#eSkills4Girls: How to integrate digital literacy in national education systems

Documentation
Washington, October 20, 2016

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eSkills 4Girls

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Acronyms

A4AI	Alliance for Affordable Internet
AACTE	American Association of Colleges for Teacher Education
ADB	Asian Development Bank
EU	European Union
FAWE	Forum for African Women Educationalists
FSD Kenya	Financial Sector Deepening Kenya
GEMR	Global Education Monitoring Report
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
ICT	information and communication technology
IEA	International Association for the Evaluation of Educational Achievement
ICT-CFT	ICT Competency Framework for Teachers
ICTeTD	ICT Enhanced Teacher Development
ISP	Internet Service Providers
ITU	International Telecommunication Union
MSET	Ministry of Science, Energy and Technology (Jamaica)
PPP	Public-Private Partnership
SDG	Sustainable Development Goals
STEM	science, technology, engineering and mathematics
TPCK	Technology, Pedagogy and Content Knowledge
USAF	Universal Service and Access Funds
UNGEI	United Nations Girls Education Initiative
UNESCO	United Nations Educational, Scientific and Cultural Organization
USAID	United States Agency for International Development
WITIN	Women in Technology in Nigeria
WEF	World Economic Forum

About the G20 initiative #eSkills4Girls

Under Germany's G20 presidency in 2017, the initiative #eSkills4Girls was launched to improve digital skills and employment perspectives for girls and women in particular in low income and developing countries. As part of the initiative, a report was published which examines the factors that influence the pathways of girls and women who aspire to enter, are transitioning to, or are currently working within the digital economy (BMZ, 2017). At their summit in Hamburg, the G20 committed to promote education, employment, and entrepreneurship opportunities for women and girls in the digital economy and society in low income and developing countries and decided to set up a platform (www.eskills4girls.org) to collect and disseminate information and knowledge and to promote exchange between different actors on how to overcome the gender digital divide.

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Introduction

Besides reading, writing, and numeracy, digital literacy has become the new literacy of the 21st century. The digital transformation is changing our world and the ways we live, work, and learn. Today, more people in developing countries have access to mobile phones than clean drinking water or sanitation. The massive spread of information and communication technology (ICT) offers new opportunities for economic and social development worldwide as it can transform education, increase access to health or financial services, and alter the way governments interact with their citizens. On the other hand, the majority of the world's population – 4 billion people – remains offline (A4AI, 2017; ITU, 2016). Particularly, people living in low-income countries are excluded from the benefits of the digital transformation, and most of them are girls and women (Web Foundation, 2015). The digital divide is not only a matter of access to infrastructure and technology, but it is also a matter of digital skills. According to the Global Education Monitoring Report (GEMR) (UNESCO, 2016), even in developed regions like the European Union (EU), a third of adults do not master simple ICT basics, such as putting an attachment on an email or doing basic arithmetic formulas on a spreadsheet. A World Wide Web Foundation (2015) report reveals that women are 1.6 times more likely than men to report lack of skills as a barrier to the use of Internet. However, women's confidence in their digital abilities rises dramatically with increased education (Web Foundation, 2015). Digital literacy is also an important prerequisite for the success of ICT-based education interventions. All learners and teachers need at least a minimum of digital skills, if they are supposed to reap the benefits of digital technologies in education. If the target group's digital skills are not properly taken into account in ICT for education projects, they risk enhancing the exclusion of already marginalised groups.

Thus, similar to the literacy efforts in the last decades – focusing on reading, writing, and numeracy – the question today is: How can we scale up digital literacy, especially for girls and young women? It is clear, that education systems – formal and nonformal – have to play a key role, if we want to reach all. But how can we best integrate digital literacy and digital skills in national education systems? What should adequate policies, curricula, and pedagogy look like? And how can we make sure that they address girls and boys equally? Even though in some contexts girls outperform boys in ICT (IEA, 2013), worldwide girls and women only hold 24 percent of all jobs in the ICT sector (WEF, 2016a). There are many more challenges and questions revolving around digital literacy in education. What is digital literacy and can it actually be taught? According to a United Nations Educational, Scientific and Cultural Organization (UNESCO) (2011a) report, different countries may have fundamentally different needs for digital literacy. A good solution in a 'western country' may turn into a dead-end when applied e.g. in Uganda or India. But are schools the right place to convey digital skills or with whom should they partner? Education systems must go beyond a simple transfer of knowledge, they have to ensure that people acquire knowledge and vital skills – including digital skills. This is also reflected in the targets of Sustainable Development Goal (SDG) 4.

The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) organised a workshop to address questions related to the integration of digital literacy in education systems with a special focus on girls and young women. The aim of the workshop was to stimulate a dialogue that includes different perspectives from academia, policy makers, private sector, non-governmental and international organisations to identify challenges, but also promising approaches and find out what works. As a product of this effort, presenting experts at the workshop have contributed to this documentation to bring forth the challenges, considerations, questions, and recommendations. Even though the following contributions are independent from each other, they also have certain observations and recommendations in common, such as the impact of gender stereotypes, the important role of parents, teachers and female role models and the necessity for a gender-sensitive curriculum to facilitate digital skills acquisition for girls and young women.

Key considerations with regard to the integration of digital literacy in national education systems

The role of teachers and educators:

- Female teachers and educators using ICT in teaching and learning act as role models to girls throughout their educational journey. Such role models help alleviate the negative societal expectations of girls using ICT and support greater aspirations for careers in ICT for girls. To ensure this, there needs to be dedicated support and empowerment of female teachers to integrate technology in their daily teaching practices.

- Building awareness and capacity of teachers and educators to facilitate appropriate gender sensitive interventions can help to address the challenges around equity of access to technology in the learning process that supports digital skill acquisition for girls.

