 2006). The Action Plan of the Norwegian Ministry of Children and Equality, in promoting universal design, asserts: “The government wants to get away from a way of thinking in which the individual is defined as the problem and in which special measures for people with disabilities are the main solution” (BLID, 2005). In principle, universal design may provide a mechanism for recognising the overlapping forms of discrimination that persons with intersectional identities experience. However, like the United Nations, the Norwegian government fails to recognize the application of universal design to persons with intersectional identities, such as women with disabilities; in this regard, the Norwegian legislation is vulnerable to the same criticism as the UK’s Equality Act.

While ICT accessibility is typically associated with the removal of barriers, making ICT products usable by persons with disabilities, scholars have recently begun to adopt broader conceptualisations, which relate more closely to the concept of universal design (Giannoumis, 2016). Persson et al. (2014) define accessibility as “the extent to which products, systems, services, environments and facilities are able to be used by a population with the widest range of characteristics and capabilities (e.g., physical, cognitive, financial, social and cultural, etc.), to achieve a specified goal in a specified context.” Similarly, Petrie et al. (2015) propose a unified definition of web accessibility, arguing that web accessibility means that “all people, particularly disabled and older people, can use the range of contexts of use, including mainstream and assistive technologies, to achieve this, websites need to be designed and developed to support usability across these contexts and using ICT”.

The scope of the definitions provided by Petrie et al. (2015) and Persson et al. (2014) are similar to the definition of universal design proposed in the CRPD. According to the CRPD, universal design “means the design of the products, environments, programmes and services to be usable by all people, to the greatest extent possible, without the need for adaptation or specialised design”. (We note that the caveat “to the greatest extent possible” echoes other limit-setting legal provisions, such as the phrase “undue burden” that appears in disability anti-discrimination legislation in the United States.)

While universal design may provide a useful basis for identifying and removing barriers that providers with intersectional identities, such as women with disabilities, experience in accessing and using ICT, the concept has not been fully analyzed and operationalized in a way that would allow scholars and advocates to integrate an intersectional perspective into the design and development of ICT. For example, research on universal design shows that persons with intersectional identities generally experience barriers in accessing information on the web. Other research shows that persons with intersectional identities are seen as autonomous or sexual beings (Shakespeare, Gillespie-Sells, & Davies, 1996). This suggests that a woman with a disability may experience overlapping barriers in attempting to access meaningful information on the web. The challenge remains for web content to be developed with consideration of the barriers that the individual may experience, based on the intersection of disability and gender.

GAPS IN THE LITERATURE

Research has yet to examine fully ICT accessibility and universal design. Existing studies need to be built upon, in four important directions:

1. First, while research on ICT accessibility has typically focused on the usability of web content for persons with specific impairments (e.g., the blind and partially sighted, or deaf and hard of hearing), scholars have yet to investigate extensively the experiences of persons belonging to multiple socially marginalised groups. This includes presenting content in a rich and culturally-embedded way rather than attempting to “sanitize” it, as well as using technology use in innovative ways to invite broader active participation, rather than requiring users to separate themselves from their multiple identities.

2. Second, while ICT developers have made significant strides towards the automatic detection of hate speech online, the implications of such technology for persons with intersectional identities have yet to be explored (Diruc et al., 2015; Ota, et al., 2015; Badjatiya, 2017).

3. Third, research on ICT accessibility has not yet fully examined the socio-economic and socio-political mechanisms that persons with disabilities experience accessing ICT, particularly women with disabilities in the Global South (Badjatiya, et al., 2016). As generally understood, is accessible for only a small fraction of people with disabilities.

4. Fourth, research in universal design, similarly, has yet to provide a useful theoretical framework or model that captures the experiences of persons with intersectional identities, such as women with disabilities (Lid, 2014).

RECOMMENDATIONS FOR RESEARCH AND PRACTICE

Research

Future research could usefully collect data on the experiences of women with disabilities, focusing especially on ICT barriers that are created at the intersection of such discriminating structures as racism, transphobia, sexism, homophobia, and xenophobia.

Universal Design has yet to establish its theoretical anchoring. Future research could bring interdisciplinary application of models and methods used in other fields, to inform further research and development within the field of Universal Design of ICT.

Researchers could usefully examine the experiences of women with disabilities across the gender diversity spectrum, in accessing and using ICT. Similarly, an intersectional perspective can better illuminate such highly salient topics as online privacy, child online protection, and cybersecurity.

Finally, future research could usefully employ culturally responsive computing (CRC) (Scott et al., 2015) to enrich computing education by focusing on an individual’s cultural and social identity. This includes presenting content in a rich and culturally-embodied way rather than attempting to “sanitize” it, as well as using technology use in innovative ways to invite broader active participation, rather than requiring users to separate themselves from their multiple identities.
Laws, Policies, and Technical Standards

National and international law and policies require systematic reform to incorporate an intersectional understanding of accessibility in technical guidelines, accessibility regulations, and antidiscrimination laws.

In order to ensure access to ICT for all persons, governments must recognize, under law, the experiences of persons with intersectional identities that are subject to multiple forms of discrimination (Solanki, 2011). Laws and policies offering legal protections only for single forms of discrimination may not provide a clear enough standard to ensure access to ICT for women with disabilities. To ensure ICT access to everyone, laws, policies, and standards must include requirements for ensuring the universal design of ICT, while recognizing human diversity and the overlapping forms of discrimination and inaccessibility that exist at the intersection of different forms of social disadvantage.

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Women play a critical role in food security in the developing world, but their agricultural activities are often characterised by gaps in information and resource access, with deficiencies in several areas: land, labour, credit, information, extension, and technology. Increasing stresses on food security, brought about by a changing climate, call for the active contributions of women in agriculture. This will require equal participation in decision making, equal access to agricultural resources and services, institutions that address their concerns, and technologies and information that are useful to them. ICTs are so far not providing them with the information, services, and knowledge they need and want. Sufficient evidence and experience exist, however, to develop agricultural information strategies for food security that support women and promote gender equality. This chapter provides a review of women’s access to and use of climate and agriculture information; it provides examples of successful strategies for reaching women, with suggestions for further research and programming to promote gender equality along with climate information.

KEY FINDINGS

- ICT and information services have the potential to promote gender equality and empowerment of rural women, if they contribute to needs and priorities of both women and men in rural areas and increase their resilience to cope with climate change. Currently, however, information is not reaching women farmers adequately.
- ICT can play an important role in facilitating support to women in the critical areas defined by FAO for supporting women’s activities in food security: livelihood support, reducing women’s workloads, ensuring protection from gender-based violence, and equitable access to resources and services.
- “Mixed” approaches may provide the most successful approaches to reach women with agriculture and climate information, in view of women’s low resource access and the widespread gender norms that inhibit women’s information access. Intermediary organisations, such as farmer associations and women’s organisations, also serve as important avenues for women’s information access.

ICTs have the potential to promote gender equality and empowerment of rural women in developing countries, while increasing food security, by decreasing workloads, increasing decision-making power, diversifying agricultural production, enhancing ability to respond to climate and weather variability, and improving livelihoods. Although ICT4D has a significant track record in development, the technology has not yet provided rural women in developing countries with the information, services, and knowledge they need and want — even as climate change has increased their need for innovative solutions. The problem lies in designing the transmission of information that women need in ways they can access readily. When this does happen, women have shown their readiness and eagerness to use and benefit from information through technology.

Women play a critical role in food security in the developing world. Their participation in the agricultural labour force in sub-Saharan Africa ranges from 60% to 80%; in least developed countries (LDCs), 80% of women list agriculture as their major employment sector. These percentages will increase in many countries, as rural women play a growing role in smallholder agriculture as a result of male out-migration to urban centres for employment (Doss, 2011; FAO, 2011; UN, 2015). However, women’s agricultural activities are often characterised by gaps in information and resource access, with deficiencies in critical areas: land, labour, credit, information, extension, and technology (Huyer, 2016). The Food and Agriculture Organisation (FAO) has calculated that, if women farmers were to have the same access to resources and services as male farmers, their production would increase by 10–14%, with a resulting massive decrease — of up to 150 million — in the global population that experience hunger (2011). Women’s vital contribution to food production, subsistence farming, and the agricultural labour force in the developing world means that strategies to promote gender equality and women’s empowerment in ICT in agricultural development must be a priority for global food security. Such efforts are also central to a global development agenda based on human rights and the Sustainable Development Goals (SDGs).

Globally, rural women fare worse than either rural men, urban women, or urban men, on every gender and development indicator for which data are available; they show lower levels of health, education, employment, and decision-making power. They face higher levels of poverty and violence. Women and girls also face a higher risk of undernourishment — about 60% of people living in hunger are female (UN, 2010; UN, 2015; FAO, 2017). They are more affected by environmental deterioration and hazards, as they depend on, and have responsibility for, natural resources.
resources. In 2010, an estimated 66% of households in sub-Saharan Africa, 55% in South and Southeast Asia, and 31% in Latin America relied on collected fuelwood for cooking, primarily responsible such as fuelwood collection. Rural women are at especially high risk of negative impacts from climate change, as other household responsibilities entail natural resource-based activities, including subsistence agriculture and fetching water and fuelwood. Increasing rates of male out-migration from rural areas means that women also take on additional work in agricultural production. For these reasons, environmental stress in farming systems (such as those caused by climate change) intensifies women’s workloads while decreasing the assets of poor households (Jost et al., 2016; Agwu &fill kimbi, 2015).

Despite global gains in food production and reduction in poverty, the world faces a crisis: some 795 million people still suffer from hunger, and more than two billion experience either micronutrient deficiencies or some form of over-nourishment. Increasing pressures on natural resources due to population growth and resource extraction are exacerbated by climate change, natural disasters, and other shocks, which threaten the sustainability of food systems at large (FAO, 2017). Other major challenges include increasing urbanisation and demand for food, erratic food prices, conflict, population displacement, and continuing economic inequality. A transformation of rural production systems (such as those imposed by climate change) in the developing world is to cope (IFAD, 2016). Given the gendered division of labour, female workers may work longer days than men, and new activities that require additional labour are often allocated to already burdened women (Grassi et al., 2015; Beuchet & Badoua, 2013). The latest IPCC assessment on social vulnerability makes clear that climate change will exacerbate these existing gender inequalities (IPCC, 2014).

At the same time, women’s contributions to resilience building and peace processes are often overlooked; they are rarely represented in leadership and decision-making positions. As a result of these inequalities, women have less opportunity to influence policies, programmes, and decisions that affect their lives. The effects of climate variability, shocks, and extreme weather events are likely to increase the existing inequalities and vulnerabilities faced by women (Dankelman, 2010; Kakota et al., 2015; IPCC, 2014). But women are also active agents for community resilience and in developing responses to the impacts of climate change. They are actively involved in the implementation of food security strategies for women’s agricultural activities (see FAO, 2017), women are consistently less considered in the design of agricultural interventions in West Africa (Congleton et al., 2015).

Reflecting the digital gender divide, as well as the general digital divide, women tend to be less connected to some of their reference sources (see FAO, 2017), women are consistently less considered in the design of agricultural interventions in West Africa (Congleton et al., 2015).

In specific contexts, the Role of Women in Agriculture (World Bank Study) investigated whether and how ICT can support women-managed agro-entrepreneurs in Kenya and Zambia, concluding that women and men differ in their access to, use of, and need for ICT tools. It found high unmet demand for extension information among women in these countries. The resulting pattern is that women and men differ in their access to, use of, and need for ICT tools. In Ghana, women are able to identify locations for new wells based on their knowledge of local water tables (Lane & McNaught, 2009).

Food security in a changing climate requires the active participation of women, who will entail equal participation in decision making and equal access to agricultural resources and services; institutions that address their concerns; and technologies that are useful to them. ICT and information services have the potential to promote gender equality and empowerment of rural women, as they allow information to contribute to the needs and priorities of women and men in rural areas and increase their resilience to cope with changing weather and climate change. However, information currently is not reaching women farmers adequately. ICTs are not providing much-needed agricultural information, and knowledge they need and want. Sufficient evidence and experience are already available to inform new agricultural information strategies for food security that at the same time support women and promote gender equality.

CLIMATE AND FOOD SECURITY INFORMATION IS NOT REACHING WOMEN

Access to ICTs — including ownership, control, and use — generally remains much lower for women than men in developing countries (TJ, 2016). Reasons for this include: lack of financial resources to secure the use of ICTs; lower levels of language literacy among women and girls; norms that discourage women and girls from using technology; and lack of control over and ownership of technology (see Huyer & Hafkin, 2006). The resulting patterns of unequal access to climate information and advisory services determine which individuals can make use of such services to manage climate risk and strengthen their resilience at the farm level. The farmers who tend to be most vulnerable to climate change stresses are resource-poor, female, and lower caste — individuals who are marginalised by their communities’ sociocultural norms (Tall et al., 2014). Women’s information networks are often smaller than men’s, and women tend not to have access to formal organisations, depending instead on family members, neighbours, and other traditional sources of information (Manfre & Nordheim, 2013). While women in rural areas can clearly benefit from these informal sources for information, men are able to access information from agricultural extension services, NGOs, and consulting firms (Kristjanson et al., 2015; Cramer et al., 2016; Perez et al., 2015).

Women also have fewer opportunities for learning about and taking up new productive and commercial opportunities (Sebastien et al., 2014). In Southeast Asia, women and men played different roles in domestic labour, sharing their participation in agricultural production (Duong et al., 2017). Women were responsible for most meal preparation and daily care of children. With fewer domestic responsibilities, men had more time to engage in income streams outside of agriculture that are less weather-dependent and that generate higher levels of income, while women earned their income mainly through agriculture. Men also made most farm-related decisions, such as crop selection and application for loans. As a result, the resulting patterns of the effects of weather events: more women than men experienced major damage to their crops from natural disasters, such as droughts or floods, and extreme weather events during the 2014-2015 El Nino. In these contexts, a major difference is that women are more vulnerable to climate change impacts than men, due to their lower economic status, political participation, and access to technology and information (Tall et al., 2014). The resulting patterns of unequal access to ICTs and information services determine which individuals can make use of such services to manage climate risk and strengthen their resilience at the farm level. The farmers who
slightly predominated: they reported contacting veterinarians for livestock assistance on a regular basis. This assistance allowed them to save money on travel and keep their livestock healthy in order to breed them successfully. Small livestock is often an area where women have decision-making power and can benefit from the proceeds, so they find it worthwhile to bear the cost of mobile phone use to improve results. (Martin & Abbott, 2011).

In general, however, context addressing women’s specific interests as priorities represents a large gap (Huyer, 2010; Coffey et al., 2015, particularly in the agricultural sector. Women seek out a wide range of information to support their household and farming activities; and although much information is not readily available to them (Cramer et al., 2015, GSMA, 2012, Pashenichnaya, 2015; Caine et al., 2015).

DESIGNING CLIMATE INFORMATION FOR GENDER EMPOWERMENT

Ensuring that women have access to information and knowledge (and act effectively) represents an important step towards gender equality and women’s empowerment (see Hafkin & Huyer, 2006). Research demonstrates that when women have access to information on agricultural technologies, along with the resources to implement it, they in fact implement the knowledge they have gained (Duong et al., 2016, Jost et al., 2016); the resilience of households, communities, and food systems are increased as a result (World Bank, FAO, & IFAD, 2009). Climate change, extreme weather events, and natural disasters make it even more important for farmers to take steps to minimise or prevent losses in agricultural production. Farmers need accurate climate information to help them cope with extreme weather events and variable rainfall patterns, including early warning systems, improved forecasting, and historical data and event records, including early warning systems, improved forecasting, and historical data and event records — adapting communication channels to reduce travel and mobility, and schedules — can reduce the barriers women face in accessing these services (Tan et al., 2014a; Pourouh, 2014).

