digital icons
Studies in Russian, Eurasian and Central European New Media

Gender Digital Divide in Latin America: Looking for a Helping Hand in the BRICS

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Abstract: ICT has traditionally been a hostile territory for women. In information societies, this implies a drastic reduction in opportunities and autonomy for women. In emergent economies, the situation is even worse due to women's subordinate status in society and little research regarding the intersection between gender and the digital divide. Such is the case in Latin America. In light of this, the purpose of this essay is to introduce a first comprehensive review of the few studies made in Latin America, against the background of the history of women's digital exclusion. Based on a review of literature, we identify the main causes for women's digital exclusion in the region and talk about the prospects for development of gender policies in the BRICS countries (Brazil, Russia, India, China and South Africa). We conclude that what this group of countries may achieve in regard to gender equality, will mark the future of the world. The aim of this essay is to make a call for the creation of international research networks and propose the BRICS as host for these efforts, as they combine characteristics that will make them leaders of change in vast regions.

Keywords: Gender digital divide, Latin America, Brazil, ICT, information society, BRICS

During the second half of the 20th century, gender studies and feminist theory unveiled gender-based exclusive structures and practices that were naturalized to the point of not being perceived. The capacity to perceive and discuss these problems has given people a chance to rethink existing social relations. However, these discussions did not imply an immediate change in the situation of women but marked the beginning of struggle against different forces that oppose change. Science and technology (S&T) remain a bastion of gender exclusion until today, as it will be shown in the next pages. The presence of women in the upper rungs of hierarchy has been recognized only recently and it is still far from satisfac-

tory. Computer science, and the information and communication technology field (ICT) share this problem.[1]

In the worldwide information society, where IT capabilities are central, countries with an advanced IT industry have engaged in research efforts to identify and understand how gender operates in the field of ICT, and how this field has been building a gender-based divide, known as the 'gender digital divide'. Many developing countries, for example, Latin American countries, do not perceive this as a priority; research initiatives in the area are minimal, existing research is poorly cited and the results as a whole still remain disarticulated (Berrío Zapata et al. 2017; Berrío-Zapata & Gonçalves Sant'Ana 2017; ONU et al. 2014). On the other hand, countries like BRICS (Brazil, Russia, India, China and South Africa), with advanced technological developments in certain areas, like aeronautics and energy (Brazil, Russia), health and biotechnology (India) and ICT (China) (Breschi & Tarasconi 2013), seem to maintain a patriarchal model in terms of women and technology. Patriarchal societies like these tend to perceive feminist claims as a subversive act or a risky enterprise rather than an opportunity for increasing social equality (Chatterjee 2016). Despite their economic growth, BRICS still have a long way to go in regard to gender equality. Nevertheless, just as Brazil may play a leading role in Latin America in increasing gender equality in the field of ICT, its counterparts from BRICS have a similar potential in Asia, Africa and the post-Socialist space.

In this manifesto, we advocate for a change in attitudes towards women and ICT in the BRICS and building collaborative networks to assess gender exclusion in technology. This essay is a 'call for action' targeting the academic communities in the BRICS to join efforts in initiating multinational research on the gender divide in information technology. Our work at Brazilian and Colombian universities has shown us how difficult it is to build a clear consciousness about these problems, but it has also shown that research and dialogue help reconceptualise our personal experiences so that we become aware of the extent to which we reproduce exclusive and hierarchical structures based on a patriarchal understanding of gender relations. Education, research and dialog have opened our minds to the gender digital divide and here we are, ready to put our efforts into making gender exclusion in information technology the centre of critical assessment and deconstruction.

To make our case, we will give a brief historical overview of gender exclusion in computing and technology and review some theoretical explanations of this phenomenon. Then we will move on to discuss the situation in Latin America, including Brazil, based on the case studies available. In the final section of this essay, we discuss gender and technology in BRICS and consider how these countries, relying on their uprising economies, could support each other in increasing technological inclusion of women. We propose international research networks within the BRICS countries as a way to learn from each other's experiences of technological gender exclusion.

[1] In this essay, we will refer to information and communication technologies (ICT) as the combination of computing and telecommunication industries, while information technology (IT) will refer specifically to computing.