- Consideration must be taken with regard to the design and implementation of teacher and educator training programmes to ensure that the outcomes of these programmes focus inclusively on pedagogy, technology, subject matter, and gender.

- Stakeholders implementing programmes focusing on gender equity and equality, ICT and teacher development must continue to broaden the evidence base of what is working to guide educational policy and programming at national levels.

- The role of Ministries of Education and Youth is essential to mainstream initiatives that support teachers and educators address challenges around gender equality, ICT, and digital skill acquisition for girls.

Gender-sensitivity in curricula

- Authentic gender inclusion in the ICT learning system and curriculum requires recognition of social issues such as gender stereotypes and especially unconscious bias around women and ICTs. This will ensure that initiatives are gender-sensitive in their architecture and do not widen the ICT gender gap.

- Gender-neutral content, language, and teaching modality are major aspects that need to be incorporated in the digital learning system by various stakeholders, especially teachers.

- Digital literacy content needs to tackle gender stereotypes, but also needs to be inspirational to empower women and girls to learn about topics that are of interest to them. The involvement of women who are in this field as content creators is one way of ensuring this happens but also training other stakeholders including men and boys on producing inclusive and empowering content is vital.

- Digital literacy programmes that promote active learning and participation through peer exchanges are a highly recommended modality of encouraging women and girls to learn ICTs. Active learning also contributes towards retaining more women in STEM.

- Gender sensitivity needs to be mainstreamed within the entire digital literacy curriculum design cycle, from content development to teachers training. This calls for an investment in capacity development of all stakeholders from authors and content developers to educators and education ministries.

Factors influencing young women's career pathways in Science, technology, engineering and mathematics (STEM)

- Digital literacy begins at home. By educating parents about opportunities for females in STEM at a young age they can nourish their children's intrinsic interest and build their confidence.

- When parents are aware of the opportunities for their daughters in STEM, they also give them independence to live outside their community environments to pursue the field.

- Educators need training and information on how to mentor young students to explore fields in STEM.

- Career counselling needs to be provided for children from a young age.

Strategic partnerships with the private sector:

- Public-Private Partnerships (PPP) can make a valuable contribution to the implementation of digital literacy policies and programmes. However, governments and their partners need to ensure that PPPs integrate a gender perspective.

- Governments should work with all stakeholders to design and roll out digital literacy programmes and curricula for all ages that address the significant gender gap in digital empowerment identified in the Web Foundation's (2015) Women's Rights Online study. This includes programmes that are designed to boost the confidence and interest of girls, and focus on empowerment and rights, not just technical abilities. Civil society groups can act as an intermediary between the government and private sector to overcome a lack of trust.

- Governments and their partners need to invest in more and better ICT training and support for teachers; fast, free broadband for schools; and Open Educational Resources.

- Digital skills programmes, whether supported through PPPs or otherwise, need to ensure that adequate training on privacy and data protection must be included as critical parts of teacher and school administration training, as well as student curricula.

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The role of teachers and educators

Contributing author: Keith Magee

The importance of the role of teachers and educators in supporting the acquisition of digital skills for girls is a statement that can be read as fact, and challenged on its assumptions in parallel. Teachers and educators play an ongoing central function in learner development throughout informal and formal education systems worldwide. Growing global demands of a workforce with digital skills focuses the attention of the education sector to meet this need (UNESCO, 2011a,b). With these demands, focus sharpens on teachers and educators to deliver graduates, with not only digital but 21st century skills, from the education system to the workforce. In addition, integrating technology into teaching and learning practices to enable digital skill acquisition has fuelled questions and heightened expectations around the role of teachers and educators. Educators are now expected to prepare learners for an ever changing workforce. This can entail adopting student-centred practices that technologies can facilitate, leveraging data that is generated from platforms for reporting and accountability, or simply adopting technology as a tool for teaching in modern classrooms. These shifts in daily practices that technology brings all challenge the existing roles and responsibilities of teachers and educators. With these changing workforce demands and new technologies emerging daily, the question of the role of teachers and educators always persists (Van den Berg, 2002).

Equity, digital skills, and the role of the teacher

Access to technology, one of the components to support digital skill acquisition, is often championed as gender neutral (Faulkner, 2001) and democratising the learning process. These perceptions that technology bring has translated to a precursor to equity of access to technology for both girls and boys (Mitra, 2005). Research across many contexts have highlighted that this assumption needs to be challenged (Arora, 2010; Arora, 2005; Solomon et al., 2003, Orlando, 2013). Instances recorded of preference of access for boys over girls was due to existing social norms and societal expectations (Bray, 2007, Volman & Van Eck, 2001). Girls are often actively discouraged by families, teachers, and career advisors from pursuing further studies or careers in ICT and the lack of positive female role models using ICT can impact the perception of how girls intend to engage with technology in their futures (Gras-Velazquez et al., 2009). Building awareness and capacity of teachers and educators to facilitate appropriate interventions can help to address the challenges around equity of access to technology in the learning process that supports digital skill acquisition (Gras-Velazquez et al., 2009).