Digital information can be incorporated into spaces and processes that are already part of women’s routines such as business activities, visits to or women’s groups (Tan et al., 2014a; Venkatasubramanian et al., 2014) — with transformative results. Social networks and community organisations, such as local women’s organisations or health clinics, can play a crucial role in promoting women’s access to information (2002). In Vietnam, intermediary organisations such as farmer associations and women’s organisations played a central role in disseminating climate information on water-conserving agricultural production and to realise their personal goals (Farwnorth et al., 2017). A survey in Uganda found that women preferred to receive climate information in descending order of importance via megaphones, letters, village leaders, farmers groups, school children, religious and social groups, and print media. They also perceived that men’s involvement in these forms was useful since it was presented in the local language and was location-specific (McOmber et al., 2013).

In India, access to mobile-phone-based agricultural information has reduced knowledge gaps between large and small farmers as well as between men and women. The “listening rate” of women farmers was equivalent to that of men farmers; 70% of women farmers felt that the “agro advisories” had increased their knowledge about farming, increasing their yields as a result. At least 48% of the women farmers surveyed responded that the information helped them to improve yields. For example, rice farmers who had access to input management, and 56% felt that the information helped them to reduce crop losses from rainfall. In one region, 83% of women farmers reported having taken action based on the information they received through this service. Interestingly, women also felt that the information increased their participation in household decision-making with their husbands (Mittal, 2016).

Another successful case of providing information to women is Shamba Shape-up in Kenya, a television programme that tests the effectiveness on the model of popular house makeovers. A survey found that most viewers of the show reported that the programme helped them to improve the profitability of their enterprises and had a positive influence on the management of their families’ food security. It is estimated that 43% of 566 households made changes in their farming practices and/or reported increased income or food production as a result of watching the programme. The programme focused mainly on maize and dairy; survey results were sex-disaggregated. While both male and female maize farmers benefited from the changes they made on their farms, men benefited slightly more, increasing their consumed output by 58% compared to an increase for women of 23%. Similarly, an output for sale doubled for men and increased by 83% for women. In dairy, although men farmers had greater returns than women, women dairy farmers experienced greater proportional returns: their production increased by 59%, compared to improvement for men of 41% (Africa Enterprise Challenge Fund & University of Pretoria, 2014).

Rádio Kambá demonstrated the potential for an effective transformation tool in many routine areas. In a village in Kenya, Kamba women were able to hear women like themselves talk about their experiences with digital information, notification of social events, discussion forums, and entertainment in the form of radio vignettes and plays. They were able to interact with community leaders and programme hosts online to discuss programming and offer content, providing them an opportunity to speak out publicly and demand answers from farmers’ leaders. As a result, they experienced increased agency and positive self-perception in the organisation of their input from the larger community (Stierley & Huyer, 2009). Dimitra community listening clubs in Congo and Niger represent a gender-responsive participatory approach to information dissemination, using training sessions, proved effective in disseminating climate information and support content, providing an opportunity to speak out publicly and demand answers from farmers’ leaders. As a result, they experienced increased agency and positive self-perception in the organisation of their information delivery (Caine et al., 2015). Intermediaries (or “infomediaries”) who are respected community members can request information on topics of interest. Information is disseminated using both new technologies (internet, on-line database, etc.) and more “traditional” means of communication (newsletter, brochures, and community radio). The experience of Malagasy farmers in a community forum allows the public airing and debate of many issues and has provided a platform for examination of how information is exchanged. For example, in a rural community began to take on childcare duties, while their husbands had responsibilities outside of the household (DIMITRA, 2013).

A more traditional approach to information dissemination, using training sessions, proved successful in serving women rice farmers in Vietnam, improving livelihoods and household incomes; and women’s empowerment (see Hafkin & Huyer, 2002). In Vietnam, intermediary organisations such as farmer co-operatives to spread new technologies (internet, on-line database, etc.) and more “traditional” means of communication (newsletter, brochures, and community radio). The experience of Malagasy farmers in a community forum allows the public airing and debate of many issues and has provided a platform for examination of how information is exchanged. For example, in a rural community began to take on childcare duties, while their husbands had responsibilities outside of the household (DIMITRA, 2013).

Successful approaches to reach women in the developing world with climate information most often centre on the use of available resources as well as gender norms often inhibit women from interacting with formal and organised information channels and networks; thus accessing certain communications technologies. Mixed modes or channels of communication can overcome the barriers faced by women at various points in the information dissemination process, taking advantage of existing communications networks and channels. For example, traditional local social networks can transmit information to mobile phone users, producing a significant increase in the quality and speed of information delivery (Caine et al., 2015). Intermediaries (or “infomediaries”) who are respected community members can pass on the information they receive on topics of interest. Information is disseminated using both new technologies (internet, on-line database, etc.) and more “traditional” means of communication (newsletter, brochures, and community radio). The experience of Malagasy farmers in a community forum allows the public airing and debate of many issues and has provided a platform for examination of how information is exchanged. For example, in a rural community began to take on childcare duties, while their husbands had responsibilities outside of the household (DIMITRA, 2013).

SUCCESSFUL APPROACHES TO INFORMATION DISSEMINATION
Finally, the potential for women farmers to use and benefit from the newest technologies needs to be researched and supported. Technological approaches including extending big data, smart farms, geo-intelligence, and bioinformatics will play an ever-increasing role in food production in the developing world.

Unfortunately, the representation of women in STEM fields is low in general, and particularly low in fields related to ICT, natural resources management, and agriculture. Women are not well-represented as researchers, agricultural extension agents, skilled workers, professionals, or decision-makers (Huyer, 2015; Akedrodou, 2008; World Bank & IFPRI, 2010). Remedying these glaring gaps must be an urgent priority: increasing the enrolment of women and girls in these subjects, employing non-formal educational approaches on the ground, promoting the employment and retention of women in these fields, and ensuring their representation in decision-making in these fields at all levels.

CONCLUSION AND RECOMMENDATIONS

ICT and information services have the potential to promote gender equality and empowerment of rural women while increasing food security, through decreased workloads, increased decision-making power, diversified agricultural production, ability to respond to climate and weather variability, and improved livelihoods. But these gains are possible only if information and knowledge are well designed and ensuring their representation in decision-making in these fields at all levels.

Experience and evidence suggest several promising avenues for promoting gender equality:

• Consult with women and women’s organisations in the design and development of ICT-enabled agricultural information, to ascertain their information needs and priorities.
• Assess climate information needs of women and men farmers separately, with further disaggregation — by male- or female-headed household, age, and socioeconomic status — or other factors that may shape roles, constraints, and information needs.
• Assess gender barriers in accessing ICT and information.
• Select or develop ICT services and channels in consultation with women’s and community organisations.
• Consider providing a range of useful and affordable information services tailored to women’s expressed interests, including nutrition, health, weather, and livelihood, in order to increase the value of these services to women.
• Assess the value of climate information services to women in terms of rate of access, use, and perceived benefits from use.
• Promote the participation and women and girls in STEM-related subjects, workforce, and decision-making at all levels.
• Work with the private sector to recognise the potential of women as a market for agricultural technologies, including ICT.
• Assess the value of climate information services to women in terms of rate of access, use, and perceived benefits from use.
• Assess impacts of key factors and strategies promoting women’s empowerment in the use of climate information, including choice of content and channel.

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INTRODUCTION

The first industrial revolution introduced the use of mechanical power, complementing or replacing manual human labour to enable efficiency across industries; similarly, the second revolutionary industrial development, in the twentieth century, brought the use of electricity and wired communication. A third epoch of industrial change brought large-scale digitisation and advances in computing; in recent decades, further advances have produced a digital and cyber revolution that was designated as “the fourth Industrial Revolution” at the 2016 World Economic Forum (Schwab, 2016). This revolution will place major emphasis on skillsets in technology and engineering fields, including in areas such as robotics and artificial intelligence. Indeed, the fields of science, technology, engineering, and mathematics (STEM) prominently provide opportunities for young graduates to make significant contributions towards both economic growth and scientific research.

STEM skills are widely considered an essential skillset, particularly in the Global South, which suffers from a shortage of engineers, doctors, programmers, etc. However, many organisations have come to appreciate the importance of arts and human-centred skills in these fields. The acronym STEM has thus evolved further to include arts, to form the new name, STEAM. Various studies have shown the importance of problem-solving inquiry skills such as novelty and ingenuity in addressing societal challenges, as well as compassion and related human-centred attributes; STEM academic programmes often neglect these key skills (Bequette & Bequette, 2013; Land, 2013; Saddiqi & Marcus, 2017). Addressing these human-centred skills can support the emphasis on equality of opportunity for female students. This chapter will examine these and other ways in which tertiary institutions play a role in improving female representation in STEM fields.

Institutions of higher learning have always played a vital role in encouraging the participation of women in the STEM fields, as key gateways to STEM employment. The higher education sector still struggles to achieve proportionate or even substantial representation of the female workforce. As a kind of snowball effect, with a disproportionately small number of women employed in STEM fields, their impact is limited as role models to women students. Similarly, higher education generally fails to challenge the dominant gender-stereotypical cultures and non-diverse workplace environments in STEM (Cheryan et al., 2016).

This chapter presents the following research question for evaluation: “What role can higher learning institutions play in improving the participation of females in STEM fields?”

KEY FINDINGS

- The lack of female role models in STEM has been cited as a major factor in the low uptake of STEM programmes and courses by young girls in both elementary and higher educational institutions.

- The lack of a diverse academic and research STEM workforce in educational institutions, particularly in management roles, leads to perceptions of STEM as a male-dominated domain. Academic institutions thus find it difficult to attract and retain women both as students and as employees in STEM.

- Educational institutions have sought ways to improve the participation of women in STEM fields through student funding incentives, gender-sensitive institutional admission criteria, and gender-sensitive curriculum designs. These policies all have a role in increasing the representation of skilled women in STEM.

ABSTRACT

Several recent developments support the enrolment of women in STEM fields within educational institutions, including: educational institutions’ adoption of policy frameworks advocating for increased STEM female participation; incentives for funding female STEM students; and criteria ensuring gender-sensitive institutional admissions. Curriculum design also has a role in increasing the representation of skilled females in STEM (Reyes, 2011), including viewing the humanities as representing critical skillsets relevant for STEM curriculum (Savaria & Monteiro, 2017). Such approaches also require complementary governance frameworks supporting female representation in STEM fields. Furthermore, organisations increasingly recognise the critical role of humanities in equipping the future STEM field workforce; the importance of human-centred skill sets has been recognised in the inclusion of arts skills into the STEM acronym, as STEAM. Today’s workplace requirements include creative problem-solving skills as well as human-centred approaches to STEM challenges, prompting a discussion of the role of arts subjects within the field (Bequette & Bequette, 2013; Land, 2013). This chapter evaluates the role of higher learning institutions in improving female representation in STEM, by reviewing studies conducted globally in the period 2011–2017. It documents the lack of female representation in STEM fields and the role of new policy frameworks and practices in diversifying STEM student populations and workforces. The paper reviews lessons learnt from various countries’ experiences and provide key recommendations for educational institutions to reduce the female student enrolment and human resources gap.
A range of factors contribute to strongly or disproportionately underrepresenting STEM representation in higher learning institutions, including the following.

**Standard STEM academic programmes.** Traditional STEM offerings tend to focus narrowly on STEM majors and electives, with no attention to cultivating creativity and human-centred approaches in problem inquiry (Taylor & Taylor, 2017). While methods such as design thinking and co-design (Bequette & Bequette, 2012; Boy, 2013) are finding their way into some engineering and computing curriculums, STEM programmes’ slowness in adapting means that fewer female students take STEM courses.

Cheryan, Ziegler and Montoya (2017) examined the relative prevalence of STEM students in the U.S. in biology, chemistry, and mathematics courses, in comparison to their numbers in engineering, computer science, and physics courses. In addition to a dominating masculine culture, they point to a lack of practical opportunities for women in those fields, deterring women from enrolling as well as contributing to opportunities for women in those fields, deterring women from enrolling as well as contributing to women leaving these programmes.

**Pipeline factors.** In countries where women’s uptake of STEM academic programmes is especially low, the decline can be seen at the high-school level, when girls’ interest in participating in mathematics and science subjects starts to decrease (Ellis et al., 2016; Shabangu, 2015; UNESCO, 2016a). Increased participation in higher learning institutions is unlikely, if learners have not acquired prerequisite skills at lower educational levels. The absence of primary female interaction in schools with STEM subject field can also affect the uptake of these programmes in higher learning institutions (Cheryan et al., 2016). While many higher learning institutions have created bridging opportunities to enable such learners to further their studies, continued focus is needed on basic education in mathematics and science. Additionally, in the OECD countries and the U.S., the cost of higher education puts it out of reach for many (Melsen, 2017).

**Role models and stereotyping.** In the UK, the Higher Education Statistics Agency (2016/2017) found that only 25% of professors are women, and only a fraction of them hold senior academic positions in STEM fields. Similar patterns hold in countries such as South Africa and the U.S., indicating a near-absence of women role models for students in STEM. More generally, gender stereotyping through the media and the society has been identified as a contributing factor affecting the uptake of STEM studies in higher education (Wang and Degol, 2017).

**Gendered content and programmes.** School textbooks typically depict males dominating the science environment, while providing historical examples of men predominantly making significant contributions to the STEM field.

**Lack of skilled teachers.** To achieve SDG4, quality education, UNESCO has estimated the need for over 69 million teachers (UNESCO, 2016b). This need is particularly concentrated in mathematics and science-related subjects. Universities and vocational training institutions have a role to play in producing teachers with skills to meet the twenty-first century STEM demands, especially in countries where few women are engaged in STEM higher-learning institutions.

**High gender equality and low uptake.** Women may be underrepresented in STEM fields even in countries with high gender equality. Nordic countries that rank high in terms of gender equality were shown to have some of the lowest numbers of STEM female graduates in the world (Gossanom, 2018). Access to opportunities does not always mean guaranteed uptake of STEM subjects by young women. The lack of female representation in such resource-rich economies calls for further investigation into such factors as STEM role modelling, pipelining, and academic and workplace cultures in contributing to the lack of gender representation.

A UNESCO report on the levels of women’s employment in STEM in Asia-Pacific countries found wide disparities. Japan at 115% and Kazakhstan at 57% of the STEM workforce, as compared to 52% and Thailand at 53% (UNESCO, 2016a). Kazakhstan and Thailand showed the highest participation rate of women in both primary and higher learning institutions and the labour force. In the U.S., 14% of engineers are women, compared to 45% of mathematicians and 47% of employees in life sciences (UNESCO, 2016a). The fact that gender-sensitive policies do not always translate into increased participation of women in STEM fields can also be seen in the low participation levels in developed G20 countries compared to those in gender-conservative countries such as Algeria, Turkey, and the United Arab Emirates.

The role of higher learning institutions is fundamental to educating the labour force in STEM fields as well as producing teachers and educators. A gender awareness needs to be incorporated as a critical factor in national science and technology programmes. In addition, efforts need to be focused at the local level to attain the SDGs (Miroux, 2011).
Figure 6.1  Percentage of females among STEM graduates, by country

engineering organisation, provides engineering education programmes in Malawi, Mexico, Brazil, South Africa, and Kenya. The programmes are geared towards providing fellowships for young women in the engineering field, giving them theoretical instruction, practical experiences, and mentoring to pursue an engineering career.

Creating a community of female academics. Universities in the U.S. have created initiatives, such as Empowering Women in Science (Cornell) and Engineering Women (University of Minnesota), that showcase professional women in STEM research and facilitate seminars on positions and compensation in STEM (Spotrell, 2016). Cornell now observes an equal uptake of engineering programmes by male and female students as a result of intensive outreach**. Such programmes provide a network, enabling women students to become aware of opportunities in STEM and fostering relationships between senior and junior females in STEM fields. This approach also promotes the retention of young women in STEM through mentoring opportunities.

In Kenya, the Women for Science Working Group developed out of The Network of African Science Academies; it aims to enable a network of women in STEM fields, cultivating collaboration and sharing experiences among women in related research and academic institutions, with the aim of influencing priority areas of research. The network’s publications showcase the contribution of African women in STEM fields. A growing number of awards recognise the contribution of women in STEM fields. The United Nations “Equals in Tech” Awards includes a skills and research category to recognise women in the STEM field; the African Union Kwame Nkrumah Awards for Scientific Excellence includes a category recognising women in STEM fields.