A brief historical overview of women and computing

Following the industrial revolution, a massive automation of human intellectual activity began in the 17th century. This occurred by the means of mechanical computing machines like the Pascaline, that evolved to programmable mechanical devices such as Charles Babbage's analytical engine. Such adaptability extended the applicability of computing machines to almost all human activity, transforming this technology into a social epistemology: a way of looking at all social practices, as stated by Babbage in his book On the Economy of Machinery and Manufactures (1835). This scientific and technological revolution, however, represented little advantage for women and demanded great sacrifices from pioneering female scientists who often found their roles reduced to secondary ranks, their work discredited, and their accomplishments omitted from the official historical records of technology and computing.

Augusta Ada King, Countess of Lovelace, better known as Lady Ada Lovelace, was one of these female pioneers of computer science. She worked as Babbage's collaborator in programming as her noble origin had allowed her a scientific and mathematical education. This, combined with her skills and passion for science, enabled her to break the stereotype of the Victorian woman: she was co-developer of the analytical engine's computer program, which makes her the first programmer in history. However, she could not openly publish her work and her contributions were withdrawn from scholarly journals of the time as she was a woman. Her importance for the development of computing was acknowledged only a century later (Green 2002). Grace Hopper shared the same fate as the programmer of the first electromechanical computer built by IBM, the Harvard Mark I, in 1944 (Isaacson 2014). Similar discrimination was applied to the ENIAC programming team in 1946 (Kleiman 2013), to Joan Clarke, Alan Turing's collaborator in 1949 (Jackson et al. 2017) and Angela Ruíz Robles, inventor of the mechanical book in 1962 (Min Economia & Min Educación 2013).[2]

These cases are just a glimpse of the hardships that female information scientists and technicians dealt with, but they convey the persisting idea that women and informatics are incompatible. With the development of IT industries, the conflicting relation of women with information technology transformed from public disqualification and oblivion to more diverse and subtle forms of exclusion. Even today, one can witness a tendency to discredit women's achievements and undermine their attainment of directorial positions within the IT industries. Although the number of women studying and working in computing has substantially increased, men continue to monopolize positions of leadership and power. Academia reproduces this tendency only recently, as women have received visible recognitions for their contributions to computer science. Xiaoyuan Tu became the first woman to win the doctoral thesis award from the Association for Computing Machinery (ACM) in 1996 and the only three women to win the Turing Award are Frances Elizabeth Allen in 2006, Barbara Liskov in 2008 and Shafrira Goldwasser in 2012 (ACM 2017). However, the impact of these achievements remains low as computing is still considered a male domain. Keeping girls

[2] The Obama administration in the United States created a website to honour the contribution of female scientist. The list of names presented on the website includes Lillian Gilbreth (industrial engineer), Edith Clarke (electrical engineer), Ellen Ochoa (engineering, space exploration), the 'Calutron Girls' (isolation of enriched uranium), Grace Murray Hopper (computing, creation of COBOL), Katherine Johnson (mathematician, space travelling), Maria Klawe (computer education) and the 'First Lady Astronaut Trainees' (FLAT's) (Obama-White-House 2018).

away from science and technology (S&T) activities in education and limiting women's professional development has significantly contributed to the creation of the gender digital divide. Such circumstances have left women in the position of 'late and lagged users' of IT (Carveth & Kretchmer 2002b; Rogers 2003).

Gender-based technological differences in various sectors of society became evident after the 1970s. Videogames and personal computers contributed to gender digital divide among new generations. Boys were attracted to computer science through videogames, which are often based on a masculine ethos and aesthetics that reproduce gender stereotypes (Clark & Gorski 2002). Computers were socially defined as 'boys toys' (Cooper 2006; Cooper & Weaver 2003). When these technologies were applied as pedagogical tools in the classroom, stereotypes spread to basic IT application in education, increasing girls' discomfort with ICT. Nevertheless, in the 21st century ICT products are widely used by female consumers. However, in terms of gender equality in technology this presents a false image of inclusion. Increased use of ICT does not mean a deeper appropriation of technology by women, or increased influence over this industry and its knowledge (Jackson et al. 2004; Jackson et al. 2001). Although women's participation in computing has grown, their number in the upper rungs of the sector's hierarchy has decreased during the past two decades (Mitchell 1986; ONU et al. 2014). Moreover, women's technological socialization in the family, at school and the university as well as at work, keeps reinforcing the gender digital divide.