Curriculum, pedagogy, and digital skills

Curriculum and pedagogical approaches are two mechanisms that are leveraged by teachers and educators for competency and skill acquisition in education. Pedagogy designed through models like Technology, Pedagogy and Content Knowledge (TPCK) support the integration of technology into teaching process (Angeli & Valanides, 2009). Evidence shows that adopting pedagogy based on TPCK (Handbook of TPCK for Educators, 2008) and designing and using TPCK-based curricula (Harris & Hofer, 2009) facilitates digital skills acquisition. Such an approach has shown to bridge the digital divide between learners in more disadvantaged communities and learners from better off socio-economic backgrounds (Banister and Reinhart, 2011). The work of the Forum for African Women Educationalists (FAWE) has addressed how teaching and curriculum practices can improve the societal expectations of girls using ICT. Their programmes contribute to improvement by adopting a gender responsive pedagogy (FAWE, 2005) and their curriculum addresses issues specifically around access to technology (FAWE, 2005, p. 31). Results of the work of FAWE have shown a change in teachers' attitudes and practices and improved access for girls to education which brings positive change in the gender dynamics in schools and greater retention of girls (Wanjama and Njuguna, 2015). Programmes such as She Will Connect (Intel, 2016), Every1Mobile (Every1Mobile, 2017), and the joint UN Women and Mozilla Foundation's Digital Literacy for Girls programme focus specifically on digital literacy for girls and women. Though to scale the impact and learning of such programmes, a broader evidence base on programme impact is required. In addition, emphasis must be placed on importance of the role of government to mainstream appropriate pedagogy and curriculum that can support digital skill acquisition for girls across the whole education system.

Teacher development and efficacy of digital skill acquisition for girls

International frameworks such as the UNESCO ICT Competency Framework for Teachers (ICT-CFT) (UNESCO ICT, 2011) provide a comprehensive roadmap for supporting teachers' professional development vis-à-vis ICT in the teaching and learning process and the context where learning takes place. Further to such frameworks are teacher development models such as the UNESCO ICT Enhanced Teacher Development (ICTeTD) model (UNESCO, 2012), which leverages TPCK models to analyse, implement, and evaluate teacher integration of ICT specifically into the teaching and learning process where learners are situated. Camara Education has been leveraging these models to build, implement, and evaluate teacher professional development programmes in Kenya, Uganda, Ethiopia, Tanzania, and Zambia for over 25,000 teachers. In Zambia in 2016, Camara Education implemented a project to support the Ministry of General Education to roll out the new Computer Studies curriculum for Junior Secondary level in three provinces: Copperbelt, Lusaka, and Southern. As a result of the training and ICT access, teachers reported greater confidence and ability in integrating technology into their daily practice on a more frequent basis. For example, non-computer studies teachers who received training from Camara were more likely than those who did not receive training to integrate ICT into their teaching and learning (88% vs. 63%). Based on the 2016 exam, learners from both genders in Camara project schools achieved a pass rate more than 10% higher than the overall provincial results. The most noticeable result was the bridging of the gap in results between girls and boys in project schools. In all schools in the three provinces of operation, girls achieved a pass rate 6.5% lower than boys, however, in Camara project schools, the results were almost on par (79% for girls against 80% for boys) (Camara Education, 2017). An evaluation of the project suggests that girls are more eager to learn in computer class and do better in theory than boys.

Conclusions

Evidence has shown that international initiatives to support teachers and educators integrating technology in teaching and learning practices are yielding positive results of digital skill acquisition for girls. Despite this, perceptions of, and aspirations towards, technology continue to show bias towards males influenced strongly by cultural and social norms (Gras-Velazquez et al., 2009). Lack of comprehensive and systematic support to improve societal expectations of girls using ICT and aspirations for careers in ICT will continue to challenge girls' acquisition of digital skills. There is little evidence of programming beyond small projects that targets these issues throughout the broader education sector.

In this lies an opportunity to focus on the intersections between gender and ICT to support the enhancement of digital skill acquisition for girls. Practitioners and academics can investigate approaches to integrate gender responsive pedagogy and TPCK into teacher professional development programmes. This will support teachers and educators to focus on support for girls digital skills attainment and address challenges of equity that technology presents and societal and cultural norms.

Stakeholders in education must act on expanding development of gender sensitive curriculum as a normal practice and broadening programmes that empower female teachers to be positive role models to learners in education. This will provide teachers and educators appropriate tools and competencies to support the multifaceted approach to supporting digital skill attainment for girls.

The role of Ministries of Education and Youth worldwide is critical to mainstream and embed programmes that ensure teachers and educators are empowered, with necessary support, to ensure girls have every opportunity to acquire necessary digital skills for an evolving workforce. For this to happen, all stakeholders implementing in projects and programmes that focus on gender equity and equality, ICT, and teacher development must continue to broaden the evidence base of what is working to guide educational policy and programming at national levels.

Gender-sensitivity in curricula

Contributing author: Ruth Miyandazi

Overview

Social norms, the job and labor markets are rapidly changing in the 21st century and evolving information and communication technologies (ICTs) are at the driving seat of this change. The World Economic Forum (WEF, 2016a) estimated that technological disruptions will change the future employment landscape, as particular tasks within existing occupations will be substituted by technological systems such as machine learning. Furthermore, the Science, Technology, Engineering and Mathematics (STEM) sector has been projected to create more jobs in the 21st Century and within this sector, computer and technology related occupations alone, projected to create the most jobs, around half a million new jobs in for example, the US by 2024 (USBLS, 2017). It is expected that 90 percent of jobs now and in the future, will require digital skills (EPRS, 2015). While it is clear that the future of work will require digital fluency and ICT skills, most women and girls are not effectively equipped to reap the gains of this knowledge economy. Women only make up about 1 out of 3 of around 7million persons working in the information and technology sector (European Commission, 2014).