Funding. There has been a global increase in academic funding earmarked for outstanding women in STEM, such as the Graca Machel scholarship for women from the South African Development Community (SADC) region, the Anita Borg Global Scholarship, and L’Oréal-UNESCO Fellowships for Women in Science. Such initiatives enable talented females to pursue studies in STEM fields in prestigious academic institutions while growing their research expertise.

A South African example combines government policy with government and private sector funding. Ranked eighteenth on the World Economic Forum Global Gender Index, South Africa adopted targeted policies to increase representation of women in the STEM fields. Through a public-private partnership between the South African National Research Foundation (NRF) and the First Rand Foundation of the private banking sector, funding is earmarked to enable over 40 women in South Africa’s higher learning institutions to focus on their research and ultimately to increase the number of female professors, particularly in the STEM field.

**https://i100rocks.com/news/025520-cornell-engineering-women/
Taking Stock: Data and Evidence on Gender Digital Equality

PART TWO


Taking Stock: Data and Evidence on Gender Digital Equality

PART TWO

THE GENDER WAGE GAP IN THE DIGITAL ERA: THE ROLE OF SKILLS

AUTHORS: MARIAGRAZIA SQUICCIARINI, ROBERT GRUNDE and LUCA MARCOLIN (OECD DIRECTORATE FOR SCIENCE, TECHNOLOGY AND INNOVATION (STI), ECONOMIC ANALYSIS AND STATISTICS DIVISION (EAS))

ABSTRACT

As the digital revolution contributes to changing the nature and content of jobs, the demand for skills also changes. This chapter addresses whether women are equipped with the skills needed to navigate the digital economy. It analyses data from 31 countries to compare the returns to skills for men and women in terms of wages, and how these returns vary between digital-intensive and other industries. If labour markets value different skills differently, with greater rewards to specific skills needed in the digital era, wage differences should highlight high-demand skills and show the degrees of wage variation in digital-intensive in comparison to other industries. Results show that the digital transformation may be contributing to widening the gender wage gap: digital-intensive sectors display greater gender wage disparities than less digital-intensive sectors, even after accounting for specific features of workers and places of employment.

KEY FINDINGS

- Variations in workers’ skills, both cognitive and non-cognitive, explain only part of the gender wage gap, in 31 countries.
- Men on average are more likely than women to have the task-based skills that are most demanded in digital-intensive industries: managing and communication, self-organisation, and advanced numeracy skills.
- Men generally obtain higher returns than women for the same high-demand skills in digitally intensive sectors, but not in less digitally intensive industries.
- Women are more likely than men to have specific information and communication technology (ICT) task-based skills, and they are better rewarded for them, in both digital-intensive and less digital-intensive sectors.

A NARROWING GENDER WAGE GAP?

Significant progress has been made in recent years to reduce gender inequality along many dimensions. Young girls in OECD countries now out-perform boys at school and represent the majority of tertiary graduates (OECD, 2017a, 2017b). Gender gaps in employment also appear to have narrowed, although a 12-percentage point difference in labour market participation still exists, on average, across OECD countries. Importantly, gender inequality features among the top policy priorities of G20 and G7 countries; in 2014, G20 countries adopted as a key goal narrowing the gender gap in labour force participation by 25% by 2025.

Despite all this, there is still a long way to go to attain gender equality. In higher education, girls are not well represented in the scientific and technical disciplines, areas currently commanding high wages. In OECD countries, the gender wage gap still averages 14.3% across all sectors (OECD, 2017b). Women are scarce in senior management, public leadership, and entrepreneurship roles, accounting for only 4.8% of CEOs in 2016. It is likely that similar, if not greater, gender wage gaps exist in non-OECD countries.

The ongoing digital transformation is already affecting the life and work of women. On the one hand, the transformation can offer women new opportunities for economic empowerment, through new forms of work created by e-businesses, workspace platforms, and flexible working arrangements, for example. On the other hand, digital technologies may increase the gender divide, if women lack the needed skills or if flexible work arrangements mean low quality jobs.

This chapter points to specific policies which can ensure that women are equipped with the skills needed to thrive in the digital era. To what extent do skill differences between men and women contribute to the gender wage gap? What types of skills are in high demand in the digital era, and how do various industries reward them? Econometric analysis allows us to explore the factors determining individual wages, in digital-intensive versus less digital-intensive sectors, with a focus on workers’ skills. Data comes from the Programme for the International Assessment of Adult Skills (PIAAC) dataset, described below.

Skills are found to explain part — but not all — of the gender wage gap; differences emerge in the way digital-intensive and less digital-intensive sectors reward workers’ skills. On average, men are more likely to have the skills most in demand in digital-intensive industries: managing and communication, self-organisation, and advanced numeracy skills, and are likely to obtain higher returns than women with the same skills in digitally-intensive sectors. Women are more likely than men to have ICT task-based skills, and they are rewarded relatively more for them, in both digital-intensive and less digital-intensive sectors, than men with similar skills.

64 http://www.g20.utoronto.ca/2014/2014-1116-communique.html
65 These skills need not perfectly coincide with “digital skills” as defined in different contexts (e.g., OECD, 2016; Camerero et al., 2017).
66 Self-organisation here relates to workers’ ability to plan or decide the tasks to be carried out, the style and speed of work, and the possibility to plan working hours. Management and communication task-based skills relate to negotiating with people, planning the activities of others, and to instructing, advising, persuading or influencing others.
Many factors, observable and unobservable, contribute to shape the gender wage gap, as reviewed in Blau and Kahn (2017). These can include: schooling, work experience, psycho-emotional characteristics, sector of employment, family responsibilities, and job characteristics, as well as cultural norms and discrimination. Gender may affect the specific tasks carried out on the job: women may be less able to commit to tasks requiring flexibility in working hours, or travelling on short notice (Goldin, 2014). This chapter finally takes note of how digital technologies are affecting some components of work.

THE GENDER WAGE GAP IN THE DIGITAL ERA: THE ROLE OF SKILLS

The last century saw narrowing differences between men and women in terms of labour force participation, paid hours of work, and hours devoted to household production, as well as in type of occupation, educational attainment, and choice of college majors (Goldin, 2014). Gender wage gaps also narrowed, to varying extent among different countries (OECD, 2017b). Examining the relationship between workers’ wages and their competencies and skill use at work, we can assess the contribution of workers’ skills to the gender wage gap. A novel OECD index shows the digital penetration of industries (Calvino, Criscuolo, Marconil, & Squicciarini, 2018), allowing us to compare the wage gender gap and its determinants in digital-intensive as compared to less digital-intensive industries, while controlling for features such as workers’ education and age and size of firm.

We rely on measures of the cognitive, non-cognitive, and social skills of workers for 31 countries, as extracted from the OECD Survey of Adult Skills (Programme for International Assessment of Adult Competencies, or PIAAC) (Grundke, Kalamova, Keslair, Jamet, & Squicciarini, 2017). PIAAC surveyed 154,293 individuals aged 16–65, between 2012 and 2015, in 31 countries (all but three OECD countries). In each country, the sample was chosen to be representative of the population (albeit with different sampling schemes). We combine the skills results with PIAAC-based information on labour market participation and the socio-economic background of workers70. The analysis assumes that work is composed of a set of tasks which workers are required to carry out on the job, and for which they are rewarded. This is in line with studies arguing that human capital needs are highly specific to the particular tasks carried out, and less determined by the occupation, industry, or firm (Gathman & Schoenberg, 2010; Gibbons & Waldman, 2004; Poletaev & Robinson, 2008)71.

To understand how the digital transformation affects the demand for different types of skills — cognitive, non-cognitive, and social — we examine how workers’ skills are rewarded and whether rewards vary according to the digital intensity of the sector. Valued skills in short supply should command higher returns. Higher returns in digital-intensive industries, accordingly, should point to the skills that are in relatively high demand in jobs that are more exposed to the digital transformation, and that may represent needed complements to the deployment of digital technologies at the workplace72.

The analysis is carried out on data from the OECD Survey of Adult Skills (PIAAC), covering 31 countries. PIAAC provides a wealth of information about workers’ skills, the tasks they perform on the job, and their workplace, making it possible to estimate the role of skills in determining wages with greater accuracy than in the past. Workers’ cognitive skills (literacy, numeracy, and problem solving in technology-rich environments) are assessed through administered tests, limiting the risk of mismeasurement. By relying on the six task-based skill indicators identified in Grundke et al. (2017), it is possible to see how non-cognitive and social skills are rewarded in both digital and less digital-intensive industries.

Digital-intensive and less digital-intensive industries appear to pay better than less-digital intensive industries for workers with higher levels of managing and communication, self-organisation, and advanced numeracy skills73. These results may reflect characteristics of tasks in those industries: the need to operate in a more independent or decentralised fashion; to communicate across disciplinary boundaries and in diverse and decentralised teams; to perform more routine tasks; to be better matched with the tasks to be carried out; or to deal with continuously changing settings, for which self-organisation, management, and communication skills are important. Do women possess the skills that are more in demand in the digital era? Do rewards for these skills differ between men and women? These questions are key to understanding whether the gender divide may widen with the ongoing digital transformation.

AN EMPIRICAL ASSESSMENT OF THE RETURNS TO SKILLS IN DIGITAL-INTENSIVE AND LESS DIGITAL-INTENSIVE SECTORS

of ICT specialists in the workforce. Digital marketing is proxied by the share of e-commerce. Sectors are ranked along each dimension, and the rankings are then aggregated to yield a single taxonomy of sectors by digital intensity74. Sectors are defined according to the UN classification, published as the International Standard Industrial Classification (ISIC, Revision 4.)

We control for many characteristics relating to wage or skill levels (e.g. years of education, age, gender, as well as country, industry, and occupation. The analysis isolates variation of skills and wages within the same type of job and aims for an unbiased comparison between men’s and women’s earnings. Differences in the occupational composition of digital and less digital-intensive industries should not influence the findings on return to workers’ skills in different industries. The dichotomy between digital and less digital-intensive sectors is an artefact used for analytical purposes. In reality, there is a distribution of digital intensity levels, both between and within sectors; moreover, specific employers may be more (or less) digitally intensive than their sector.

70 The dichotomy between digital and less digital-intensive sectors is an artefact used for analytical purposes. In reality, there is a distribution of digital intensity levels, both between and within sectors; moreover, specific employers may be more (or less) digitally intensive than their sector.

71 See Grundke et al. (2018) and OECD (2018c).

72 For a full description of the approach, see Grundke et al. (2018).

73 OECD (2017b).

74 See Grundke et al. (2018) and OECD (2018c).

75 Several studies take a task perspective in assessing the returns to working in a given occupation, and how technological change affects them (e.g., Acemoglu & Autor, 2011; Acemoglu & Handel, 2013).
These results are worrisome, especially because the digital transformation will ultimately affect all industries, including those that are less digital-intensive. Women’s lower scores in the skills needed in the digital age may thus lead to increasing wage inequality between men and women. Additional results show that the gender wage gap is indeed higher in digital-intensive than in less digital-intensive industries (Figure 7.2). This is partly due to the different skills possessed by men and women: the same graph displays larger gaps when not controlling for skills (results omitted here). (For more discussion, see OECD (2018c).) To address this effect of the digital transformation on gender-based income inequalities, governments need to ensure that women have opportunities to gain advanced numeracy skills and to develop management, communication, and self-organisation skills.

Nevertheless, women do not lag behind men across the whole spectrum of skills needed in the digital era. Women generally score better in literacy skills as well as in ICT, accountancy, and selling skills. While women have higher ICT skills than men (and they conduct more ICT-related tasks than men in the same occupation), this may not be reflected in higher earnings. This study does not find higher returns to ICT skills in digital as compared to less digital-intensive industries, even though ICT skills are obviously important in the digital era. However, when we control for cognitive and task-based skills (results omitted here). (For more discussion, see OECD (2018c).) To address this effect of the digital transformation on gender-based income inequalities, governments need to ensure that women have opportunities to gain advanced numeracy skills and to develop management, communication, and self-organisation skills.

Figure 7.1 shows that men are generally more likely to possess the skills that command wage premiums in digital-intensive industries. Independent of age, education, occupation, country, industry, or size of firm, and whether full- or part-time, men overall have higher numeracy and advanced numeracy skills as well as higher task-based skills related to self-organisation, management, and communication.

Figure 7.2
Gender wage gap by country and industry
(conditional difference in hourly wages for men and women, in %), 31 countries, 2012 or 2015

Source: OECD (2018c), based on PIAAC data.
Note: The figure shows the differences in hourly wages for men and women (in percentages) for employees in more and less digital-intensive industries. The estimates are based on OLS wage regressions, using data from the OECD Survey of Adult Skills (PIAAC), and control for the same covariates as in Figure 7.1 as well as for skills.

ICT skills commanding the highest wage returns. Possibly women’s advantage in ICT skills may help to reduce gender-based wage inequality over time. Policy makers may therefore want to focus efforts on increasing ICT skills to reduce the gender wage gap.

Skill sets explain only part of the gender gap. When we control for cognitive, non-cognitive, and social skills, the gender wage gap is greater than can be explained by the difference in workers’ skills. In addition, the gap is considerably larger in digital-intensive industries than in less digital-intensive ones. Contributing factors may include women’s longer out-of-work spells (e.g., for child-bearing), household duties, and gender-based roles and division of labour (Blau & Kahn 2017; Goldin, 2014). In addition, to possible measurement issues, other factors in the wage gap may include gender discrimination. If digital-intensive industries reward men more than women for certain skills, more than is the case in less digital-intensive industries, the gender wage gap will be higher in digital-intensive industries even for workers with similar skills.

ICT skills relating to the use of programming languages, email, word processing software, and spreadsheets, as well as processing transactions through the internet.

See OECD (2018c).
Figure 7.3 shows the skill returns for men and women in digital vs. less digital-intensive industries. Men obtain significantly higher returns than women for advanced numeracy and management and communication skills in digitally intensive industries (Figure 7.3a). The differences are not statistically significant in less digital-intensive industries (Figure 7.3b). However, for one of the key skills in the digital era — ICT skills — women obtain higher returns than men in both digital-intensive and less digital-intensive industries. The analysis controlled for observable characteristics of the individual (age, education, part-time status) and for country, industry, occupation, and size of firm.

Factors that may contribute to the gender difference in earnings include: network effects among male colleagues; better wage bargaining outcomes stemming from the greater self-confidence of men (found, for instance, by Niederle & Vesterlund 2007); and proportionally higher bonuses associated with advanced numeracy and management and communication skills. Also, broader productivity effects may be a factor, if companies that are more productive require (and better reward) the skill sets more associated with men. Finally, if digital-intensive industries are more dynamic, they may require more competitive behaviours and stronger negotiation skills than less digital-intensive industries; this may hurt women, as studies have shown that women are less oriented to negotiating and competing than men and are more risk averse. For reviews, see Bertrand (2011) and Croson and Gneezy (2009).

**CONCLUSIONS AND POLICY IMPLICATIONS**

The digital transformation is changing the demand for skills in both OECD and non-OECD countries. A wide range of skills appears to be required for firms and individuals to perform successfully in the digital era: foundational skills such as literacy and numeracy; and skills that are transferable across jobs, including technical and socio-emotional skills (including self-organisation, management, and communication). However, skill sets differ as between men and women, and different skills are rewarded in different ways for men and women, in digital and less digital-intensive industries.
LEARNING MATTERS: SHARING THE COST AND BENEFITS OF LIFE-LONG LEARNING

Making the digital transformation more gender-inclusive entails extending education and training to all, and especially to girls and women, both at a young age and later in life. Narrowing the gender wage gap further requires giving girls a solid educational foundation, especially in numeracy, to address early gender gaps. Education and training may need to become more flexible and adaptive: the digital transformation enhances opportunities to learn outside of working or school hours, and digital tools can help mitigate or overcome societal barriers and norms. As the digital transformation accelerates the need to continue learning throughout life, policy makers need to re-design life-long learning systems: providing sound initial education, and fostering synergies among all stakeholders — individuals, governments, and the private sector — to further enhance human capital, especially of women. The private sector of course benefits directly from a trained workforce and also provides training for workers.