Women's relationship to technology carries a heavy burden: erased from the history of IT and driven away from an enriched technological socialization. These burdens are especially heavy for women from deprived backgrounds and racial minorities. And yet, the most efficient barrier is the construction of disinterest, superficiality and lack of self-confidence in regard to IT. New technological waves, such as the democratization of mobile phones, shake the assimilation of ICT for new generations of girls, but at the same time, they absorb the patriarchal legacy of the computer industry (Cotten et al. 2009; Jackson et al. 2001). Ultimately, the fundamental cause for the persistence of the gender divide in IT is the belief in technology's 'neutrality'. This idea prevents computer scientists from seriously considering a research agenda regarding gender markers within IT, creating a disconnection between gender studies and computer science (Kirk & Zander 2002).

Gender-related conflict and domination permeate every social interaction imprinting inequalities into them and the same applies to technology. It is necessary to deconstruct the idealization of IT to understand it as an arena of conflict, which reproduces and extends the patriarchal contexts, in which they originated. Women face a segregation system where different types of exclusion overlap, affecting different facets of their life. This system of exclusion is reproduced and recycled by technology, its appropriation and its social application (Kennedy et al. 2003).

The gender divide in information technology

The ways digital divides are perceived as socio-technical phenomena change over time (Jackson et al. 2003). Digital exclusion involves a constant process of creation and destruction of gaps between social groups, with respect to their differing degree of assimilation of new

technologies (Liff et al. 2004). At the same time, it is important to consider that access to technology constitutes a different sphere of social exclusion from mastering new technologies, acquiring skills needed in ICT professions and entering the 'communities of practice' or professional groups where social recognition can be attained (Hargittai 2002; Warschauer 2002, 2004).

In general, people can be classified according to their attitude towards new technology, their ability to process the risks of innovation and their absorption level of new paradigms.[3] The early adopters are usually composed of elites, aggressive supporters and developers of technological innovation, i.e. technicians, specialists and leaders with high educational and economic standing. Then comes the 'middle tier' technological adopters, which consists of the majority of new users, of those more cautious, acting upon uprising fashion or popular novelty as technological waves involve their social networks. This tier also includes a 'late majority', with a weaker economic and educational profile, and some reluctance to technological change. Then we have the 'bottom group', the majority of the population, that are delayed in their adoption of new technologies, have limited skills to use them, and who in general hold traditionalist views and resistance to novelties (Castaño Collado 2008a; Rogers 2001, 2003). In general, women are a disadvantaged collective in all three groups (Castaño Collado 2011; Jackson et al. 2003; Kennedy et al. 2003). In the group of early adopters—the technological elites—the lack of women at professional spheres throughout the history of computing has resulted in scarcity of feminine iconic figures. We do not have female 'Bill Gates' or 'Steve Jobs' to inspire today's girls.[4]

The bottom group encompasses the majority of the world's population and it deals with severe problems of digital exclusion. 'Development gaps' within countries involve a juxtaposition of economic constraints and infrastructure-based limitations typical of the ecosystems of poverty. Usually, these sociocultural systems offer little support for women's technological empowerment (Gilbert et al. 2008). Moreover, those policy projects that are designed to address the gender digital divide often provide insufficient or recycled infrastructure while ignoring systemic, non-technology-related limitations of people (e.g. religion, culture or the context of extractive economies), obscuring them under 'quantitative improvements in access' (Menou 2001; Luyt 2004). Given the precarious status of women in this group, small changes in access to technology-related skills and knowledge bring about noticeable effects. However, women are often unable to use their newly acquired IT skills due to the restrictions of patriarchal gender system in their communities.

The social environment, in which new technological competencies are acquired, will determine shared perceptions of what is useful or inappropriate for women. This plays a crucial role in women's detachment from any IT-related life projects and their exclusion from the

[3] According to the diffusion theory of innovations, an estimated 3 percent minority will adapt new technologies in the first stages (Carveth & Kretchmer, 2002b, 2002a; Rogers 2003). If the technology succeeds, diffusion turns viral and becomes the standard for social routines.