One of the reasons for this gender gap in STEM careers is the low level of digital literacy and ICT skills amongst women and girls, as a result of the low female participation rates in STEM studies. Globally, the gender gap in STEM graduates is at 47 percent and even in more developed economies like the US only about 35 percent of undergraduate degrees in STEM studies go to women (WEF, 2016c) (WEF, 2017). An ICT curricula that is not gender-sensitive is one contributing factor to this lack of participation and skills as it fails to address the societal stereotypes about women and ICTs. For instance, by failing to provide content that accommodates the needs and interests of women and girls, ICT curricula may fail to capture their enthusiasm and sense of ownership (Huyer & Sikoska, 2003). A gender dimension starting from the level of classroom curricula will play a significant role in positively changing this trajectory and ensuring that women are part of the fourth industrial revolution both as creators and active users of content. Suggestions that have been put forward in terms of coming up with a gender-sensitive ICT curricula include: gender-responsiveness in curriculum design and content development process and; gender-sensitive teaching approaches and teacher training practices. Fewer studies have looked at the role of gender-sensitive content. The next section of the discussion will look at the two themes mentioned above, emphasizing the important role of gender-sensitive content within ICT curricula in tackling negative stereotypes about women and ICTs.

Current ICT curricular: Perpetuating Gender Stereotypes

One of the barriers contributing to the widening gender gap is a global system that is indifferent to and does not effectively address negative stereotypes around women and ICTs and women and girls in the STEM sectors (Williams et al. 2014). This is mostly perpetuated within organizational contexts through content and messaging that is biased and not as women-friendly as it is men-friendly (National Science Foundation, 2003). This manifests itself in not just the general content but also in the teaching modality and language

used within the field that contributes to the low interest levels as women and girls feel uncatered for. Additionally, studies confirm the incongruity between feminine gender role stereotypes and STEM stereotypes (Dasgupta, N., & Stout, J., 2014). The latter clashes with the former as STEM sectors seem to conform more to 'masculine' norms thus favoring men. For a long time, therefore, within the ICT and STEM sectors, the stereotypical needs of men and boys have been considered representative of both genders, further alienating the needs and benefits of a curriculum to women and girls. Findings from research done by Geena Davis Institute of Gender in Media (2017c) found that women will switch off from a movie or TV programme that does not have women characters or that is "too stereotyped". This form of biased content, whether it is on screen or in the classroom, makes women feel disconnected and disengaged to whatever is being communicated and therefore might choose to opt out in search of spaces where they feel more welcomed. (Cheryan et al., 2009). The implicit bias in learning materials also leads women and girls to autostereotype themselves. This means that they start believing the negative stereotypes put across about them, which lowers their confidence levels in STEM studies. When this happens, society is further deprived of valuable future innovators who would bring unique and diverse perspectives to these male-dominated fields. It is therefore important that girls can 'see' themselves through the visuals portrayed in the learning resources and that they find such learning material of interest and inspirational.

Assimilation and learning continues to change people's perspective about a women's role within the society and most importantly women's own thoughts about themselves and their abilities. This has a lot to do with not only what is taught but how it is taught. Teachers have a lot of influence on the teaching style. Accordingly, recent studies have shown that having gender-equal teaching modalities in the classrooms as well as teachers who rise above traditional gender stereotypes, improves girls' achievement in STEM studies (Alan et al, 2017). Gender sensitivity in the ICT curricula needs to be mainstreamed into the entire process and structure of teachers' training, content development, and as a policy protocol within the curriculum design cycle.

Promising Practice

Mainstreaming gender in curricula is rather a process that needs to be adopted and upheld throughout the development of any curriculum. It requires having more women developing learning resources as authors and content developers. It also needs to include teachers, students, as well as parents. Some stakeholders like the Geena Davis Institute are providing teachers, parents, and students with customized material on gender equality and gender stereotypes (Geena Davis Institute, 2017a,b). For example, they have developed the "Guess Who" video learning series that are tackling existing societal perceptions of gender. Through the modules, students can learn what a stereotype is, including how to interrogate the stereotypes about men and women perpetuated through the media, movies and video games. They learn, for example, that a girl can become a mathematician or a pilot and not just a princess like some movies suggest. The modules also pinpoint the negative impact of these stereotypes, which include, for instance, girls being ashamed for excelling in STEM subjects such as science and math and boys growing up with a perception that girls cannot peruse certain careers. Additionally, they have also developed a participatory curriculum with activities such as discussion groups and role playing as well as a guide for teachers accompanying the video series. This is valuable resource for educators as it supports and demonstrates to them how to engage with young girls and boys on the topic of gender stereotypes, which remains a key contributor to women's underrepresentation in STEM studies.

Other organizations like UNESCO continue to champion gender-responsiveness in education through the production of training manuals and guidelines for teachers as well as curriculum developers. These guidelines tackle issues such as gender-sensitivity in pedagogy and instructional material and educate teachers on aspects such as eliminating gender bias in learning material and language. They also guide teachers on how to be gender responsive in their teaching style, treating both male and female students in an egalitarian manner and avoiding for example, directing more questions to male than female students. Specific guidelines need to be developed within the ICT curricula, which possess unique challenges. (UNESCO, 2015).

In 2016, UN Women collaborated with Mozilla Foundation to impart hundreds of women and girls with web literacy skills to ensure that they are active participants and not just consumers of content. The project was implemented in Nairobi and Cape Town through the establishment of 20 digital literacy clubs for women and girls. From the onset,

this project was designed with women and girls in mind and with their input. This particular project employed a peer-to-peer learning modality that targeted women and girls in both formal and informal settings. Most importantly, the project was established with a recognition that the mode of teaching web literacy for girls and boys differs. A guideline was therefore developed with principles on how to eliminate issues such as unconscious bias to create a safe space for women to actively participate when facilitating digital literacy clubs (Clubs Mozilla 2017). The digital literacy curriculum was also further adjusted and made more participatory and collaborative to suit specific learning needs of women and girls. These small, volunteer-led community groups, referred to as Mozilla Clubs, meet twice a month and support the development of web literacy skills for women and girls. These groups target local women entrepreneurs, technology leaders, students in local educational institutions, and women leaders in other sectors of the economy, including in the informal sector. While the approach taken in this project together with the initiatives by Geena Davis Institute and UNESCO mentioned above are a step in the right direction, there is need for these practices to be consolidated into formal education curricula in order to benefit more women and girls.