TECHNOLOGY FOR LEARNING

Recent years have seen significant progress in women’s education. In OECD countries, more women now achieve tertiary education than men (OECD, 2017a), and the proportion of women engaging in on-the-job training is higher, on average, than that of men (OECD, 2018a). However, when workers’ characteristics are taken into account (e.g., age, education, part-time contracts, industry, and occupation), men are found to receive 5% longer training than women. In many non-OECD countries, women’s access to education still lags behind men’s. Digital technologies can support more equitable access to education and training by lowering the direct cost of accessing educational material, or by allowing distance learning on a flexible schedule — important for women having to combine work and family duties, for instance through paid paternal leave. Within the workplace, affirmative action and even policies relevant to both OECD and non-OECD countries; of course, equal access to education is an essential first step. The private and non-governmental sector can also contribute in this effort, influencing the public debate and leading by example.

FOCUS ON THE ‘RIGHT’ (SETS OF) SKILLS

The gender wage gap is related in part to the type of skills possessed by workers. Digital technologies display different degrees of complementarity and substitutability of skill sets. Interestingly, women perform ICT-related tasks slightly more frequently than men; moreover, they are rewarded significantly more for those skills. For those to promote ICT skills for women to help narrow the gender wage gap.

Advanced numeracy (STEM) skills are among the most demanded skills in digital-intensive sectors, and these skills are associated with more women than with male workers, even within narrowly defined industries and occupations. Policies to enhance female workers’ advanced numeracy skills will therefore be important to address the gender wage gap. As skill set differences are influenced by educational choices, and the decision to pursue fields such as ICT and STEM (OECD, 2017b), educational policies are important: encouraging girls’ enrolment in STEM studies at young ages; creating single-sex classes where women feel freer of stereotypes (Booth, Cardona-Sosa, & Nolen, 2014; Dustmann, Ko, & Reask, 2017); facilitating women’s access to STEM-related apprenticeships; and addressing gender biases in education curricula, parental preferences, and social norms (OECD, 2018b). These policies are relevant to both OECD and non-OECD countries; of course, equal access to education is an essential first step. The private and non-governmental sector can also contribute in this effort, influencing the public debate and leading by example.

THE GENDER WAGE GAP

Women’s lower labour market participation can reflect the uneven burden of family duties. Government policies can expand the public provision of child care services; they can also support a redistribution of family duties, for instance through paid parental leave. Within the workplace, affirmative action and even policies relevant to both OECD and non-OECD countries; of course, equal access to education is an essential first step. The private and non-governmental sector can also contribute in this effort, influencing the public debate and leading by example.

A HOLISTIC POLICY APPROACH TO THE GENDER GAP

Closing the gender gap in skills and wages requires cross-cutting approaches that involve most, if not all, aspects of public policy and that include specific gender-related objectives (OECD, 2018a). Digital strategies will be especially important in this regard, to shape the interplay between digital technologies and workers’ jobs and skills.

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ABSTRACT

The call centre industry continues to grow as a major business outsourcing avenue. National and international organisations are increasingly using call centres for marketing as well as for outsourcing customer services, often based in developing countries. The South African government supports such business outsourcing through prioritising call centres for investments and as job creation for its young people. A quarterly labour force survey (QLFS), released by Statistics South Africa in the last quarter of 2017, shows a national unemployment rate of 26.7%, with a high youth unemployment rate of 29.7% among 15- to 24-year olds. Such high youth unemployment rates make call centres especially attractive in South Africa. Empirical findings from this sector show that 75% of the employees in South African call centres are women who have just finished school and female college students. An exploration of skills development in the call centre industry is therefore also an exploration of skills development for young women, who are the majority of workers. This chapter presents findings from qualitative focus group discussions and individual interviews conducted with young women who work as agents in call centres in Cape Town and Johannesburg. We conducted four focus group discussions of six to eight participants and 20 semi-structured individual interviews, with women aged 19–34 years working as agents in various call centres. All interview participants were recruited through convenience and snowball sampling. Focus groups and interview data was analysed through a qualitative thematic analysis.

KEY FINDINGS

• Training for key competencies varied from organisation to organisation, from a few days to several weeks. Training took different forms: brief teaching sessions followed by tests; memorising scripts to answer possible questions; basic keyboard skills, including word processing and speed typing; communication skills of pronunciation, phone etiquette, and voice demeanour.

• Some participants indicated that training consisted of hands-on experience on the shop floor, with minimal prior training. This included informal side-by-side coaching, or “buddying up” to understand their fellow workers.

• Agents might be put under pressure designed to test their level of resistance.

• Much emphasis was put on the development of “people skills”; respondents considered call centres highly focused on developing people skills, more than any technical or digital skills, no matter what technological systems were adopted in training. They questioned call centres’ capability to promote technical skills development.

• Skills developed in call centres were specific to work in call centres rather than transferable to other work.

• Few leadership positions were available, and there was a lack of personal growth.

INTRODUCTION

Numerous business organisations have begun to use call centres in developing countries, through both onshoring and outsourcing services, taking advantage of their cheap labour and favourable labour attrition rates. Call centres operate on information communication technology (ICT) platforms that enable easy global access. Key destinations for global outsourcing call centres are India, the Philippines, and, of late, South Africa and Kenya. The South African Government prioritises call centres for investments and job creation (Banks & Roodt, 2011). As such, the industry has grown tremendously over the years, becoming a key source of employment for young people. A quarterly labour force survey (QLFS), released by Statistics South Africa in the last quarter of 2017, shows a national unemployment rate of 26.7%, and 29.7% for youth aged 15–24. Given high youth unemployment levels, it is not surprising that the government supports call centres to address the issue.

This chapter draws on a project that explored young women’s work in call centres in the cities of Cape Town and Johannesburg in South Africa. Focus groups and individual interviews were conducted with young women who work in call centres, to explore the dynamics of skills development in this largely digitalised industry. The chapter evaluates the skills development of the young women workers, considering the link between the training and skills acquired on the job and advancement prospects for workers, in view of evolving information and communication technological systems. It begins by looking at the nature of call centre work in South Africa, followed by an exploration of women’s work in call centres. The chapter then presents the voices of young women, capturing the experience of skills development of these young workers.
LOCATING SOUTH AFRICAN CALL CENTRES IN THE GLOBAL ECONOMY

The call centre industry in South Africa has grown immensely since the ‘80s, becoming a thriving domestic industry and a key employer of young people who would otherwise be unemployed. Banks and Roodt (2011) describe the industry as growing largely through business-owned centres, which incorporate call centres as part of their own business processes. They emphasise that call centres have “moved from occupying a relatively small niche to being a significant part of the global economy” (Banks & Roodt, 2011, p. 3). South African call centres are an integral part of the global market system based on neoliberal capitalism.

Neoliberalisation favors opening up international markets through easing trade and labour regulations. Firms can benefit from access to external labour and capital markets for outsourcing services, capitalising on cheap labour as well as on flexible ways to build capital. Raewyn Connell sees neoliberalism as “the agenda of economic and social transformation” which dominates “global politics” and is systematically implemented in “institutions under neoliberal control” (Connell, 2014, pp. 5-6). The globalised economy entails outsourcing ancillary services, such as telemarketing and service provision, to emerging markets (Panday & Rogerson, 2014). Of concern to feminist scholars is that these outsourced services mostly depend on women’s cheap labour.

In South Africa, call centres emerged in the late ‘80s, growing rapidly in the ‘90s due to improved technology and lower communication costs (Bennner, 2004; Holman; Batt & Holtgrewe, 2007; Panday & Rogerson, 2014). The industry has grown steadily since then and now serves both local and international markets. Research shows that more than two-thirds of call centre employees in South Africa are young people under age 35 (Cohen, 2013; Panday & Rogerson, 2014), approximately 75% of these young people are women (Benner, Lewis, & Omar, 2007). This employment pattern is also a common global trend (Belt, 2002; Bonds, 2006; Darsun & Bayram, 2014). Any investigation into call centre work is also an investigation into women’s work, the concern of this chapter.

UNDERSTANDING THE CALL CENTRE INDUSTRY IN SOUTH AFRICA

The South African government policy prioritising the call centre industry is focused on attracting international investors, a strategy that is emphasised in the recent Business Process Enabling South Africa (BPESA) Key Indicator Report (2016). The government Minister of Trade and Industry, Rob Davies, notes that South Africa was named the offshoring destination of the year at the Global Sourcing Association (GSA) awards in London in 2016, an award the country had also received in 2014 and 2012 (BPESA, 2016). Figure 8.1, from the BPESA report, illustrates some of South Africa’s key strengths as a potential business outsourcing destination.

This strategic positioning of South Africa is widely documented (DTI, 2013; Hall, 2011). In line with neoliberal free market approaches, and to reduce unemployment, the South African Government is focused on strategies to develop a “sustainable skills” pool for its growing Business Processing Outsourcing (BPO) market (BPESA, 2016). Key strategies considered include the following (adapted from BPESA, 2016, p.9):

- extending BPO skills through development of industry-specific academies
- facilitating participation of government educational institutions in the BPO agenda
- addressing critical skills gaps
- building competence of team leaders and managers
- developing English and foreign language skills
- harnessing technology for skills development

It is still unclear how the South African government will translate this commitment into action, and what advantages and disadvantages it will entail for women working in this sector.

WOMEN’S WORK IN CALL CENTRES AND SOCIO-ECONOMIC TRENDS

South Africa serves as an ideal destination for BPO, particularly in the service sector. The growth of the service sector has seen a huge pool of women entering the global labour market (Gillard, Howcroft, Mitev, & Richardson, 2007; Eisenstein, 2009; Darsun & Bayram, 2014; Howcroft & Richardson, 2008), and the call centre industry is largely dependent on women’s labour for both offshore and onshore services (Bonds, 2006). This global practice highlights the importance of women’s labour as significant for global markets and international competition (Moghadam, 2000).

Scholars have viewed women’s predominance in the call centre labour force in widely differing ways. On the positive side, some see the growth of the service sector resulting in substantial increases in the number of women in the labour force, especially in emerging markets. Labour force participation is seen as allowing women economic independence, providing a basis for resisting patriarchy (Diane Wolf, cited in Eisenstein, 2009, p. 149); some endorse call centre jobs as decent work (Cohen, 2013). Other scholars argue that call centre work is service labour and thus likely to perpetuate the feminisation of labour (Standing, 1999; Howcroft & Robinson, 2008; Blin, 2010). Some scholars go further, accusing the governments of developing countries of being complicit in “offering up” their workforce as capable and affordable to a capitalist world largely driven by neoliberal market competition (Lacity & Wilcock, 2013). Service provision jobs are criticised for centralising gendered notions of femininity, to justify women’s participation in the labour force. These stereotypes are seen as contributing to the “devaluing” and “deskilling” of women’s work, while promoting occupational segregation and polarisation (Bonds, 2006, p. 32). Such occupational segregation reinforces inequality in the labour force, since women in the call centres occupy the lower end of the employment spectrum.

The fact that women are the majority of workers in call centres also has clear economic implications: profit margins remain protected, or even increase, due to the devaluation of women’s labour, which is always coupled with a reduction in labour costs (Gillard, et al. 2007). Furthermore, evidence shows that digital environments, such as that of the call centre industry, have the potential to “erode labour protection standards” (Gillwald, Mothobi & Schoentgen, 2017, 2013).
SKILLS DEVELOPMENT IN THE CALL CENTRE INDUSTRY

Scholarship on skills development in call centres is very limited. Evidence from sites that advertise call centre work shows that the industry does not routinely seek applicants with prior call centre skills, but rather offer their own training (see www.jobin.co.za). Recruitment efforts target marginalised, less-skilled young people, particularly women, who are either school leavers or college students (Bennet, Lewis, & Omar, 2007). Call centres are highly routinised, the work requires little skills variety (Coetzee & Harry, 2015), and worker development is precluded by the flat organisational structure (Choi, S., Cheong & Feinberg, 2012). This research explores the implications of skills development for young women workers in South Africa, building on the body of scholarship on women’s work in call centres in the Global South, particularly in the African context.

Figure 8.2 presents key skills-development approaches for managers in call centres in South Africa, as shown in the 2016 BPESA report. It shows that South African call centres pay significant attention to skills development, taking particular interest in upskilling staff.

METHODOLOGY

This chapter is based on a research project that investigated the participation of young women in the call centre industry in the cities of Cape Town and Johannesburg in South Africa, using surveys, focus group discussions, and individual interviews. Surveys noted demographic information on the participants as well as socio-economic and work-related factors. This paper draws particularly on the focus group discussions and individual interviews, to explore the impact of the call centre industry on skills development among these young women. Four focus group discussions of six to eight participants, as well as 20 semi-structured individual interviews, were conducted with young women aged 19–34 who currently worked as agents in different call centres. Participants included college students, school leavers, and other women. All interview participants were sampled through convenience and snowball sampling, and interview sessions took place in various settings where the participants would feel comfortable: at their workplace during breaks; at their homes or colleagues’ homes; and at their colleges. Participation was voluntary, and all participants were informed that they could leave the study at any time without penalty. Focus group and interview data was analysed through a qualitative thematic analysis.

FINDINGS

The young women interviewed in this study included both part-time and full-time workers at call centres, which served British, American, and South African companies focusing on finance, telecoms, retail, data collection, and gaming. The interview questions concentrated on their experiences as workers, with particular reference to skills development. This section presents participants’ perspectives and insights on skills acquisition for both job competency and career development.

SKILLS TRAINING FOR JOB COMPETENCY

Participants indicated that training took different forms that varied by organisation, with the initial training ranging from a few weeks to several months.

You get theory for like maybe 2 weeks, and then you are on the floor for another week.

The training was 3 months, and… you would need communication, interpersonal skills, be computer literate, patience, and I mean a lot of it, and then good listening skills.

You just get basic training on how to do the job: how to answer the phone, how to understand accents, how to operate their system and all that stuff. Their training is actually self-training, so you read stuff off the pc, then when you are done with that; they test you based on that and if you fail, they terminate your contract based on that.

There is a script that they give you that you memorise.

The training included teaching sessions followed by tests, that determined either progression to the floor or termination of contract. Agents also memorised scripts to master the questions they would have to answer on the shop floor. They were trained in basic keyboard skills, which included word processing and speed typing. They received training in communication skills: how to pronounce certain words, phone etiquette, and voice demeanour. Most of these skills have been labelled “effeminate” (Bonds, 2006) — and, scholars note, they are critical to these and similar industries that capitalise on women’s biological and social characteristics to drive profits.

One participant touched on the issue of gendered recruitment when she emphasised how prospective employers considered it necessary to listen to her voice as part of training:

. . . so that my potential employers could hear the sound of my voice, whether my speech is slurred or . . . This is because call centres often want a voice that is pleasing and softer in terms of sound. Men are often linked to having voices that are rough and edgy, so maybe most men who apply do not get the job because of the sound of their voice, but I cannot be sure.

A number of participants felt that initial training sessions did not assist much in equipping them for their work, and that the most useful training occurred when they got to the shop floor.

INFORMAL TRAINING: “WE LEARN ON THE FLOOR”

Some participants indicated that key readiness for tasks was developed only through hands-on experience on the shop floor. They spoke about side-by-side coaching, which they termed “buddying up”, where they were assigned to understudy fellow workers or be assisted by more experienced colleagues.

The first three days, you buddy up with someone else, you listen to their calls, you are with them as they take calls, you get to listen to the type of queries the clients raise, and you note how they are able to answer and then after that you go on your own.

You also have someone else buddy up with you: . . . It’s the older people that come and listen in so if you’re struggling and you need to ask something you can quickly ask to put the client on mute and in the meantime, you quickly find out the information that you require and then give it to the client. Then after that buddying up you’re on your own.

They found this mode of training interesting and quite effective. Shop floor skills development was informal, however, and such informal processes do not secure skills recognition for career development, since they are not documented.

Training also involved putting agents under pressure to test their level of resistance, as one agent explained:

They suss up who can deal with high pressure situations and who can’t — a lot of trainees leave at this point and do not return.

High pressure training was also linked to training towards achieving set targets that measure the worker’s competency for the job.