[4] Middle class at industrialized and semi-industrialized countries would correspond to the middle tier group; they showed a promising increase in women's participation within IT education and industry, but still insufficient in number or hierarchy to challenge the patriarchy (Enoch & Soker 2006). A meta-study by Gil Juárez shows fourteen case studies indicating that although the number of women at the university is increasing, they remain a minority in technological fields. In some countries such as China, the United States, Germany, the United Kingdom, Spain, Italy and Ireland, the informatics field is diminishing in enrolments (Adriana, Vitores, Feliu, & Montse, 2011; Gil Juárez, Vitores González & Feliu i Samuel-Lajeunesse 2012).

'communities of practice'. An excluding scenario for women is typical of extractive economies and non-industrial or religious communities, i.e. communities whose primary system of production is not compatible with the informatization of societies (Berrío-Zapata & Rojas 2014). This means that in the age of information and global networks, technological skills and digital literacy, that are critical to accessing knowledge and economic opportunities, are barred for most women in developing countries and impoverish areas of developed nations (Castaño Collado 2008b; Edet et al. 2007; Hill & Dhanda 2004). Contemporary societies have created info-rich and info-poor castes, leaving women in the latter as the result of a 'juncture of multiple social inequalities' (Sebastian & Ayuso García 2011). Changing this situation requires that women gain 'technical capital' at the same rate in which they increase their social capital.[5] Indeed, social factors have proven to have a greater influence on women's technological empowerment than economic factors (Korupp & Szydlik 2005).

Tendencies and mechanics of gender digital divide

Existing scholarship on the use of IT technology shows some fundamental gender differences. Women tend to use the internet as a communication tool and suffer more anxiety over IT use, while men focus on information seeking, the use of applications and online entertainment services. For example, L.A. Jackson et al. reported this observation in two different studies with more than one thousand informants (Jackson et al. 2008, 2001). Tracy Kennedy and collaborators found evidence for similar results using the National Geographic Survey from years 2000 and 2002, in a sample of 34,839 Americans and 4,372 Canadians (Kennedy et al. 2003). These studies show that men are more extensive users of internet than women. Alternately, women are more concerned of internet safety, which means that they feel less secure in this communication environment and are more into e-mails and other forms of electronic communication such as text messaging. EUROSTAT 2008 Community survey on ICT in 31 countries, showed a similar tendency. It found clear differences in the types of applications preferred by women and men. Men tend to use economy-related and game applications while women focus on social activities or networking applications (Castaño Collado et al. 2011).

Gender biases in the use of IT exist but are not fixed or 'natural' to all male and female; they are a statistical tendency. These results fit with the traditional representation of women being communicators and networkers in the family, while men are 'explorers' of new technologies. In any case, these surveys show that gender is also performed when people produce and use technology; gender relations shape technology, and technology shapes gender relations. Thus, technology can be understood as phenomenon of culture (MacKenzie & Wajcman 1985; Wajcman 1996, 2009). Gender tendencies in IT use reflect certain abilities or interest from men and women, but they do not limit or constitute a 'gendered natural order' in technology. Information technology as a culture has attained its masculine expression as the result of centuries of patriarchal conceptualization of machines.

New technologies and new generations reconfigure gender tendencies in technology, although, they build their understanding on a gendered legacy. For example, the use of smart-

[5] 'Technical capital' means the ability to explore and master the ways of applying technology and its associated knowledge resources.

phones shows no gender differences in text messaging, but gender tendencies persist in specific uses like playing games, listening to music and sharing pictures, where boys are more active than girls (Cotten et al. 2009). However, research still does not discuss to what extent gender is perceived as a 'biological' or 'cultural' force in regard to IT use. What is clear, however, is that user's interaction with IT reproduces the gendered ideas of men's technological domination. In the digital age, the societal roles and constraints that affect women in the physical world are brought to the virtual world (Castaño Collado 2008b; Castaño Collado et al. 2011).