Considerations

Gender-sensitivity in digital curricula is a necessary pre-requisite for us to close the gender digital gap and achieve Goal 5 of the Sustainable Development Goals on the advancement of gender equality and women's empowerment. It is more specifically in line with Goal 5b which aims to enhance the use of ICTs for women's empowerment (UN-DESA, 2015).

Authentic gender-sensitivity in ICT curricula must unpack the stereotypes around women and ICT that persist within ICT content as well as within teaching modalities. We need to provide girls with content that inspires them to pursue new and 'unconventional' career pathways. Content also needs to be adapted to girls' interests and should be delivered in a non-stereotypic manner. Designing curricula in collaboration with women and girls is key to ensuring their full buy-in from the start. As we continue towards this information age and digital economy, digital skills should not only be understood as job-relevant skills, but rather as a life skill for all, women and girls included.

Factors influencing young women's career pathways in STEM

Contributing authors: Deepa Srikantaiah, Naureen Bhullar

Maria Charles (2011) found that less affluent and less economically developed countries have higher numbers of women in the science, technology, engineering and mathematics (STEM) fields than more affluent and industrialised western nations. She hypothesized that the freedom to choose their careers led the women in western countries to stereotypical gendered careers and less towards STEM fields. With global disparities between men and women in access to benefits from digital transformation (Web Foundation, 2015), it is important to understand how and why women who are able to choose STEM careers.

Drawing on qualitative research

We conducted our study from December 2015 – March 2016 in Bangalore, India. We followed eight young women in the beginning of their careers over a period of six months to understand their educational backgrounds, how they got to their current position, and what their aspirations are to continue working. We focused on India because of the ongoing challenges of educating girls entering STEM fields. India was also relevant because of the low retention rates for women in the labor force; approximately 27% of labor force participation is by women (World Bank, 2016b).

This topic of women's careers in STEM fields in India is important because it helps us understand the social and cultural backgrounds of women in the field, and how it influences their career decision making processes. According to a national survey in 2014, about 94% of people in rural India do not own a computer and digital literacy is extremely low (National Sample Survey Office, 2015). To combat this, the government of India has launched a 1800 crore rupee digital literacy mission to improve this statistic substantially in rural India in 2016-2017 Union budget. Further, there is limited information on digital literacy in girls in India, but based on these aforementioned statistics, one can safely assume it is abysmally low.

India is of interest because women and men in less affluent countries do not have the luxury of choosing or exploring their passions, and they are more likely to gravitate to fields with more career opportunities and financial security. Careers in India are not classified as masculine or feminine like in the west, but in terms of their prestige (Adya & Kaiser, 2005). Women from both India and China have reported more positive attitudes towards careers in math, science, and technology (Trauth, 2002), which may have direct effects on gender literacy.

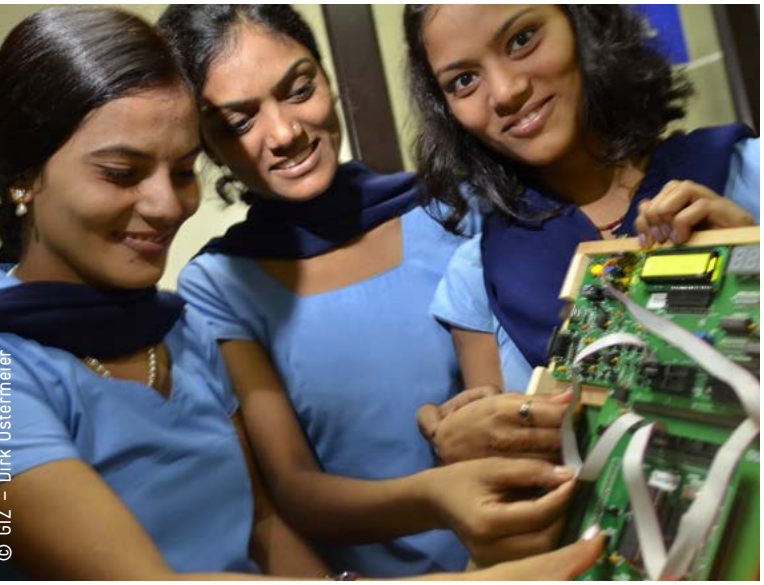
Findings

Our research was based on women in their early stage of careers in Computer Science and Engineering, because we wanted the women to be able to have a more recent memory of their educational experiences. The women in our study are mainly middle-class and from educated families. However, many of them grew up in small towns, where access to quality education and technology was limited. Although our sample reflects the middle class society in India, we

have learned much from the women in our study which can inform digital literacy for all girls in India. For example, one key finding from our study is that without family support, these women would not have had the opportunities to becoming digitally literate or advance to the current careers they have. Although the parents in the study were not in computer science, they encouraged their daughters to pursue the field. In some cases the encouragement from the fathers was critical for their daughters to leave their small towns to pursue higher education in bigger cities. Hence, the role of parents was of paramount importance in this context. The women in the study mentioned that although they learned digital literacy in school, without the encouragement and moral support from their parents, pursuing a STEM career would not be possible. The encouragement and support the women received from their parents were critical to not only motivate the women to pursue a STEM field, but also gave them confidence to see themselves in the field in the long term.

From our findings, we also noticed that female participants were intrinsically inclined to select a career in computer science or engineering as they showed interest in mathematics and science fields from an early age. This interest was supported and encouraged by their parents too. Based on this finding, one can speculate that encouraging interest in STEM fields like Computer Science and Math from a young age could improve the digital literacy in women.