Figure 8.2
Skills development in call centres in South Africa

<table>
<thead>
<tr>
<th>Skills Type</th>
<th>Female</th>
<th>Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upskilling staff to work across</td>
<td></td>
<td></td>
</tr>
<tr>
<td>multiple query types</td>
<td>82%</td>
<td>62%</td>
</tr>
<tr>
<td>Upskilling staff to work across</td>
<td></td>
<td></td>
</tr>
<tr>
<td>multiple contact channels</td>
<td>80%</td>
<td>76%</td>
</tr>
<tr>
<td>Knowledge management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>tools</td>
<td>73.3%</td>
<td>73%</td>
</tr>
<tr>
<td>Defining a career development path</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>61.3%</td>
<td>61.2%</td>
</tr>
<tr>
<td>Using customer feedback to promote best practice</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>61.2%</td>
<td>61%</td>
</tr>
<tr>
<td>Employee engagement schemes</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>58%</td>
<td>58.1</td>
</tr>
<tr>
<td>Formal qualifications and accreditation schemes</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>61.3%</td>
<td>61%</td>
</tr>
<tr>
<td>Mentorship programme</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>57.6%</td>
<td>58.6%</td>
</tr>
<tr>
<td>Celebrating best practice</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>52.9%</td>
<td>52.8%</td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>10.4%</td>
<td>8.9%</td>
</tr>
</tbody>
</table>

Source: BPESA, 2016, p. 28.
The women workers admitted that all these forms of training and exposure provided them with some new skills. This chapter examines the nature of the skills acquired on the job and their value for career development.

While some participants felt that the initial training improved their skills in some ways, others dismissed it as routine training that did not add to their skills. Respondents put emphasis on acquiring what are often called “people skills” (White & Roos, 2005), and agents believed they “picked up” these skills on the job.

I wouldn’t say training empowered me with any skills but the work environment did. Having to deal with people, having to solve peoples’ problems and having to think on your feet. It is the experience and not necessarily the training that matters. Training is just theory, information on the product the company offers and that is all. In most cases you forget those things, it’s doing the active to try to do what you being active that gives you the training and experience that you take with you out of the call centre business, to other companies or to other aspects of your life where you will implement them.

I learnt to listen more attentively and work within very demanding circumstances. This job has also taught me to be very patient with the customers and use the skills acquired on the job and their value for career development.

Participants repeatedly discussed the lack of career growth, with some characterising the nature of call centre work as exploitative. In this view, they saw some call centres capitalising on workers’ vulnerability, arising from a lack of alternative employment.

I would say that call centres are exploitative. They use the basic work load that we have here in South Africa. . . . It’s cheaper we have to employ people than it is overseas . . . and someone did mention that you are easily replaceable in a call centre.

You are told straight out if you are not happy, it’s fine, leave, there is someone that wants that job that you don’t want. You are easily replaceable, you are not important. You are just a number in a lot of numbers they can easily get rid of.

Although not a common observation, one participant also raised what she saw as the gendered nature of promotion in her organisation.

I have heard a lot of skills such as communication skills, persuasiveness, conflict management, computer skills, and skills on sales. . . . But the thing is, even though I have learned all these skills at this job, I am still in the same position I started off with. I have never been promoted. They mostly promote guys. When we ask why it’s only guys that get promoted, they say it’s because they perform and that’s why they earn it. Surely there must be at least one girl who performs in this job.

DISCUSSION

Call centres largely provide service through use of digital technologies. Firms engaged in outsourcing have absorbed large numbers of young people, especially women, into various occupations (Belt, 2002; Taylor & Bann, 2005; Singh & Pandey, 2005). Call centres are not gender-neutral, as the industry is significantly driven by women’s labour (Russell, 2008). The feedback of workers in the surveys and interviews cited above indicates that call centres do not focus on developing skills that lead to career development. The skills acquired by working in the industry do not add significant value to women’s advancement in the labour market, keeping them on the lower rungs of the employment ladder (Ngabaza, 2017, Webster, 2004). Similarly, this study shows that the minimal skills developed in call centres are not intended to empower the women employees but rather to maintain low profit margins. The absence of unions represents a business policy, as high levels of unionisation might drive away possible investors (Blanchard et al., 2007) — further compromising labour protection standards (Gillard, et al., 2007; Gillwald, et al., 2017).}

Examing the intersection of skills development with the gendered dynamics of employment can provide a more complete understanding of the implications of skills development for women call centre workers. Research shows that ICT-driven work can reach marginalised and vulnerable communities (World Bank, 2016); indeed, call centres in South Africa mainly employ young women from such communities. Since ICTs are not gender-neutral but are “embedded in a range of social economic and political contexts” (Bonds, 2006, p. 31), it is important to interrogate the gender dynamics to understand what the skills development process implies for workers.

The recruitment process focuses on “feminine” skills: basic keyboard skills, phone etiquette, word processing, and voice demeanour. Workplace skills development focuses on effective service provision, not career growth. Workers develop their skills informally, coached by colleagues or memorising scripts. Scholarly research in similar contexts, that such informally obtained skills are not recognised as skills or considered in promotion prospects (Webster, 2004). While some participants valued the interpersonal skills they had acquired, they felt that these were of limited value to their career progression, and that they had not gained technical skills that could also lead to further employment in the information sector.
REFERENCES


ABSTRACT

This chapter explores the fundamental notions of digital security and privacy from a gender perspective. In a world that is increasingly relying on digital technologies, learning how to be safe when online is of paramount importance. Studies show that, as much as digital technologies represent an undeniable opportunity for growth and change, they also offer a larger platform for abuse. The Association for Progressive Communication has pointed out that cyberstalking, online harassment, image manipulation, and privacy violations have compromised women and girls’ safety both online and off-line, in many countries (APC, 2015). This disturbing behaviour extends to geo-tracking and surveillance, in some extreme cases. Equipping women with adequate digital knowledge and skills to ensure a more secure and private online experience can help to limit this kind of abuse. Going further, however, we advocate women’s involvement in fundamentally rethinking security research and design in terms of gender. Security technology (including cryptography) is not gender-neutral; to date, it has been proposed and designed by a specific, non-diverse community, which has shaped its development. Specific trust assumptions, security models, and the technical language of security — using such terms as attacks and adversaries — that underpin contemporary security research appear to be male-driven and male-oriented. However, there is growing awareness that security solutions need to be designed in, and for, a specific context, and that they need to take incorporate diverse, context-sensitive design principles. This goal requires reducing the gender gap in digital literacy, ensuring that women have the necessary skills to experience technology in a private and secure way (for instance, with better understanding of password use, encryption functionality, and data integrity). Women’s greater involvement in the design of security and cryptographic solutions is key to safer integration of digital technologies in our lives.

INTRODUCTION

This chapter details how the lack of knowledge of online security and privacy can have a deeply negative effect on technology users, especially women. A straightforward solution to this problem is to equip women with the necessary skills, so the chapter then examines women’s involvement in the area of information security. Finally, we note that this imbalance in skills has led to a lack of diversity in the design and development of security solutions, and in particular of even basic cryptographic concepts. In view of the fundamental role of digital security in the adoption of technology in our lives, reducing the gender gap in this field is of paramount importance.

KEY FINDINGS

- Technology unfortunately provides a wider platform for abuse towards women. The solution requires both individual digital skills to enhance personal security and privacy, and women’s participation in design and development of security and privacy technologies.
- In the field of Information Security, women are largely underrepresented: globally, women account for just 11% of the cyber security workforce, mainly in non-managerial positions.
- Security technology is gendered; cryptography incorporates gendered assumptions relating to sources of threat, potential "trusted" allies, and resource availability. More diverse design principles need to be developed.
Society is immersing itself in the digital world. At the end of 2015, it was estimated that there were 3.2 billion people online (Internet Society, 2016); similarly, in 2016, it was estimated that 47% of women owned a mobile phone and 35% owned a smartphone (Statista, 2016). These numbers are significantly lower in the Global South: in low- and middle-income countries (LMICs), the percentage of women owning a mobile phone was 41% in 2015 (GSMA, 2015). Pay-as-you-go mobile phones have been important in enabling women in LMICs to get connected (Wajcman, 2004, p. 120). In 2017, 36% of women were using, or had previously used, online dating sites or apps (Statista, 2017b).

What security and privacy concerns does such connectivity entail? The advent of mobile technology has enabled economic and social changes, especially in LMICs. Innovations include branchless banking, mobile apps, and health-related applications (including care, medical advice, counseling for HIV/AIDS patients, and anti-counterfeiting checking of pharmaceuticals).

However, mobile technology can reveal tensions and complex relations between technological mobility and social expectations. The generalisation that technology increases economic and social advantages is too simplistic. An ethnographic study in India, conducted by Jo Tachí, shows that in some households men control technology (phones in particular), believing that technology has been developed, as well as greater agency in navigating information security. This highlights the need for progress in increasing both the digital skilset required for personal security and privacy (for which training and schools are being developed), and the way it is taught in the design and development of security and privacy technologies. (We note that there is also the dual need to restrict and punish the perpetrators of online crime). This often comes in the form of calls for better and more balanced laws to prevent cybercrime, online harassment, however this will not be the focus of our study). We focus on the need to increase women’s participation in InfoSec, since this has received less attention in the literature so far.

Social control can be exerted through simple calls and text messages, or it can be amplified through apps such as Phone Tracker and Find My Friends, which allow a user to follow a spouse or partner, for example. This can allow abusive partners to exert more control over their victims. It is estimated that 35% of women worldwide have experienced physical or sexual violence (World Health Organisation, 2017). Security and privacy may be even more at risk in the online world. American women are more likely than men to seek healthcare advice online (MarketWatch, 2013). Women in the UK are reportedly seeking illegal abortions online, even though abortion in the UK is legal and publicly funded (New Scientist, 2017). Whether or not this indicates a problem in accessing healthcare, there is certainly some room for seeking out medical help online. Illegal healthcare creates a security issue, placing women in danger, particularly with regard to reproductive health and abortion services; they may receive incorrect medical information or be given medications that, at best, do not work or, at worst, are dangerous.

The problems and dangers that may be encountered by women seeking health and human services on the internet include: difficulties in ascertaining the credentials and identity of service providers; accessing information; reliance on self-tested methods; difficulties in online assessment; exposure to disinformation; communication; development of inappropriate online relationships; and lack of standards or regulations regarding online human service practice. In addition there is the possibility of victimisation through loss of privacy, understanding, and identity theft (Finn & Banach, 2000).

Overall, use of these new technologies may expose users to an unprecedented level of threats, such as control, abuse, and theft of sensitive data, reflecting the lack of certain security properties (Quaglia & Heath, 2017). One solution is to equip women with digital knowledge and skills to ensure a more secure and private online experience, as well as greater agency in navigating information security.

In order to address gender bias, employers must first be aware of possible bias and take positive action to prevent women being discriminated against. For example, since women are much more likely than men to have work and childcare responsibilities, and therefore more likely to work part-time or take employment after having children (Frankland, 2017, pp. 4-8), Google increased maternity leave for new mothers. By reducing the number of new mothers leaving the company, this step was also cost-efficient, saving costs of recruitment and training (Quartz, 2016). While women’s input to technological progress has been overlooked in the past (Wajcman, 2004, p. 13), their role in the history of technology is now being presented in popular media. Notably, the 2016 movie Hidden Figures documented the little-known role of African American women in NASA’s space programmme in the 1960s. Women’s issues are widely covered, and campaigns against stereotypes of women in industry are reported in the media (BBC News, 2015). Women in different industries fight against gender inequality, using social media to highlight issues; the #MeToo (Wikipedia, n.d.) and TimesUp (Wikipedia, n.d.) campaigns showed the power of online action.

GENDERED SECURITY

Radical feminists see all technology as intrinsically patriarchal, that is, as part of a system controlled by men to further male goals. These arguments are explored in (Frankland, 2004, pp. 4-15). This argument can apply to digital technologies and privacy, as part of the technology, security and privacy can also be considered to be gendered.

Cryptography focuses on enabling secure communication over an insecure channel, such as the internet. This is typically done by means of cryptographic primitives — basic algorithms, such as encryption and digital signature schemes — designed and tested by cryptographers.

In order to test that a system is secure, researchers adopt rigorous and precise definitions of security, modelling properties such as confidentiality, integrity, and availability. Each definition is carefully designed to capture a particular security property, under detailed assumptions about resources, required trust, network availability, and even the notion of identity.

As noted in Quaglia and Heath (2017), the assumptions regarding available resources (such as processor speed and network access), as well as notions of identity and trust, can strongly influence the cryptographic solution design. Each definition is carefully designed to capture a particular security property, under detailed assumptions about resources, required trust, network availability, and even the notion of identity.

Women in Information Security

WOMEN IN INFORMATION SECURITY

Globally, women only account for 11% of the cyber security workforce, and they are likely to hold non-managerial and entry-level positions. Men are much more likely than women to hold management, and more senior positions. The prevalence of women in information security professions varies by region, ranging from 5% of the workforce in the Middle East to 14% in the U.S., but women are underrepresented globally (Executive Women’s Forum, 2017).

Accordingly, decision making in information security is disproportionately carried out by men.

One reason for this gender gap is that women are less likely to interact with STEM subjects (i.e., science, technology, engineering, and mathematics). STEM background appears to be critical: 61% of women entering the information security workforce have a degree in a STEM subject, as do 74% of men (Executive Women’s Forum, 2017). However, girls’ interest in STEM subjects in schools is low. For 16-year-olds in the UK, only 35% of girls choose to study a STEM subject, compared to 49% of boys (Pew, 2017). Jane Frankland points out that large numbers of women were engaged in STEM subjects throughout WWII, followed by a sudden decrease factor. Frankland argues, may be media portrayal of STEM subjects as masculine areas of study; she cites examples of movies and popular media showing males interested in information security (Frankland, 2017, pp. 143-4). Another factor is misconceptions about gender, and gender bias. Gender bias can appear in many forms, from unequal pay to more subtle issues, such as asking women to perform different duties than men, influenced by gender norms (TechRepublic, 2015). Biases against women in the workplace include assumptions such as that a woman will leave to have children, or that she will not want to work as much as a man (Frankland, 2017).

Globally, 39% of women in information security do not come from a STEM background (Executive Women’s Forum, 2017), compared to 30% of information security professionals overall (Alta Associates, 2017). Since women are more likely to enter the information security profession from a non-technical background, Frankland points to the importance of non-traditional (i.e., non-STEM) routes into the information security; she prefers to refer to STEM (science, technology, engineering, and mathematics) (Frankland, 2017, pp. 87-88). Women are more likely to have interdisciplinary skills, and employers should consider the benefits this brings to the workforce (Executive Women’s Forum, 2017).

Programs that target information security initiatives at girls can help to raise awareness as well as increase digital skills. Girls Who Code operates across the U.S. and the UK (Girls who code, n.d.). IBM run the Women in Security and ElsaTech (WISE), launching a 2016 programme called Cyber Day 4 Girls to teach girls in the U.S. and Canada cyber security awareness. (IBM, 2016). Google launched a website in 2014, “Made with Code”, that includes coding projects aimed at girls (Time, 2014). Government initiatives also exist, such as CyberFirst (CyberFirst, n.d.), run by the National Cyber Security Centre in the UK, that provides courses and apprenticeships. In the U.S., GenCyber is a free summer camp for students and teachers (GenCyber, n.d.). Many initiatives are developed to increase women’s participation in information and knowledge, and tested by cryptographers.

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a (classic attack against cryptographic protocols). More significantly, perhaps, cryptographic models make assumptions that may not be relevant to gender-specific threats.

The model of cryptographic threat incorporates the notion of attacker/defender, which is often assumed to refer to a distant and unseen third party with malicious intentions. As discussed in Part 1, the malicious intentions towards women’s security and privacy often originate from the domestic environment, and the assumption of a distant adversary appears irrelevant. Similarly, the trust assumptions made in these models often assume the existence of a trusted institution, such as a bank, a company or the government, which can be fully relied on and considered benign. In contexts where important institutions are male-dominated or male-oriented, such assumptions of trust could be detrimental to the security of women. Finally, even assumptions regarding resources can be considered biased: if a cryptographic solution is proved to be secure under specific resource requirements (e.g., power and network availability, computing capacity), when such requirements are not met security cannot be guaranteed. Given that women around the world tend to have limited access to resources, this basic assumption cannot be considered gender-neutral. These and related considerations need further research to serve women’s unique and urgent security and privacy concerns.