The lack of technological empowerment among women turns into technological low self-esteem, disbelief in one's capabilities and inhibitions to show one's skills. In general, women tend to underestimate their skilful use of internet, as there is no collective belief that would endorse their technological capacities (Cheong 2007). This lack of support for women in IT culture increases the chance for female users to perceive computers as anxiety-generating objects rather than tools for amusement or entertainment.[6] Thus, the marginalization of women in IT culture can become a self-fulfilling prophecy, as low self-confidence regarding the use of IT produces weak performances, reinforcing the idea that IT 'is not for women'. To a certain extent, women's cultural role in IT follows the logic of the 'Pygmalion Effect'. This means that certain beliefs and stereotypes of parents, educators and friends reproduce the adverse conditions for young girls to become skilful in IT, thus perpetuating the stereotype of women's weak performance (Cooper 2006; Cooper & Weaver 2003).

A final difficulty is reconciling family and work responsibilities. Telework was supposed to be an opportunity for men and women to harmonize work and family, nevertheless, family responsibilities remain a feminine domain, so women cannot take advantage of this possibility. The job market continues to be gender biased, feminizing generic professions that are abundant, but offer low wages and few opportunities for promotions, while specialized jobs are kept mostly for men. Low salaries, low IT literacy and multiple family tasks keep women out of the cyberculture and the cyberspace (Castaño Collado 2008b, 2008b; Castaño Collado et al. 2008).

Gender digital exclusion in Latin America

How does this situation manifest in Latin America? At the Fourth World Conference on Women in Beijing in 1995, the UN addressed ICT as a crucial sector where equality, democracy and social justice needed to be improved. It was considered critical to stimulate women's technological education and participation in labour markets, increasing their contribution to content production and development. To encourage women to take a more visible role in ICT (as 'beneficiaries' and 'protagonists'), increasing scientific and technological literacy were deemed fundamental. Twenty years later, the Beijing +20 report for Latin America (ONU et al. 2014) found that policies to stimulate women's appropriation and effective use of ICT were not taken as a priority in the region. Women are a minority in scientific and

[6] This condition feeds a destructive dynamic in girls' attribution patterns, that is, the way in which they explain their own success or failure. IT success in men is attributed to skill and failure to bad luck. In the case of women, success is associated with luck or great effort, whereas failure is predictable due to 'female nature'. Men's pattern is self-protective, while women's is self-destructive (Cooper 2006; Cooper & Weaver 2003).

technological education, and the few women trained in IT-related study programmes do not have the same opportunities or remuneration as men have in the labour market. The plans for women's digital inclusion were merely good intentions (CEPAL & ONU 2015). A Peruvian NGO, Laboratoria, summarises the situation as follows:

> Thirty million youth in Latin America are NEETs (Not in Education, Employment or Training) and 76 percent of them are women; less than 20 percent of women finish their studies and get formal jobs; 50 percent of businesses are unable to find sufficient skilled workers, so for 2019 the estimate is to have more than 450,000 unfilled tech jobs in the region, in an industry where women are minority (Laboratoria 2018).

In Argentina, Juan Carlos Tedesco, the Minister of Education during the mandate of President Kristina Fernández de Kirchner, published an extensive analysis of technological education in Latin America, concluding that the incorporation of IT in education did not create a framework for reducing existing inequalities in the region. Equality is not an inherent feature of technologies, but the result of the intentions of policy makers, IT providers and users. Existing social inequities are reflected on ICT, unless technology and education are developed as a social exercise for inclusion, fair distribution of wealth and political participation. The challenge is to build a critical metacognition of how and what to learn (Tedesco 2014).

A study conducted at the Catholic University of Peru, confirmed that early technological socialization and closeness to S&T is critical for girls in order to build an interest in ICT (Navia 2008). The researchers found that although gender equality is advocated in Peruvian society, there is an institutional 'hidden curriculum' that systematically hinders women's professional development in the technology field, related to persisting gender roles and stereotypes. In this context, studying S&T becomes an act of resistance against what women 'should do' in society. Girls develop survival strategies to overcome the sexist environment —some assume a rebellious attitude, while the majority of women ignores the pressure and accept to be 'protected' by the males. As the result, studying engineering becomes extremely hard and involves fears of losing one's femininity.