However, these women were educated mainly in private schools, which are generally assumed to be of superior quality than the government schools in India. This is a source of concern and could be one of the reasons behind the lower digital literacy of girls in India. Although parental support is important, the women in our study had access to resources to which many girls, particularly from poorer backgrounds, do not have.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Conclusions

As mentioned earlier, the women interviewed in this study were from middle-class India population which comprises of 50 million people in a population of 1.3 billion in India (WEF, 2016b). All of them were fluent in English as that had been their medium of instruction in school from an early age. Their schooling was from private institutions, however, the findings from the study have implications across socioeconomic classes and for women entering STEM fields globally. Access to a quality education is limited in some geographical contexts and many communities are not comfortable with sending their girl children or young women to study outside their communities. The women interviewed in our study are a representative sample of women professionals across India aspiring to study STEM and work in the field. Our study illustrates the stories of young women professionals as they journey from students to young professionals and highlights the support they received from their families, communities, and teachers. It also showcases their struggles and challenges of moving away from their families, living in large urban cities on their own, and working in a male dominated field. The findings and insights from this study can be transferable not just to other countries, but across socio-economic incomes.

Parental knowledge in the importance of educating their girls, and encouraging them to pursue male dominated fields like STEM were a key finding in our study. Digital literacy starts at home. Therefore, we recommend educating parents about the opportunities in STEM for females from a young age so that their intrinsic interest is nourished and honed and their confidence is built. We also recommend that educators in both private and government institutions mentor the students in these fields at a young age, for example, by providing career counselling. Further, by providing better resources and continuing education opportunities to these educators, it can make their tasks easier and ensure that more girls are digitally literate.

For future research, it would be good to build on this study and understand the experiences of women in STEM from lower socioeconomic parts of society to determine their unique challenges in obtaining education and pursuing careers in a STEM field. The influence of first generation college goers on their younger siblings, relatives, or friends could provide a clearer view of the mentoring opportunities for improved digital literacy in this part of the population.


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Strategic partnerships with the private sector

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The benefits of ICTs and Internet use in particular are well documented, yet women are less likely to use the Internet than men (Web Foundation, 2016), a trend which is unfortunately increasing globally (A4AI, 2016). A lack of skills is one of the main reasons why women are not using the Internet and other ICTs as much as men, and even where women who are online, they are less likely than men to use it to improve their livelihoods or status (Web Foundation, 2016). The Web Foundation's Women's Rights Online programme recently released scorecards from a Digital Gender Gap Audit in ten countries (Web Foundation, 2016). The audit revealed that in most countries in the study, there is almost no teacher or community digital literacy training.

In order to maximise the potential of ICTs for women (e.g., achieve SDG 5b) it is imperative that we focus on multiple avenues to improve digital skills among women and girls. One such avenue is the use of PPP to implement digital literacy programmes (ADB, 2015).

Why Public-Private Partnerships?

PPPs can facilitate access to more affordable connectivity for the education sector and enable access to online education services. These services can aid teachers in adapting curriculums and enhance student learning and outcomes. In addition, PPPs can assist in providing systems to facilitate education management, human resource planning for digital literacy programmes in schools and financial management systems. PPPs can provide additional resources for online communication systems, ICT hardware and software for ICT educational tools, and support for staff involved with digital literacy programmes. These programmes can also be better designed to meet workforce requirements of private sector partners. Indeed, PPPs that put people-centred development at the heart of their design can provide benefits to the wider society.

Solutions for digital literacy initiatives implemented by strategic partnerships are priority for country digitisation initiatives (Malkani, 2016). Governments and development partners do not always have resources to implement digital literacy programmes alone. However, through strategic PPPs, projects can be supported in a sustainable manner.

How do partnerships with the private sector assist digital literacy programmes for girls?

Strategies for digital literacy partnerships could include working with Universal Service and Access Funds (USAF). USAFs are funded through contributions from telecommunications companies. Jamaica is a good example of a country that makes use of its USAF to fund ICT access in education. The government programme provides equipment via partnerships with local Internet Service Providers (ISPs) to provide Internet access in schools. The fund also finances the e-learning Jamaica programme (Ministry of Science,

Energy and Technology, 2017), an initiative that facilitates computer-based learning, as well as virtual classrooms. The project targets students at a secondary level and encourages them to make use of ICT to improve their performance at school, however, there is no specific focus on girls.

While many digital literacy initiatives focus on programmes in secondary school, investment in ICT skills at primary school level is also critical. By making sure that primary school curricula include ICT literacy basics, programmes can take advantage of relatively higher enrolment rates at this level. PPPs can play a role in creating effective, interactive ways to teach digital skills, especially in resource-constrained settings, to reach all students.

USAFs are problematic, however, in that there is a lack of transparency and effective fund management (A4AI, 2017). Governments should therefore make greater efforts to improve transparency of these funds as a means of partnering with ISPs and others to support digital skills training.

Other programmes have a specific focus on girls. An example of this is the Digital Girls Club in Nigeria, which is a technology club developed to give girls a chance to get online (Digital Girls Club, 2017). Girls are taught computer related courses and skills, using an online portal. These lessons boost their computer skills and introduce them to the potential opportunities that ICT skills can provide. The Women's Technology Empowerment Centre, and Women in Technology in Nigeria (WITIN, 2016), partnered with the Federal Ministry of Communications and local IT companies to produce the curriculum for the online portal and train the teachers who will manage the project in the schools. The teachers will also monitor the progress of the project.

Another example is the Women and the Web Alliance (USAID, 2016). The Alliance is a PPP among USAID, NetHope, Intel Corporation, World Pulse, World Vision, UN Women, and Women in Technology in Nigeria. The Alliance aims to create a movement to address the digital gender divide, by bringing over 600,000 women online in Nigeria and Kenya over a 3-year period. This includes several digital skills programmes such as the digital literacy programme, which integrates digital literacy training into gender and development programmes, the Knowledge and Voices programme (Women and the Web Alliance, 2017). The Alliance also focuses on economic empowerment of women and the creation of a movement which will address the digital gender divide, by nurturing a partner network of similar development programmes.