**CONCLUDING REMARKS**

This issue has not been raised before in the context of cryptography, as the analysis of security in general has been heavily influenced by gender. Feminist security studies have proposed a more people-centered notion of security, in which people contribute to and become part of the definition of security. Quaglia and Heath (2017) describe a growing awareness that technology needs to be designed for a cultural and societal context. Seminal work by Hall, Heath, and Cole-Kemp (2015) describes how visualising security with the use of LEGO bricks enables participants to question traditional notions of security (such as the one user/one password paradigm).

Rethinking security through a gender lens is a necessary step to ensure women’s greater involvement in the design of security and, in particular, cryptographic solutions, enabling a successful integration of digital technologies in our everyday lives. There are some limitations to our considerations so far: for instance, we have not extensively covered issues of security and privacy globally, and we have not addressed intersectionality. This paper should represent a starting point for further detailed studies and research.

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INVESTIGATING EMPOWERING NARRATIVES AROUND WOMEN, WORK, AND TECHNOLOGY

AUTHORS: NAGLA RIZK, STEFANIE FELSBERGER, AND NANCY SALEM (ACCESS TO KNOWLEDGE FOR DEVELOPMENT CENTER)

ABSTRACT

Despite many efforts, women’s participation in STEM fields and representation in the tech workforce remains low in many places, made more difficult by gender prejudice in education as well as work. Women’s work in technology-related fields has been historically and structurally devalued. With a focus on women’s work in information and communications technology (ICT), this chapter reviews feminist literature on women and technology and discusses gaps in the current narrative of the empowering potential of technology. We explore two areas of existing research: literature on women’s work in ICT, especially intersectional and global literature; and a specific literature that reframes data production as labour, with reference to the influence of feminist literature on these arguments. We provide some recommendations for incorporating this perspective in research agendas on women in ICT and STEM.

KEY FINDINGS

• A more diverse literature on women and work in ICT and STEM should incorporate a more global analysis that takes into account women’s experiences of work in these sectors.
• Early writings on the impacts of technology assumed gender-neutral effects, as if technology is created outside social constructs and limitations. The potential benefits of ICT need to be viewed in the context of women’s lived experiences of these technologies.
• Historically, when women have been engaged in fields using technology, those fields of employment are defined as low-skilled and low-prestige (e.g., textile production). Similarly today, although women are actively involved in digital technology production, their contribution is undervalued and the fields where they work become less attractive.
• Online activities create valuable data and might be understood as work that should be compensated. Nevertheless, this work is often undervalued, invisible, and regarded as unskilled.

INTRODUCTION

There has been a push to make the field of digital technologies a safer and a more inclusive workplace for women over the last decade. Nevertheless, women across the globe continue to face discrimination both online and offline, as do other marginalised groups and individuals. Women’s participation in STEM fields remains quantitatively low, with women facing prejudice in education and work. Representation in the workforce in STEM and other technology-heavy areas is especially lacking. This is consistent with a history of women’s work often being structurally devalued, with women being viewed as less valuable workers (Seguino, 2000; Elson & Pearson, 1982).

This chapter focuses on women, technology, and women’s work in technology. We examine the gendered ways in which women’s engagement with technology is portrayed and we investigate the view (known as technological determinism) that technology is automatically bringing about progress and benefits for women. We address how women’s work has historically been undervalued, whether it was housework, textile manufacturing, or women’s crucial contribution to programming — which was disregarded as “clerical” work. Women’s work has often not been acknowledged as “work”, or their skillful contribution has been ignored as low-skilled.

We draw from a range of literature: on housework, care work, and affective labour; on the feminisation of labour; and on deskilling. Our chapter also joins the conversation on how to close the digital gender gap, which generally focuses on promoting skill development and self-confidence in women and girls. We argue that a wider effort is also needed, to reexamine how women’s skills and contributions to technology have traditionally been undervalued.

The chapter has three sections. Section one discusses technological determinism — the view that technology drives progress — contrasting its assumptions with women’s global experiences with technologies. Section two explores narratives on two areas of women’s work relevant to the digital era: women producing ICTs, and women producing data and content. Finally, we make recommendations on the current research agenda, including expansion to include, as a default, a diversity of experiences from the Global South.
TECHNOLOGICAL DETERMINISM AND WOMEN

Since the 1850s, technology and its potential for positive change have captured the minds of scholars as well as politicians. When the first transatlantic cable was installed, it was hoped to connect “all the nations of the earth” and make it impossible for “old prejudices and hostilities” to exist (Boyd, 2014, p. 156). The birth of the internet was heralded with similar hopes and dreams, as a new place that “allegedly freed users from the limitations of their bodies, particularly through stemming from their race, class, and sex” (Chun, 2006, p. 2).

The literature

Guillermo Gómez-Peña (1997), an early critic of that utopian rhetoric, describes how American digital artists viewed “the net” or “cyberspace” in the 1990s: they “spoke of a politically neutral/race-less/ gender-less and class-less ‘territory’ which provided us with ‘equal access,’ and unlimited possibilities of participation, interaction and belonging” (Gómez-Peña, 1997). In reality, this “territory” had a “digital border”, and on the other side “there lived all the techno-illiterate artists, along with most women, Chicanos, Afro-Americans and Native Americans in the U.S. and Canada, not to mention the artists living in so called ‘Third World’ countries” (Gómez-Peña, 1997).

Even at the beginning of the internet age, therefore, despite many people’s attempts to make the web as inclusive as possible, its empowering potential was already limited and exclusive. Nevertheless, such utopian claims still influence discourses around access and use of ICTs (Boyd, 2014, p. 158). According to danah boyd, technological determinism is the belief that “technologies possess intrinsic powers that affect all people in all situations the same way” (boyd, 2014, p. 15). The larger literature on technological determinism investigates the relationship between technologies and societies and theorises how societies respond to technologies. The core tenets of technological determinism hold that technology is created outside social constructs and limitations, and that technology drives (socio-economic) change.

Leila Green (2001, p. 3) argues that early representatives of this view perceived technology “as being ‘good’ or ‘bad’ as an abstract entity. It was as if technological progress and development were inevitable.” The assumption is that technology is created in a vacuum independent of how society uses it. Indeed, it is seen as society’s role to “adapt to (and benefit from) technological change” (Green, 2001, p. 2). Technological determinism still pervades today’s discourses about technologies and their progressive potential for society (Wyatt, 2008).

A crucial, early piece of literature argued the opposite: that technology is imbued with its creators’ biases. This was Langdon Winner’s 1980 article, “Do Artifacts Have Politics?” He used the case of technology in New York City to argue that the urban planner’s privileged and advantaged position led him to design a city less accessible to marginalized groups, including bridges under which public buses were unable to pass. Winner’s article contributed to the larger debate around technologies (i.e., “artifacts”) and whether social, political, economic, and cultural biases influence technology production and innovation.

Relevant for this chapter is the determinist argument that technology drives progress for all of society, including women. Donald MacKenzie and Judy Wajcman (1999 [1985]) contend that social circumstance, rather than technology itself, determine its adoption, use, and consequences. Leila Green builds on these insights, arguing that armed forces, bureaucracies, and corporate power mainly determine technological progress. Development of technology “represents the priorities of the elites which sponsor it, rather than representing the society as a whole” (Green, 2001, p. 10).

Many observers highlight the overall positive potential for women in ICT. Debra Howcroft and Marie Hicks investigate the experience of women workers in Information Technology Enabled Services (ITES) potential for women in ICT. Debra Howcroft and Marie Hicks (2010) argue that the freedom of working in the global information industry, Elson and Pearson (2012) note that women are seen as naturally docile, disciplined, and predisposed to repetitious work that other women undertake in producing software and hardware — often, Asian and American immigrant women workers. We therefore use a broader definition of work in ICT and STEM that incorporates this contradiction. We follow Christian Fuchs and Marisol Sandoval in defining digital workers as those involved in the production, circulation, and use of digital media (Fuchs and Sandoval 2014). Fuchs illustrates the diffusion of the digital production process, encompassing mineral extraction, manufacturing and assembling, and software engineering, but also including the work of hours and employment. Analyzing economic growth in Asia, Stephanie Seguino (2000) argues that wage differentials reflect levels of discrimination against women. Martha Chen (2008) concludes, in her analysis of global poverty reduction programmes, that women are over-represented in lower-quality employment.

David Hesmondhalgh and Sarah Baker (2015) identify similar dynamics. They explore job segregation as a relative concept, with certain occupations being strongly associated with either women or men: while women mostly work in coordination, men occupy more prestigious, monetary, and technical” positions. Occupations become “feminised” with a growing concentration of women working in them through not necessarily biological processes. This process is linked to inequality in three critical ways: feminised occupations tend to pay less; job segregation hinders women in pursuing masculine occupations for which they are qualified; and it makes it more difficult for women to find an occupation that matches their talents (Hesmondhalgh & Baker, 2015). Overall, women in feminised industries tend to work less, be paid less, and report less job satisfaction.

Efforts to promote girls’ and women’s skill development need to go hand in hand with a broader reassessment of how women’s skills are commonly valued and regarded.

EXPERIENCES OF WOMEN’S WORK WITH DIGITAL TECHNOLOGY

In this section, we consider the experiences of women both in producing physical ICTs and software and in providing the intangible services that create content and data. Several characteristics of feminised labour remain relevant, with striking variations that call for context-specific analysis. We also question narratives about technologies that are based on the specific histories of the Global North: the overly positive portrayals of the potential of ICT often ignores how this technology is produced.

Melissa Gregg (2008) and Wendy Chun (2006) argue that the freedom of working in the global information economy offered to some women masks dangerous work that other women undertake in producing software and hardware — often, Asian and American immigrant women workers. We therefore use a broader definition of work in ICT and STEM that incorporates this contradiction. We follow Christian Fuchs and Marisol Sandoval in defining digital workers as those involved in the production, circulation, and use of digital media (Fuchs and Sandoval 2014). Fuchs illustrates the diffusion of the digital production process, encompassing mineral extraction, manufacturing and assembling, and software engineering, but also including the work of
cell centers and internet “prosumers” (Fuchs 2013). In this way, digital labour is understood as a process that is geographically situated and contingent on local and global power structures.

**WOMEN IN ICT PRODUCTION AND PROGRAMMING**

The examples below provide a global perspective on narratives about women and technology. To quote Ulf Mellström, this section seeks to question “the notion that an all-encompassing culture of science and engineering transcends time and space” (2009, p. 902). We show that, contrary to narratives in the Global North, women are in fact very actively involved in technology production.

Masculine and hyper-masculine spaces in technology are well documented. Fox and Tang chronicle women’s toxic experiences of online gaming (2016), and Marie Hicks has written about programming culture in Silicon Valley (2013). The view of technology as a masculine field conceals not only women’s contributions but also global realities. Nevertheless, this assumption is often cited to explain why women may not choose to pursue careers in computer science, in the Global North and in other contexts.

Other authors point to different experiences in the Global South, where computer science spaces are not considered masculine, but where working conditions still may be less than ideal. Mellström, 2009; Lagesen, 2009; Wajcman & Anh Pham Lobb, 2007; Saloma-Akpedonu, 2005). Namrata Gupta questions the assumption that the Western experience of gender and technology, arguing that the local context has a large role in shaping the relationship between gender and technology. In India, the large number of women in tech is described as its “women-friendly” image, based on gendered assumptions regarding technology, including that it is “safe” for women (Gupta, 2015).

While opportunities for women have increased, Gupta argues that women’s presence should not be interpreted as a “radical revolution in gender relations in society”; sexist assumptions and gendered job expectations are well documented. This reinforces Wajcman’s critique of “the need to write another software programme to test a woman’s ability” (Wajcman, 1991).

**ONLINE ACTIVITIES AS WORK**

It has become a widely shared insight that the business model of many large internet-based companies, such as Google or Facebook, is to either sell (and resell) user data or to monetise it through data analysis (Jarrett, 2016, Fuchs, 2013, Lessig, 2002; Fishkin, 2016). Brooke Erin Duffy and Becca Schwartz explore the feminisation of social media employment, where advertisements construct features of sociability, emotional management, and flexibility. This “catalogue of traits presents an archetype of a woman who is both 'nimble-fingered' and docile female worker, and on the other the female professional IT worker and academic” (Mellström, 2009, p. 902). Also, online labour and technology studies need to pay more attention to culturally situated analyses that bring local gender discourses into the picture. Recommendation: media and technology research needs to be “critical in the devaluation of their labour. In this instance, the soft skills that are associated with women were not devalued, as the ICT field in the Philippines valued these skills as a core part of the industry.

In Vietnam, very differently, gender segregation in the software workforce has been shown to be significant, with systemic undervaluation of women’s work. In production, women are concentrated in the testing phase, while men work in the specification and design phases — despite the strong link and overlap between the two phases. Indeed, women testers often “need to write another software programme to test a software programme” (Mellström & Ahn Pham Lobb, 2007, p. 21). No gendered gaps in qualifications or experience were noted. This reinforces Wajcman’s earlier argument that digital gender and technology studies need to consider the “economic turn” in Internet research. Building on Dallas Smythe’s (1977; 1981) discussion of the “audience commodity” in media studies, Fuchs argues that in the business model of selling data to advertisers, the key product, or commodity, is data produced — that is, created — by users. “Commodities have producers who create them, otherwise they cannot exist. So, if the commodity of internet platforms is user data, then the process of creating that commodity is referred to as ‘value-generating labour’” (Fuchs, 2013, pp. 19-20).

Fuchs builds on feminist literature on domestic and affective labour, comparing this data production to household work (Fuchs, 2013). Feminist theory has been seminal in arguing that housework is in fact labour (Mies, 1986). Fuchs uses those insights to draw comparisons with digital labour: both have “no wages”; they predominantly take place “during spare time”; they have no labour unions and are “difficult to perceive as being labour”; and, much like household work, which is coerced by an economic imperative, digital labor is shaped by a global economy and status of social media platforms. Thus, women’s engagement with technology is not regarded as such.

Kylie Jarrett points out that using the framework of work in digital media to improve the online “labourer” is someone “who is directly and knowingly employed by the exhibitor” (Jarrett 2016, p. 2). Today’s internet users experience the online activities as placeless and not work. Conversely, she observes, “even the repetitive, physical, menial chores of housework are often driven by, or serve as expressions of, the immaterial value generated by the household. This work also produces material products such as health, dispositions or esteem” (Jarrett, 2016, p. 3). Both domestic and online labour and women’s work in the technology sector overall, are often undervalued and unpaid, while their contributions to the economic system are crucial (Jarrett, 2016).

In the field of economics, Ilbarratia et al. examine the consequences of the online “culture of free” — where users neither pay for the services they receive nor are paid for the contributions they make. They point to the consequences: “the lack of targeting of incentives undermines market principles of evaluation, skews distribution of financial returns from the data economy and stops users from developing themselves into ‘first-class digital citizens’” (Ilbarratia et al., 2018, p. 1). Their key argument is that the potential of the digital economy, as a source of innovation and benefits, with people’s concerns over privacy and fears of being replaced by automation. Their solution is that data should be considered labour, and they call for “a fair
and vibrant market for data labour” (Ibarra et al., 2018, p. 3). That argument goes against most social science analysis, which criticises the commodification of data and the exploitation of invisible work. Moreover, details are lacking on the frameworks that need to be in place to ensure such a data labour market would be fair. This could prove especially difficult, keeping in mind the needs of groups marginalised based on gender, race, or class, and the contrasting situation of countries in the Global North and South.

Anita Gurumurthy and Nandini Chami have provided an attempt to answer these important questions, asking, “How must feminism take on the challenge of a datafied world?” They point out how people’s online “invisibility” — often, acts of caring and expressions of connection — are captured in behavioural data sets and then monetised by companies. But they add that this “datafication”, and the connectivity it produces in the sharing economy, obfuscates the production of technology and data, which often takes place in the Global South (Gurumurthy & Chami, 2016). In order to counteract the skewed power dynamics between data producers and users, they suggest the solution of a “data commons”, but they warn that “it must correspond to the hope and outrage of the most marginalised and the ways in which their valuable contributions to ICT, technology, and the digital economy are often rendered invisible or overlooked.