In Venezuela, a study conducted at the Puerto Cabello University Institute of Technology (Urbina Gutiérrez 2017) reported total absence of any research agenda focusing on IT and gender. The study, that aimed to analyse the influence of gender stereotypes in the professional training of engineering students, showed that bursaries and scholarships were granted in favour of men. Female students were in minority and had high dropout rates. Most teachers were men and there was no gender policy in regard to employment within the institute. Female students participating in the study reported the existence of a strong gender bias, not from their male mates, but from the institution itself. Despite the confidence in their abilities, female students fear to be too 'emotional, delicate and fragile' to work in the industrial plant environment.

In Mexico, a case study of the labour market in the state of Tamaulipas shows that the number of women working in engineering was the smallest in the group of ten occupations investigated (Guzmán Acuña 2013). Although the number of women in university education is increasing, gender segregation continues to be a problem in the IT professional field in Mexico. Women are relegated to less valued jobs and their careers are constrained. The average wage of a female IT professional is only 60 percent of the average wage of male profes-

sionals. A similar study in Chile showed that women are more likely to work in low rank IT positions, such as analyst. Only 9 percent of high rank professionals, such as managers, are women. For similar jobs, men earned in average 16 percent more than women (Colegio de Ingenieros de Chile 2018). Gender egalitarian discourse at universities is confronted by the tolerance to the discriminative situation in the labour market that reproduces the patriarchal regime by giving tacit approval to the status quo.

In Paraguay, the research and development (R&D) cluster produced between the Faculty of Computer Engineering at the National University of Asunción[7] and the Paraguayan National Electric Administration, was assessed in regard to women's participation in its activities (Méndez & Garcia, 2014). Between 2008 and 2014, in all the activities of the cluster, 82 percent of the participants were men. Only 20 percent of the students enrolled in computer-related programmes were women. From that group, one fifth of the young women who graduate in IT, abandoned their careers for family reasons. In Paraguay, having a family while working in IT seems to be a trade-off decision for women. However, 43 percent of the staff working in the research projects of the cluster, not restricted to IT activities only, were women; that was a big success to the Faculty.

The Institute of Computing at the National University of the Republic of Uruguay (UDELAR), conducted a study about the advancement of women in the field (Tomassini Urti & Urqhuart 2011). Again, they found no previous studies focusing on gender and digital exclusion, despite the fact that Uruguay's software industry shows a promising development within the national economy. In this study, the researchers applied the concept of critical mass, which refers to the minimum share of representatives of a certain minority group that ensures that this group can be considered as an integral part of the collective. In this case, critical mass was defined to be 30 percent. The study shows that women's enrolment in computer engineering fell from 40 percent in 1987 to less than 20 percent in 2010, which means that the increase in women studying at the UDELAR did not imply producing a critical mass for computer engineering.[8] Based on these findings, the report addressed the need for further research on the behaviour and expectations of female students, extending the scope of research to cover post-graduation and the labour market, to understand the institutional environment and social milieu that maintains such persistent gender inequality. Two studies conducted in Colombia showed similar alarming results concerning women's involvement in IT (Flores Solano 2016; Gaviria 2006). At the department of Systems Engineering of the National University of Colombia, male students are reported to 'see less women enrolled' than what their real number is (Gaviria, 2006). This is how women become 'invisible' in male dominated spheres. The study also shows that in order to step out of invisibility, women have to double their efforts or use other tactics such as playing the role of a 'girl to be rescued'.

In Brazil, a study conducted by the Federal Technological University of Paraná (Carvalho & Sobreira 2008) reported just 10 percent of enrolment of women in all engineering. Specifically, in systems engineering there was a drop from 47.5 percent in 1995 to 33.8 percent in 2002. In regard to employment, between 1990 and 2000 the number of women decreased by

[7] The National University of Asuncion is a public university. It is the oldest and most traditional university in the country. The university's campus is spread out through different cities in Paraguay. The cluster is located in the city of San Lorenzo, nearby the capital city of Asuncion.