Conclusions

PPPs can provide an important option to support digital skills programmes for women and girls. However, one of the main problems to recognise is that the challenges of gender inequality are not always acknowledged by policymakers and their private sector partners in the first place. To counter this and better incentivise governments and their partners to develop PPPs for digital skills programmes that can improve the career prospects of girls, all actors need to recognise that companies with greater gender diversity in their staff have higher financial returns (McKinsey and Co., 2015).

To go further, even with access to ICT in schools, girls may not always be exposed to computer classes, as participation in ICT, computer science classes, and Internet labs are often optional. Girls can self-select out of classes. In addition, boys may be exclusively encouraged to participate. Governments and their partners need to ensure that PPPs implement digital literacy policies and programmes with a gender perspective. Girls need to be equally encouraged to participate in ICT related courses, as well as provided with the necessary tools to ensure understanding of ICTs in classroom arenas. Indeed, there are many examples of PPPs that support digital skills training (such as the example from Jamaica), but few with a specific focus on girls. It is also important that digital skills programmes and curricula address the significant gender gap in digital empowerment identified in the Web Foundation's (2015) Women's Rights Online study. In order to achieve this, digital skills programmes should aim to go beyond teaching technical ICT skills to also address how technology can encourage women and girls' self reliance (opening up new economic and educational opportunities); development of confidence, self expression and self worth (promoting positive online behaviour and discouraging violence and bullying); and active citizenship (building social capital, seeking information, forming networks and alliances).

PPPs are often difficult to implement because of a lack of trust between government and private sector actors. Here, civil society groups (especially those working in the ICT and education sectors) can act as an intermediary between the government and private sector (see the example from Nigeria above).

Finally, another concern is that of privacy and personal data protection in schools and e-learning contexts. Learners, girls and women in particular, need to be aware of how to protect their privacy online, by withholding access to personal data. Countries need to strengthen data protection and privacy laws that address both private and public sectors. More specifically, digital skills programmes (whether supported through PPPs or otherwise), need to ensure that adequate training on privacy and data protection must be included as critical parts of teacher and school administration training, as well as student curricula.

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Annex 1: Contributing Authors

The role of teachers and educators

Keith Magee

Keith Magee is the Head Of Education for Camara Education. Having initially specialised in training delivery and development in the telecoms sector, after undertaking a Masters in Education in KU Leuven in Belgium with a focus on the politics and development in education, he moved his interests away from the corporate sector into the development/NGO field. Keith began working with Camara in early 2012. He began his time with Camara with placements in Kenya and Zambia and established formalised training and orientation programmes in each of their 6 operational countries in Africa. To date, these programmes have trained over 25,000 educators and assisted in integrating ICT into teaching and learning practices. His current role focuses on expanding the educational scope of Camara Education with a specific focus on programme design and implementation for improving learning outcomes in literacy and STEM through technology, data for management and systems approaches for school development with technology.

Strategic partnerships with the private sector

Dhanaraj Thakur

Dhanaraj Thakur is Senior Research Manager at the Alliance for Affordable Internet. He has been designing and leading research projects on telecoms policy and regulation, gender and ICTs, and the socio-economic impacts of ICTs in developing countries for the last ten years. This includes assignments with the World Bank, IMF, the IDB, and several governments and NGOs. He also had several peer reviewed publications and is lead author of the Affordability Report. A former Fulbright scholar, he holds a PhD in Public Policy from the Georgia Institute of Technology (USA), and is a graduate of the London School of Economics and the University of West Indies (Mona, Jamaica).

Ingrid Brudvig

Ingrid coordinates the Women's Rights Online country partner network and research initiatives. Prior to joining the Web Foundation in 2014, Ingrid coordinated a network of anthropologists across Africa conducting ethnographic research on ICTs, and co-edited a published book on "Mobilities, ICTs and Marginality in Africa: South Africa in Comparative Perspective". Her work has also included extensive fieldwork, and monitoring and evaluation activities for initiatives in education, health, and social development across South Africa. Ingrid has a MA in Social Anthropology. She is based in Cape Town.

Nanjira Sambuli

Nanjira leads the Web Foundation's advocacy efforts to promote digital equality in access to and use of the Web. A Nairobi-based researcher and analyst, Nanjira brings broad expertise as an advocate and consultant working at the intersection of governance, media, culture and society. Immediately prior to joining the Web Foundation, Nanjira was Research Lead at the iHub in Nairobi, where she helped shape governance and tech research, and provided strategic guidance for the growth of technology research in East Africa. Her recent research includes work on the ICT and Governance Landscape in East Africa (iHub Research), Cybersecurity and Cyber-resilience in East Africa (CIGI), research into the challenges of promoting Internet access in developing countries while upholding net neutrality principles

(Journal of Cyber Policy), and Technology Innovation Hubs and Policy Engagement (Making All Voices Count). Nanjira is also a columnist for the Daily Nation newspaper in Kenya, a member of DFID's Digital Advisory Panel and served as a deputy on the United Nations High Level Panel for Women's Economic Empowerment (2016-17).

Erica Penfold
Erica joined A4AI as a Research Analyst in August 2016. An experienced researcher and writing professional, with a background in international development, she works with the A4AI research team to produce the Affordability Report and other A4AI research outputs. Prior to joining A4AI and the Web Foundation, she worked as a project manager for a team of health journalists, and as a lead researcher for the Poverty Reduction and Regional Integration project based at the South African Institute of International Affairs. She has also conducted research for Global Integrity, Management Sciences for Health, and the Democracy in Africa Research Unit. She is a French speaker and is interested in poverty reduction in both Southern Africa and Francophone Africa. Based in Johannesburg and Cape Town, Erica holds a BA in International Relations, French and English from the University of the Witwatersrand in Johannesburg and an MSocSci in Political Studies from the University of Cape Town.