Three recommendations are central to make the current research agenda more inclusive.

1. Further detailed research is needed on documenting the experiences of women working with technology in different contexts. Studies should pay close attention to intersectional approaches accounting for gender, class, race, and age.

2. More case studies on experiences from the Global South should be undertaken, for a better understanding of how women’s work with technology becomes defined as feminised labour.

3. Research on online data-producing activities should be guided by principles of intersectional feminist approaches, to identify which groups are more at risk and which groups have the means to protect their rights or participate in market-based approaches.

4. Research should not only focus on trying to increase women’s access to technology but on understanding and highlighting women’s existing contributions to technology, in their many shapes and forms.

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Feather, E. (2018). How less alienation creates more exploitation. How women’s labour in the sharing economy is constructed as a masculine domain, while in the Global South, women predominantly work in technology but often in harsh conditions of technology production. Nevertheless, in many (or most) countries, women’s work in and with technologies is rendered invisible and regarded as unskilled, or their technical skills are explained away through gendered perceptions. Finally, research framing a broader definition of work conceptualises online activities as labour.


KEY FINDINGS

- Women with STEM degrees are only slightly more likely to patent an innovation than women who lack them.
- The most significant determinant in the gender gap in technology transfer is women’s underrepresentation in patent-intensive fields (especially electrical and mechanical engineering), and in patent-intensive jobs (especially development and design).
- The lack of gender-disaggregated data for technology transfer (such as patents and copyrights) reflects the absence of any global organisation to track trends in gender balance in tech transfer.
- Virtually all indicators related to gender balance in the World Intellectual Property Organisation Patent Cooperation Treaty (PCT) or patent system show some degree of progress toward gender parity in recent decades.
- Based on current rates of progress, gender balance in patenting would not occur until 2070.

WHY IS TECHNOLOGY TRANSFER IMPORTANT FOR GENDER INEQUALITY?

As technological innovation and diffusion accelerate, little attention has been paid to the potential social impact of equality for technology transfer and wealth creation. One of the main challenges in the complex process of commercialising intellectual property (IP), according to EUIPO, is that the great majority of ideas (whether protected or not) never make it to the marketplace (Campinos, 2018). Experts on feminism and technology point to the scant proportion of women obtaining patents globally, which is even less than the already small proportion of women in the field of STEM (Rosser, 2009).

The question of gender in technology transfer can thus be usefully addressed on two levels: How does technology transfer work in practice? And how are women either involved in or excluded from...
the process? Literature on technology transfer and innovation can shed light on how prominent centres of research (as well as leading intellectual property bodies) attract women inventors and how existing mechanisms affect women’s involvement or exclusion in technology transfer.

Some researchers point to a lack of diversity in the process of developing new technologies, and to the lack of women in critical research centers to attract women inventors. Only 15% of patents are filed by women (Jensen, Kovacs, & Sorenson, 2018). Others point to gaps in relevant women’s impact funding at the early stages of proof-of-concept, prototyping, and demonstration (Alumia, 2019).

Missing in the literature is a critical analysis of technology transfer in terms of gender. Women and feminists have questioned the implications of the low percentage of women in STEM for our understanding of gender in innovation (Siegel, 2008), although the issue of implicit bias in technology transfer has long been recognised. Writing over 30 years ago, radical feminists and ecofeminists initiated a critique of the inherent patriarchal nature of technology, and of technological more generally, and are still questioning “best practices” that themselves may be flawed (Oakley, 1974; Cockburn, 1983; Corea et al., 1988; Wajcman 1991 as cited by Bray, 2007).

KEY CONCEPTS: HOW DO TT AND GENDER INTERCONNECT?

The development of technology draws upon many fields of knowledge — scientific, engineering, mathematical, linguistic, and historical — to achieve some practical realities (Frakes, 1992). Technology transfer is not a novel concept; it can be defined as an emerging process going back to the mechanical age (Bessant & Rush, 1995). Nevertheless, it would take many centuries after the first patent legislation in Venice in 1474 (Penrose & Zamora, 1974) for European and U.S. universities to begin to bring new inventions to society. With the enactment of the Bayh-Dole Act in 1980, U.S. universities started to patent and license scientific discoveries. Since then, technology transfer has evolved to become a political and corporate mantra, promising significant change based on both better and more technology (Slaughter & Leslie, 1997).

The goal of technology transfer is to take sound scientific ideas to the market (Bercovitz & Feldman, 2006). It is important to understand how technology transfer works in practice, to help women inventors protect their scientific ideas and increase their participation in the process.

Two complementary aspects are critical in increasing the role of women in the development of new technologies. First, university policies need to attract, support, and reward women inventors. Second, the barriers need to be addressed that may prevent female inventors from commercialising their scientific ideas or inhibit their professional advancement. If female inventors are accorded unbiased support to protect and prototype their scientific ideas, technology transfer will play a part in increasing gender equality.

Young (2007, p. 545) posits that “technology transfer does not just happen.” Transferring knowledge and innovation from a public research organisation to the private sector for commercial application and public benefit requires a formal mechanism — a technology transfer office (TTO) — to help inventors protect and license intellectual property. In order to promote inclusive innovation, this mechanism must be unbiased and committed to support men and women inventors equally, at each stage of the process (Siegel, Veugelers, & Wright, 2007).

The rapidly changing landscape of innovation requires a major effort to equip female participants (scientists, engineers, researchers) with the necessary resources (such as TTO licences, access to capital, and network providers) to ensure their success. Moreover, women need not only training and qualifications to shape the right skills, but also access to mechanisms for funding in the crucial proof-of-concept and demonstration phases (Etzkowitz & Goktepe-Hulten, 2009). The traditional activities of technology transfer offices (TTOs) include identifying promising research results from the university setting and transferring them to market agents. A TTO depends on access to an active university and researchers, industrial absorptive capacity, and investors. TTOs serve effectively, bridging these three factors only when they are able to provide the missing pieces in the technology transfer process. A passive TTO may fail in the mission to promote technology transfer.

Advanced TTOs are mainly attached to more entrepreneurial universities in high-income countries; they offer effective support to researchers, inventors, and entrepreneurs by taking a proactive role to help them to cross the “valley of death” in the process of starting a new venture. World-class TTOs normally offer ten standard support services: invention disclosure, invention assessment, idea protection, proof of concept, IP commercialisation, start-up formation, licensing to existing business partners, legal support, commercialisation after licensing, and licensing revenue distribution (Debbaceke & Veugelers, 2005). Thus, the technology transfer process has become a high priority on university policy agendas, as the key to effective technology transfer mechanisms.

IS TECHNOLOGY TRANSFER GENDER-NEUTRAL?

For many people, technology transfer has no implication for gender. Gender is likely to refer to meritoric ideologies rather than structural factors to explain inequality (Cech & Blair-Loy, 2010). Business education explores how to mitigate deficiencies in women’s human capital or motivation, even though systematic structural obstacles (such as glass ceilings) are widely considered the main cause of gender inequality in science and technology (Tan, 2008).

One source of structural bias lies in unequal access to university support. In emerging science and technology-related areas, women’s participation, advancement, and recognition often seem to suffer from the same discriminatory gender patterns identified elsewhere in academia (Etzkowitz, Knebelgren, and Lizzi, 2000). The Women Inventors Committee of the Association of University Technology Managers (AUTM) states that the profession lacks diversity in different contexts to facilitate technology transfer all share one common challenge: a lack of women’s participation in several aspects of the process (WIC, 2018). The AUTM attributes this gap to the lack of university commitment to educate female university scientists about the impediments and barriers to business creation when attempting to become inventors and entrepreneurs. The report suggests action steps toward the goal of including more women scientists and engineers in successful technology transfer and business creation.

In the university environment, there are no explicit rules that position men and women inventors differently. The slow progress toward gender equality nevertheless provides obvious discrimination and invisible barriers built into male-dominated systems (Ranga & Etzkowitz, 2010). For example, discrimination against women scientists, researchers, innovators, or entrepreneurs occurs when — by default — men are over-ascribed for performing traditional female roles and women are under-ascribed for performing traditional male roles. Ranga and Etzkowitz also observe that most efforts for gender equality tend to focus on women’s recruitment rather than retention and advancement, reflecting false expectations that upward movement would take care of itself once a woman achieves a job. It comes as no surprise that disproportionate numbers of women remain in low-level positions in academia, even after many years of contribution (Handelman et al., 2000) suggest that universities are failing to take advantage of an available resource, noting that the presence of women scientists determines the proportion of women in faculty positions, and that this ratio lags far behind the proportion of Ph.D.s granted to women. They identify, as reasons for this disparity, the impediments to recruitment, retention, and advancement of female scientists. Similarly, AUTM suggests that many of these barriers reflect unconscious bias by all involved in the system, including the women scientists themselves. The Association seeks to educate female inventors and relevant institutions to address these goals. It further recommends enabling women to take leadership roles in all stages of transferring new discoveries to the market (WIC, 2018).

Several mechanisms have enhanced women’s involvement in TT. In 2011, MIT instituted an awarde program called ADVANCE, at a funding level of $19 million, to support efforts by institutions and individuals to empower women to participate fully in science and technology. The Institute cited an “increasing recognition that the lack of women’s full participation at the senior level of academia is often a systemic consequence of academic culture” (Rosser, 2003, p. 6). This programme led to a common statement by nine U.S. research universities, recognising that institutional barriers have prevented women scientists and engineers from having a level playing field in their professions; the signatories were the California Institutes of Technology, Harvard, Stanford, Princeton, Yale universities; and the universities of Michigan, Pennsylvania, and California, Berkeley.

Many of the studies of technology transfer processes and implications focus mainly on the prominent research centres in high-income countries (such as Harvard and MIT in the U.S., Oxford and Cambridge in the UK, and institutes in Japan, South Korea, Israel, and others). Research is needed badly to examine the global implications of boosting women’s participation in increasing science research discoveries and knowledge transfer to industry.

A second source of gender bias arises from the structural constraints of the IP filing system, including how patents are obtained and maintained over time. Jensen, Kovacs, and Sorenson (2018) used a recent IP filing bulk data release with the histories of 2.7 million patents issued in the U.S. between 2001 and 2014. Their analysis reveals how patent claims can be altered during the process of filing, depending on the gender of the inventors. Overall, women inventors’ patents were more likely to be rejected than those filed by teams of men; even when applications were granted, women’s patents progressed poorly and fewer were maintained, because they received fewer citations by other inventors and from patent examiners (Jensen, Kovacs, & Sorenson, 2018). This helps explain why, although women earn roughly 50% of the doctoral degrees in science and engineering in the U.S., when it comes to being issued their inventions, they trail far behind men: only 10% of patent-holders are women. Even in the life sciences, where women earn more than half of new Ph.D.s, only 15% of inventors listed on patents are women.

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Rosser (2009) argues that, if women scientists and engineers face difficulties in obtaining patents, then women are not equal participants in the newest areas and emerging technology. Of course, commercialisation of science can be extremely lucrative, if the patent results in a product that is developed and brought to market successfully. Research is therefore in order to find ways to make the application of ideas easier. One potential solution would be to make the IP filing process more anonymous, for example by listing only the inventors’ initials, further exchanges between the applicants and the examiners could be restricted to a platform that ensures anonymity.

Creating an equal playing field in the patent process will not only benefit women. Technical progress is one of the primary drivers of economic growth, and it is boosted when inventors can lay legal claim to their innovations and profit from them, and when others can build on an existing patent. Increasing fairness in the patent system, and thus bringing more good inventions to realisation, has the potential to create wealth and promote economic development.

A third source of bias is embedded in the financial environment. Registering and protecting scientific ideas as intellectual property is an essential step toward marketing an invention, but it is only the beginning of the value of many of their potential, many scientific ideas — up to 95% in the U.S. — never progress beyond this protection or to market. Stage-gate concept (POC) is usually the next step toward marketing, allowing the inventors, as well as potential investors, to identify marketable value in a timely manner. Funders and potential POC initiators can prototype the idea and show prospective clients a real version of the product, before commercialisation.

As useful as POC and prototyping can be, investors tend to be reluctant to fund prototyping ventures (Portilla, Evans, & Gay, 2010) — a factor that also affects female inventors. In general, even though POC is vital to a successful tech-transfer process (Alunni, 2019), it is the least attractive phase to private finance, despite the small amounts required per project. Providing POC is therefore a difficult task for most technology transfer offices, especially on behalf of female inventors. Hill, Leitch, and Harrison (2006) show that women get a smaller fraction of the venture capital allocated to men; despite heightened attention to the problem, the newest data suggests the problem could be getting worse. Indeed, Bosse and Taylor (2012) suggest that a “glass ceiling” prevents women entrepreneurs and small business owners from accessing the financial capital they need, to start a new firm or fuel the growth of an existing small firm. Moreover, embryonic scientific ideas usually need further development before they can be fully protected as intellectual property in any form (by patents, copyright, etc.). This early process normally has costs, and although the amounts are not large, they may prevent women from advancing the ideas.

The advantages from such gender-friendly funding mechanisms go beyond generating value from technology. Poorer performers also include diversity, for excellence, follow-up grants, industry-sponsored research, and an enhanced reputation, as well as broader educational experience through working relationships with female-led start-ups and SMEs. Indeed, Bosse and Taylor (2012) suggest that a “glass ceiling” prevents women entrepreneurs and small business owners from accessing the financial capital they need, to start a new firm or fuel the growth of an existing small firm.
venture capital firms and other investors become incubate female-driven technologies before to encourage unbiased financing schemes to female talent. An idea conceived at the first EUIPO workshop of Anthropology, 36, 37-53.


ABSTRACT

As artificial intelligence (AI) systems become more widespread, we see increasing attempts to understand the social, economic, and political implications of these technologies. One significant gap in this work is a critical analysis of AI in terms of gender. This chapter examines the gendered implications of AI, especially in the Global South (focusing on low- and middle-income countries in Latin America and the Caribbean, Africa, and Asia). We identify the ways in which AI shapes gender relationships — and vice versa — by exploring examples of AI applications from various disciplinary fields. Where examples do not yet exist, we focus on anticipating and preventing the negative impacts of potentially biased AI applications. At a minimum, we need to ensure that AI does not exacerbate existing gender inequalities. We therefore propose steps that industry, civil society, and policy-makers can take to achieve this goal.

KEY FINDINGS

- AI development is likely to encode patterns of bias and discrimination against women, unless intentionally directed otherwise.
- Far from being neutral, AI-based applications are gendered from their creation — by the inherent bias of their creators, or through bias in the data they rely on.
- AI can actually exacerbate existing gender inequalities; the lack of women working in the field contributes to inequality and bias.
  - The training data used for machine learning may under-represent women and lead to skewed results.
  - Advertising may reward the targeting of men more than women; ride-sharing algorithms may pay men more than women.
  - AI systems typically replicate the way their designers view language (usually from a male perspective).
- AI can also directly impact women by infringing on their rights and liberties.
  - Machine learning tools are being used to create very realistic but computer-generated pornographic media, using images of women without their consent.
  - The demand for more data (for training machine learning models) may ignore the need for informed consent. Such data can also be used to target women’s groups or individual women.

INTRODUCTION

Artificial Intelligence (AI) as a discipline has been around for decades, but it nevertheless offers tremendous opportunities for social and economic change. As AI systems become more widespread, there has been a concomitant interest in discerning the social, economic, and political implications of these technologies. We can consider AI’s implications on two interrelated levels: first, how such technologies are developed; and second, the kind of impacts AI can have on society.

Drawing on research in the United States and other high-income countries, some have pointed to the lack of diversity in the development of AI applications as well as specific evidence of gender, racial, and other biases (Bryson & Narayanan, 2016; Buolamwini & Gebru, 2018; Caliskan-Islam et al., 2016; Crawford, 2016). More broadly, researchers, civil society groups, and governments in high-income countries are trying to address the socio-economic implications of AI. For example, they point to due process and ethical concerns in the use of AI by government agencies and the approach to developing AI supported systems in the private sector (Campolo, Santilippo, Whittaker, & Crawford, 2017).