[8] This study also referred to diminishing enrolment at the University of Costa Rica (30.4 percent in 1981 to 16.7 percent in 2007) and the U.S. (37 percent in 1984 to 25 percent in 2004) (Tomassini Urti & Urqhuart 2011).

30 percent in IT-related jobs. The female students interviewed for the study conveyed their feelings of being outsiders within the community and being forced to do unpleasant things in order to meet their men colleagues' social expectations. Male students, in turn, reported a so-called situation of 'seduction' that would complicate professional partnership between male and female students, and make it more difficult than partnerships between men.[9]

As demonstrated by this overview, stimulating women's equality in ICT, as stated by the UN and ECLAC, has not been a priority Latin America. Declarations of gender equality do not go beyond good intentions and cosmetic actions. Institutionalized patriarchy reigns within public institutions and the government, the private sector, and the educations system, fostering a gender equality discourse while tolerating systematic gender discrimination. Laws against segregation and unequal treatment do exist, but in the case of gender discrimination, the laws are not sufficiently applied. States and institutions must take measures to enforce the law.

The situation worsened with the economic restrictions that the Third World countries face. Women's participation in engineering is diminishing, and yet, Latin America has a serious lack of human capital in this field. Sexist myths about incompatibility between femininity and engineering pollute young girls' minds. Tension between home care and professional duties is presented as a false dichotomy that forces women with computing engineering degrees to abandon their professional careers. To complete, we lack a systematic assessment of this problem, which would be needed to understand its real proportion and identify its mechanisms of action.

Conclusion: Calling the BRICS for collaboration

Latin America is not the only territory suffering from gender digital divide. Across the globe, women are systematically underrepresented in ICT jobs, top management and the academy, as well as in science, technology and engineering. Women's participation is concentrated in the areas of the IT value-chain that are feasible to extensive automation in which women face the risk of being massively released from their jobs. Yet, women do not have an extensive presence in software development (OECD & UN 2018; WBG 2016). Nevertheless, change is possible, and ICT can be part of the solution: it can be used as 'social technology', a technology enabling the interaction and cohesion of excluded social groups in an attempt to find new forms of communication and cooperation (Sproull & Faraj 1997). For women, information is a key to becoming aware of their state of alienation and assembling efforts in search for diverse solutions.

BRICS has proved to be a fruitful association in regard to trade and finance development. However, gender politics has played a minor role in this framework. From all five associates, South Africa secured the most notable improvements in women's digital inclusion during the first decade of the Millennium. From this standpoint, the Prime Minister of South Africa

[9] The number of IT-related positions held by women grew in Brazil in the 1990s (Rapkiewicz, 2012). The transition from the 'mainframe paradigm' to the microcomputer favoured the migration of women, previously working in jobs like punching cards. The gender split within the Brazilian IT workforce is approximately 45 percent women in low-tear jobs like typist or pc operator, and 19 percent in the top-tier. In public administration, differences are less prominent (women's share in the low-tier is 58 percent and the-top tier, 37 percent) as hiring practices are more transparent and controlled than in the private sector.

Bathabile Dlamini urged BRICS in 2014 to focus on women's empowerment and entry into the labour market. This endeavour proved to be extremely important as the Global Gender Gap Report from the World Economic Forum showed that the advances in gender inclusion from previous years were reversing (BRICS Post 2014; Hogg 2016).

On 12 February 2015, the BRICS launched an agenda for cooperation called 'Population Matters 2015–2020' (BRICS 2015). In this document, the BRICS confirmed its commitment to gender equality, women's empowerment, fixing gender gaps in labour, improving women's access to better jobs and improving work-pay equality. Comparing the BRICS countries on the four dimensions of the World Economic Forum Global Gender Gap Report —economic participation and opportunity, educational attainment, health and survival, and political empowerment—we found that the profiles of individual countries are different but complementary. This means that the weaknesses of one state can be counterbalanced by the strengths of the others. For example, Brazil and Russia have top educational performance while in political empowerment they are doing poorly, as India is the opposite. China, in turn, has low performance in health but is stronger in economic participation, Brazil being the opposite case (WEF 2016, 2018). South Africa's advances in gender equality can be taken as a starting point to improve the state of gender digital exclusion in the other associates. The will to cooperate exists and the problems are waiting to be addressed by the academic community of the five countries.