Factors influencing young women's career pathways in STEM

Deepa Srikantaiah
Deepa Srikantaiah, Ph.D. was a Fulbright-Nehru US Scholarship at the Indian Institute of Management Bangalore, India (2015 – 2016). She has 15 years of experience working on mathematics, science, technology and engineering education programmes in the US and Internationally. She holds an M.A. and Ph.D. in International Education Policy from the University of Maryland.

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Naureen Bhullar, Ph.D. is a Behavioural Lab Manager & Research Coordinator at the Indian Institute of Management Bangalore (IIMB). She received her Ph.D. in Developmental and Biological Psychology from Virginia Tech and taught in the Department of Psychology at Widener University in Chester, Pennsylvania for five years.

Gender-sensitivity in curricula

Ruth Miyandazi
Ruth Miyandazi is a Programme Analyst with UN Women's Policy and Programming Bureau where she works on innovation and technology for development, which includes a focus on digital skills and education. In this capacity, she is also responsible for capacity building on innovative programme planning & management. With a background in Local Economic Development and Development Management, Ruth is a graduate of the London School of Economics. She has technical expertise on gender mainstreaming, project management, and ICT4D in local governance. Prior to joining UN Women, she worked with UN Habitat, Oxfam GB, the Swiss Agency for Development and Corporation (SDC) Horn of Africa Office and AIESEC.

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Stephen Richardson
Stephen Richardson is a creative working in the international education sphere with over 15 years of experience in innovative programme design and project management. From professional involvement with documentaries on socio-political conflicts in Turkey to providing support for teachers after disasters in the Philippines, he is drawn to the malleability of education as a platform for engagement with a critical awareness of social inequities. Stephen has worked with International Rescue Committee (IRC), War Child Holland, Mercy Corps, Save the Children Norway, Save the Children US, Inter-Agency Network for Education in Emergencies (INEE), Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), Creative Associates International, and Nomadic Wax (MTV World). Stephen has a Master's of Education degree from the Center for International Education at the University of Massachusetts Amherst.

Annex 2: Contributing Organisation Profiles

Web Foundation
The World Wide Web Foundation is an independent, international organisation working for digital equality – a world where everyone has the same rights and opportunities online. Established in 2009 by the inventor of the web, Sir Tim Berners-Lee, the Web Foundation works to advance Sir Tim's vision of a free and open web 'for everyone' by influencing government and corporate policies to ensure everyone has the right to access the web and use it freely and fully.

Women's Rights Online – an initiative of the Web Foundation – is a research and advocacy network that aims to drive women's empowerment through the web. Composed of women's rights and digital rights groups across 15 low- and middle-income countries, the network is working to bridge the gender gap in technology, data, and policymaking using a blend of fresh research, policy advocacy, and storytelling.

The Alliance for Affordable Internet (A4AI) is the world's broadest technology sector coalition working to reduce the cost of internet access to enable universal, affordable access for all. Initiated by the Web Foundation in 2013, the Alliance is composed of 80+ member organisations from across the private, public, and not-for-profit sectors in both developed and developing countries. Working through a consultative, locally-driven and locally-led process in member countries throughout Africa, Asia, and Latin America, A4AI works to shape the policies and regulations needed to drive down prices and enable everyone, everywhere to afford to connect.

Camara Education
Camara Education is a non-profit international educational organisation dedicated to delivering real impact through technology by inspiring and empowering a young generation to improve their own life opportunities. Their mission is to transform education using technology to empower disadvantaged students. Their vision is a world-class technology-enabled education accessible to all. Founded in 2005 in Dublin, Ireland, Camara has built a proven model of 'education delivery' that is both sustainable and highly scalable. It currently operates five Education Hubs in Africa (Ethiopia, Kenya, Zambia, Lesotho and Tanzania), and one in Ireland. All Hubs operate as social enterprises and operate to serve local market needs through a sustainable business model. In the last 11 years, Camara has enabled more than two million young people to achieve better educational outcomes and to improve their life opportunities, through raising and generating €24m, training 26,000+ teachers across 5,300 schools and educational institutes, and installing 90,000+ ICT devices.

UN Women
UN Women is the United Nations entity dedicated to gender equality and women's empowerment, championing the rights of women and girls globally. UN Women supports UN Member States as they set global standards for achieving gender equality, and works with governments and civil society to design laws, policies, programmes and services needed to ensure that the standards are effectively implemented and truly benefit women and girls worldwide. It works globally to make the vision of the Sustainable Development Goals a reality for women and girls and stands behind women's equal participation in all aspects of life, focusing on five priority areas: increasing women's leadership and participation; ending violence against women; engaging women in all aspects of peace and security processes; enhancing women's economic empowerment; and making gender equality central to national development planning and budgeting. Present in over 90 countries worldwide, UN Women has a universal mandate and embraces information, communication and technology (ICT) and innovation in various dimensions of its work in acknowledgement of the central role they play in breaking trends and shifting current trajectories to accelerate progress on gender equality and women empowerment. UN Women takes a partnership approach to accelerate industry wide change and remove the barriers to women and girl's advancement in innovation, technology and entrepreneurship.

Annex 3: Further Resources

BMZ (2017). Women's Pathways to the Digital Sector: Stories of Opportunities and Challenges. Retrieved from https://www.bmz.de/en/publications/type_of_publication/weitere_materialien/study_eSkills4girls.pdf

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