One significant gap in this work is a critical, gendered analysis of AI. While feminists have questioned the implications of AI for gender for some time now (Halberstam, 1991; Haraway, 1985), there is less work on the gendered implications of recent applications of AI. This is particularly important given the proposed and actual use-cases of AI across sectors. This chapter attempts to help fill this gap by examining the gendered implications of AI on countries in the Global South, where there is currently only limited research on this topic (e.g., Web Foundation, 2017a; IDRC, 2018). Given the potentially broad gendered impacts of AI, it is important to take an interdisciplinary approach. We first examine research from fields including gender studies, innovation studies, sociology, law, and information and communications technology for development (ICT4D), drawing on literature that critiques ICT4D researchers and practitioners from a gender perspective. We identify the ways in which AI shapes gender relationships, and vice versa, based on examples in the literature as well as on examples of AI applications reported from a few countries in the Global South. In cases where real-world examples do not yet exist, our arguments focus on preventing the potentially negative impacts of biased AI applications. There is a responsibility to ensure that, at a minimum, AI does not exacerbate existing gender inequalities.

We therefore propose steps that industry, civil society, and policy-makers can take to achieve this goal.
In the next section we discuss what we mean by AI and gender and how patriarchy mediates the relationship between the two. We then review possible impacts, by first reviewing the potential for AI to reduce gender inequalities, and then addressing the ways in which it might exacerbate such inequalities. Finally, we conclude with policy and other recommendations.

KEY CONCEPTS – HOW DO GENDER AND AI INTERSECT?

Like most social science researchers on this topic, we take a broad view of AI. Nilsson (2009) posits that AI is about making machines intelligent — or designing them to have the ability to develop the right decisions in a given environment, with foresight. As Stone et al. (2016) note, there is a broad spectrum of systems, differentiated by scale, speed, and degree of autonomy. Another way to classify AI is in terms of the scope of the tasks undertaken, including machine learning and deep learning (Figure 12.1).

AI is not simply a novel technology with interesting applications. It can be defined as an emerging technology, particularly as a field in the Global South. Emerging technologies embody a process that updates existing techniques, tools, professions, organisational structures, and industries with new capabilities and rearranges them in new ways. Crucially, however, these technologies co-evolve with existing inequalities (Cozzenz & Thakur, 2014). In fact, some inequalities are sustained over time and even worsen — such as the gender wage gap (WEF, 2018) — as reinforcing an entrenched form of power.

In this chapter, we view gender as a range of characteristics defined by society to differentiate men from women⁸¹. Based on this gender differentiation, a patriarchal system creates and maintains social and economic structures that reserve most power to men in society, institutionalising gender inequality. As emerging technologies, such as AI, evolve, we argue that they will replicate existing patterns of bias and discrimination against women, unless intentionally directed otherwise.

Many people assume that technology has no clear link to gender, and that the application of technologies such as AI will therefore be gender-neutral. Far from being neutral, however, AI-based applications are gendered from the context of their creation. One example is the almost universal use of female voices, by default, for such AI-powered digital assistants as Google Assistant, Apple’s Siri, and Microsoft’s Cortana (Adrienne, 2016). The few existing examples in the Global South are also feminised: in Lagos, Nigeria, lara.ng⁸² provides public transportation information using a chatbot with a female identity; and when Micromax in India launched the mobile voice assistant ASHA in 2012, it also had a female identity. (We note the explicit sexual reference in the TV ad: a man in a swimming pool tells a bikini-clad AISHA, “I can sleep with you, but I can’t marry you.” To which she responds, “that’s OK, I can find you a girl in the matrimonial”).⁸³ A range of less obvious, but more consequential, gender implications is discussed in the following sections.

The discourse around AI is also shaped by gender. For example, in Western countries, much of the male-dominated focus around the impact of AI is on job losses (Crawford, 2016). In some African countries it is often about how to improve socio-economic outcomes for marginalised groups (including women) it will focus on issues of bias and discrimination (Buolamwini & Gebru, 2018). This chapter examines how emerging technological applications of AI can serve to reinforce gender inequality, and what measures are needed to mitigate these trends.

THE PROMISES AND POTENTIAL FOR AI AND GENDER EQUALITY

One area of concern is the gender imbalance in technology fields such as AI, where men dominate in both the Global North (EU, 2018) and Global South (WEF, 2018; Brandusescu et al., 2017). Some developers believe that AI can improve some forms of human decision-making by, for example, discrimination against women that perpetuates gender gaps in the workplace. For example, Google has used AI to identify reasons for higher female staff turnover in its workforce (Bohnet, 2016, p. 105). Other developers focus on reducing discrimination in the recruitment process, including in technology firms (Shah, 2016). These tools examine the wording of job postings and use internal staff surveys to identify prejudices against women. Other machine learning tools examine salary comparisons between men and women, as well as perceived differences in workplace opportunities, to highlight gender gaps (Captain, 2015).

Some have expressed optimism about these applications of AI (for example, Singh, 2017). But technological solutions by themselves cannot resolve issues that reflect an underlying power dynamic of gender inequality. This caveat is often repeated (but not always heeded) in the field of information and communications technology for development (ICT4D). Hafkin and Huyer (2006) argue that, in relation to ICT4D and gender, the focus should be on ways to improve women’s lives with the aid of technology; we cannot assume that technology is a necessary or effective means to achieve this end. Most simply, to what extent can technology support women’s self-determination and agency (Web Foundation, 2015)?

It is especially important to examine patterns in ICT4D, as a related discipline, because of the potential applications of AI in the Global South. Within a few years, we expect that ICT4D researchers and practitioners will routinely focus on AI in their work (in the form of AI for Development, or AI4D). In Africa, much of the focus is already on solutions to address local and national development challenges, such as improving health outcomes, public transportation, agricultural productivity, and access to financial services (Brandusescu et al., 2017). In the Global South more generally, potential developmental impacts of AI include creating new business opportunities for small and medium enterprises, preventing disease, deploying emergency services more efficiently, reducing illegal wildlife poaching, and improving mechanisms for public consultation and decision-making (IDRC, 2018; Web Foundation, 2017a).

As Buskens and Webb (2009) note, these uses of technologies can help individual women transform their situations, but they do not address social systems of inequity. Truly comprehensive AI-based interventions, that aim to solve development challenges while improving outcomes for women more broadly, must begin by considering the inherent gender inequalities that underpin the social and political context in which these technologies will be used. A starting point for this mission is to understand how AI, if it is not strategically deployed, can in fact exacerbate existing gender inequalities.
One of the major challenges is the low level of women’s participation in the field of AI. The resulting lack of diversity in design can produce AI applications that (a) fail to meet the needs of all, and (b) magnify existing inequalities, through uneven access and use of the application. For countries in the Global South this means not only that local AI applications are mainly designed and produced by men (Brandusescu et al., 2017; Web Foundation, 2017a), but also that — even the global dominance of U.S.-based technology companies — the imported AI applications (from firms such as Google) are most likely produced by “affluent white men” (Crawford, 2016).

One of the consequences of this exclusion of women is various forms of discrimination (Buolamwini & GB, 2018). The fact that, in almost all the cases described below, these forms of discrimination are not overt further complicates the discussion.

It is useful to distinguish between overt and implicit discrimination. In some countries, overt and legally sanctioned discrimination against women does exist. For example, a World Bank study that examined 189 countries found that in some cases it was harder for a woman to legally apply for a passport than a man, and 104 countries had restrictions on the kinds of a woman to legally apply for a passport than a man, and 104 countries had restrictions on the kinds of

In a review of different kinds of facial recognition algorithms, Buolamwini and Gebru (2018) found that those algorithms were more likely to accurately identify “lighter-skinned” people, especially men, and were much less likely to identify “darker-skinned” persons, particularly women. They argue that part of the problem is the lack of demographic diversity and representation in the many of the datasets used to train these algorithms86. Discrimination in this case, though unintended, may be a reflection of datasets that lack representation of certain groups of people.

Disconcertingly, as Lohr (2018) notes, these kinds of facial recognition systems are already being used in multiple sectors across several countries. This points to the challenges that people in the Global South (particularly women) will face, as new datasets are collated — still encoding these existing inequalities. For example, men are much more likely to use the internet in these countries (ITU, 2017; Web Foundation, 2015); therefore, collating photos using online exercises may offer far greater representation of men.

**IMPLICIT SOURCES OF DISCRIMINATION: ECONOMIC CONTEXTS**

A second source of discrimination is the economic environment in which the AI application is meant to operate, even where no explicit rules underly the discriminatory treatment of women. In one study, experiments were conducted using the Times of India website to identify differences in how Google ads were presented to users. The authors found that women users were less likely than men to see advertisements for high-paying jobs, for no discernible reason (Datta, Tschantz, & Datta, 2015). In a related study, Lambrecht and Tucker (2018) found that algorithms designed to show online ads to both men and women (in over 191 countries) ended up showing the ads to more men than women, even though women were in fact more likely than men to click on

The advertisements. The underlying problem was not algorithmic discrimination. Instead, it was a business model that, ironically, placed a premium on targeting women (in particular), as a result, it was less expensive and more economical to show the ad to men.

In many companies, the companies deploying AI applications operate in a non-competitive context, and in some cases amount to a near-monopoly. In such contexts, algorithms increasingly act as gatekeepers of knowledge, essentially determining what kinds of information and news people receive (Tufekci, 2015). Survey data from six African countries found that on average 86% of those who use the internet regularly (at least a few times per month) also regularly use social media as a source of news87. With few choices for the consumer, these monopolistic platforms and their algorithms can have a significant impact on sources of information for many people, and may have significant implications for gender equality. Whether or not these gatekeeper algorithms intentionally diffuse discriminatory content against women (although this happens), the lack of gender awareness or gender-neutral content can propagate distortions, replicating patriarchal norms and undermining women’s agency.

**IMPLICIT SOURCES OF DISCRIMINATION: SOCIAL NORMS AND LANGUAGE**

Preserving social norms and language usage tend to replicate the pre-existing biases that humans invest in their language. Feminists have long argued that language is a means by which women’s inferior position is enforced (Adam, 2006). AI systems typically require a “neutral” language, but language is often gendered, when this is not made clear in our interaction with the chatbot. For example, when the chatbot asks, “How long have you been working in this area?” the chatbot is asking for information about work experience, but the chatbot does not specify what it means by “working” — does it mean working in the sense of a job or working in the sense of doing housework? This kind of ambiguity can lead to discriminatory outcomes.

While that may be the result of a flawed dataset (i.e., the gender bias embedded in written texts), machine learning systems may also learn to use discriminatory language when interacting with users on-line. Microsoft’s short-lived AI chatbot, Tay, after a few hours of interaction with users on Twitter started to tweet racist comments and engage in harassment of users (Neff & Nagy, 2016). Like many other AI entities, Tay was given the personality of a young woman.)

Policies for AI need to recognise that no technology, including AI, is gender-neutral (Al-Aziz & Al-Aziz, 2017; Niss et al., 1997; Wajcman, 1991). Developing gender-responsive AI

**EXPLICIT SOURCES OF DISCRIMINATION: RIGHTS**

AI applications can have impacts on women’s rights and liberties. Online (and offline) gender-based violence is a problem for women globally (Gurumurthy & Meenan, 2009; Web Foundation, 201588). A related problem is the use of increasingly accessible machine-learning tools to create realistic, computer-generated pornographic media that uses images of identifiable women without their consent. This practice initially gained notoriety in the U.S., and there are also cases of such videos in India (Sharma, 2018). The increased demand for AI-based solutions drives the need to build bigger and more comprehensive data sets. Ominously, the effect of collecting this data from a range of disparate sources is to solidify existing patterns of control; women and other groups who lack the privilege or means to opt out are the focus of that control (Shephard, 2016). While many countries need better data protection frameworks, the problem is more acute in the Global South (Web Foundation, 2017b). As a result of the increased demand, most recently from AI developers, harvesting personal data has become more and more lucrative; an increasing number of (unregulated) data brokers compile and sell data profiles of individuals to various organisations (O’Neill, 2017). Such data can be used to target women’s groups or individual women, as well as marginalised groups, without their consent.

In addition, there is the potential for accessing these user profiles for political or sexual harassment or other kinds of online abuse.

Privacy is relevant also in the use of an AI application, as in the case of AI chatbots. One example that is further researched, is SophieBot87, developed by, and primarily targeted at, Kenyans. This is a free AI chatbot that works on several messaging platforms and provides information on sexual and reproductive health. It is important to assess the extent to which it harvests and utilises user data, an aspect that was not

**RECOMMENDATIONS**

The challenges examined here are immense, but strategic interventions by both policy-makers and AI researchers can make a difference. We present five key recommendations.

**Policy formulation.** Policies for AI need to recognise that no technology, including AI, is gender-neutral (Al-Aziz & Al-Aziz, 2017; Niss et al., 1997; Wajcman, 1991). Developing gender-responsive AI

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84. See also “AI’s Not A Woman?!” https://www.youtube.com/watch?v=Quo5NWr8V8B Accessed July 2018.


86. A related


88. Also see https://www.opendatafund.org/ Accessed March 2018.
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Online and offline. Having clear and understandable privacy protection can be critical for women's safety, particularly through the design process. Participatory design requires the inclusion of research networks in the Global South and the AI scientific community in a particular country should (Hajian, Bonchi, & Castillo, 2016). The members of the AI scientific community in a particular country should collaborate on developing such an approach (and by building on research networks in the Global South and elsewhere). Participatory design requires the inclusion of diverse groups (including diverse groups of women) throughout the design process.

Address direct potential harm from AI. Data and privacy protection can be critical for women's safety, online and offline. Having clear and understandable terms of service and privacy policy is important for all services, including AI-based applications. These safeguards will also require adequate data protection laws, which are currently lacking in many countries in the Global South. In addition, in most of those countries, much of the personal data comes through mobile internet. Government through telecommunication and communications regulators should work with mobile network operators to promote transparency in data collection and ensure they adhere to privacy protection rules. Another way of reducing potential harm is improving the quality of training datasets. Where possible, using open data—freely accessible and shareable data, in a machine-readable format (such as a CSV file) (Brandsevuc et al., 2017). Transparent reporting is needed on how the training data was created, and the methods of aggregation and classification used (Campolo et al., 2017).

Grievance redress mechanism. The typical route for recourse in situations of harm is via the courts. As in the examples mentioned above, there are several possible scenarios where a woman may want to bring legal action against a party because of gender-based discrimination. However, most legal systems require evidence of intent to discriminate, in order to rule against the discriminating party, and as we already noted, many of the effects of AI-based discrimination are unintentional (Barocas & Selbst, 2016). Recognising the limitations of their legal systems in providing recourse for these types of discrimination, governments will have to develop alternatives for women and others in those situations. This can include for example, mandatory bias audits for consequential decision-making algorithms.

While recognising the impact that AI is already having globally, and more specifically in the Global South, we have put forward recommendations in five key areas. Much of this impact can be negative, as our examples illustrate. However, problems linked to gender inequalities may be overlooked in societies where dominant narratives focus on those in power, namely men. Policy-makers and researchers everywhere must recognise, and be prepared to articulate, that no country can achieve its national development goals as long as gender inequality persists.

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CONCLUSIONS

Emerging technologies such as AI will co-evolve with existing inequalities, particularly for countries in the Global South. How might AI improve or worsen gender equality? Most of the evidence suggests that AI applications are indirectly or directly exacerbating existing gender inequalities. Even where there is no harm or discrimination created by the application itself, its interaction with the wider environment leads to disproportionately negative impacts on women.

This points to the importance of acting now, for policy-makers, practitioners, and researchers. A starting point is to discard the notion that AI is gender-neutral, and rather to acknowledge and incorporate analysis on gender throughout the AI policy process. Research is necessary to build an evidence base on the relation between the diffusion of AI and gender and other inequalities. The various examples highlighted throughout the chapter point to a broad range of research needs, both for those working in the field of AI and those studying its impacts.

Taking Stock: Data and Evidence on Gender Digital Equality PART TWO

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