The problems of addressing gender digital exclusion in the BRICS region range from a lack of information, research and monitoring to the lack of theoretical models produced and/or validated in developing countries for analysing the changing reality of information technology and gender. This leads to a situation, in which legislation, public policies, and policy programmes and projects are not supported by academic research and their effects on gender equality are poorly monitored. The World Bank calls this substantiated monitoring 'gender mainstreaming'—a systematic process of integrating the gender perspective into problem-solving, built over solid evidence in respect to the particularities of each community (WBG 2016).

In the following, we list five key aspects of gender digital divide we deem necessary to address through collaborative research networks across the BRICS.

1. Women's problems at work or the university are an extension of their problems at home, in their families or with their friends. Such relations must be studied to understand how this 'domino effect' responds to the new social roles that women are trying to conquer.
2. Occupational gender segregation has to be sufficiently mapped out, as this phenomenon is a combination of multiple factors. These factors include the lack of educational profile for women; gendered perceptions of women as workforce; economical environments with low demand for added value services or fragile development in e-commerce or e-jobs and differences in pay.
3. Early technological socialisation in families and the 'hidden curriculum' in formal education increase gender digital divide. Therefore, it is necessary to identify and isolate the elements in the social ecosystem that induce women's alienation and tolerance in regard to unequal relations (Bishop et al. 2001; Mehra et al. 2002).

This requires a change of social norms about masculinity and femininity, especially in regard to youth education and training in science, technology, engineering and mathematics (STEM) (OECD & UN 2018).

4. Poor women or women in underdeveloped regions have fallen into ecosystems that function like a trap and segregation attacks them from different sides. In order to improve digital inclusion for women who suffer from poverty, several changes have to occur simultaneously: increasing access to ICT, developing data literacy, creating an open community of practitioners where women are accepted, changing women's roles in the community. These are the people and communities that face the greatest need, but they can also have leapfrog advances with increased digital inclusion.
5. The struggle for gender inclusion takes place on the level of representations and discourses. There is still not enough awareness among women of the importance of becoming an organised collective, which is the only way to challenge the patriarchal structures of technological socialization, education and labour (Huyer & Sikoska 2003). We need to study and understand mental representations of femininity in order to deconstruct dominant perceptions of 'natural' gender roles supporting women's inferior status in community.

Enhancing women's agency and voice in information technology requires deeper understanding of heteronormativity and its related social dynamics. Patriarchy has existed for such a long time that it has turned into a comfort zone for both men and women. Interrupting this cycle entails the deconstruction of myths that are foundational for human life. This requires a long and extensive research programme based on joint efforts of academic communities throughout the globe, specializing in different cultures, resources and findings. The academy should supply mentors and evidence that contend with the patriarchal IT discourse in the educational and professional fields.

This work is urgent in developing countries, in which women's dreams and talents for S&T are wasted; half of the population is unable to flourish or make a difference in their own societies. Brazil and other BRICS countries are fast-growing economies that combine characteristics of the first and third world. Together, they represent almost 30 percent of the global GDP and 40 percent of the world's population (Bremmer 2017). Anything that the BRICS undertake seriously will provide a real opportunity for global change. These huge populations, economies and territories play a strategic role in the world and that will grow in the future. However, these countries still have a long way to go improving gender equality.

Let's ask ourselves what would be the global impact if BRICS became seriously engaged in studying, understanding and reducing the gender digital divide? These countries have enough stamina to act as nodes in their regions of influence and help the rest of the world to prevent gender marginalization in technology.

The intention of this manifesto has been to demonstrate the lack of research on gender digital divide in Brazil and Latin America, but also to convince academics across the BRICS countries of the opportunity we have, if we join efforts in building a worldwide dialog that could activate research networks supporting joint projects in favour of gender equality in the science and technology field. Research groups at universities and institutes may join non-

governmental organisations, in an open conversation between academics, activists, practitioners and the government. Policies and priorities could be discussed from an informed position, supported by research and strong theory. We hope that this manifesto will inspire our colleagues especially in the Russian and East European studies field and serve as an invitation to begin working together into understanding and reducing the digital gender divide.

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