Gender Equality in ICT Education

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Abstract

Is ICT somehow natural for men, and unnatural for women? Are women underrepresented in ICT professions? Does ICT education harm women? These and similar questions buzzle many. The cornerstones for any profession are set at the education phase, in different education institutions and in the curricula they follow. Gender roles and models accepted in early education will have a long tail paving the way for maybe the whole professional career of an individual. If changes in gender roles in any profession are looked for, professional education is a good place to start with. At the same time, it must be remembered and studied, if gender roles towards ICT are already formulated at the basic education.
This article performs a literature review on the gender equality issues in ICT education. The questions presented above are scrutinized especially from the viewpoint of ICT education. There is a severe search for any theoretical explanations why ICT should be male-oriented. At the end, reasons for women to be better ICT workers than men seem to be abundant, especially in less academic literature.

1. Introduction

Many information and communication technologies (ICTs) have traditionally been seen as dominated by male professionals (Broos, 2005; Crump, Logan, & McIlroy, 2007). Many studies witness that males feel more self-efficacy as it comes to ICT use (Tømte & Hatlevik, 2011). ICT-professionals might have social meetings and forums, where women do not feel welcomed (C. McLachlan, Craig, & Coldwell, 2010). There is evidence that even gender might be an important component in Digital Divide (Elnaggar, 2008). Some suggest that there is a dynamic at work through which men can appear as new ideal ICT worker (Kelan, 2008). Is there something inherent in information and communication technology that would make it more natural for men than women? Is it still true that ICT-professions are male dominated?
Information and communication technology has for a long time been considered empowering male professionals. This is surprising, as it is ICT is not about hard physical work, a factor that is usually thought to favour males. ICT work is about thinking and logical design, a skill that should not have differences between genders.
Occasionally and in some instances ICT work is very much lonely and without rich human contacts. Women might be more tended towards caring for people (rather than for machines) as (Boughn & Lentini, 1999) points out: *"the construct of desiring to care for others was readily apparent"* in the case of nursing students.
One part of the masculine image of ICT might be that almost all contemporary time heroes of ICT are men, think like persons like Bill Gates, Steve Jobs or Linus Torvalds. However, after some searching it is rather easy to identify also rather prominent women ICT inventors (although not totally at the same level of fame as the previous). A nice list of ten famous ICT heroes of female gender is for example reported in (Ribeiro, 2012).
Worldwide there is active campaigning going on to attract women to ICT professions. European governments see women as the 'solution' to the skills shortage affecting the industry (Gill, 2002) However this is not just because more workforce is needed, but because many thing that they would add new needed elements to the discipline and industry. What these new elements might be is not clearly defined anywhere, but they might contain elements such as:

- bringing in new social intelligence
- catering for and demanding sensible working time

- bringing in new elements and sensitivity to user interfaces and graphical design
- improving project management skills
- bringing in new dimensions to logical thinking.

Figure 1 shows an example on how women are attracted to ICT professions, and it also contains the detail that women count for maximum some 30 percent of ICT professionals, a data item not easily found anywhere.

Figure 1 Example of marketing targeted for women to choose ICT professions (Ma Carrière Techno, 2017)

There is also rich discussion but at the same time inconclusiveness about gender inequality in academic world (Moss-Racusin, Dovidio, Brescoll, Graham, & Handelsman, 2012): "*Despite efforts to recruit and retain more women, a stark gender disparity persists within academic science. Abundant research has demonstrated gender bias in many demographic groups, but has yet to experimentally investigate whether science faculty exhibit a bias against female students that could contribute to the gender disparity in academic science"*.
This article performs an unstructured literature review on how Gender Issues are seen in ICT education. To get a grasp on the issue, a wider perspective of ICT industry and profession is anyway unavoidable. We start the article with a short discussion of Digital Divide also materializing on the Gender Dimension (section 2). Section 3 documents our research methodology, and section 4 works out the results of our literature review. Conclusions are provided in section 5.

2. Digital Divide as a gender issue

The term digital divide refers to the gap between individuals, households, businesses and geographic areas at different socioeconomic levels with regard both to their opportunities to access information and communication technologies and to their use of the Internet for a wide variety of activities (Organisation for Economic Co-operation and Development, 2001). Although the most discussed demarcation line of Digital Divide does not occur between men and women, Digital Divide can also be seen as a gender issue.
There has long been concern surrounding gender disparities in ICT usage. In their empirical evidence from Oxford Internet Survey (Liff, Shepherd, Wajcman, Rice, & Hargittai, 2004) notes that women are less likely to use ICT than men. Although gender disparities in connection to ICT usage appear to be diminishing in developed countries, (Lang, Craig, & Egan, 2016) indicates that percentage of females pursuing ICT education

is very low as compared to males in developed economies. In general, despite the apparent closure of gender gap in ICT acceptance, there are general variations in usage.

For example, (Jackson et al., 2008) and (Punamäki, Wallenius, Nygård, Saarni, & Rimpelä, 2007) found that males used ICT for entertainment whereas females used it for communication. A recent study (Akçayır, Dündar, & Akçayır, 2016) however did not find any gender-related digital divide after analyzing a sample of 560 university students in Turkey and Kyrgyzstan.

In addition to gender race might be a key constituent of digital divide. A number of studies (Hoffman & Novak, 1998) (Jackson, Ervin, Gardner, & Schmitt, 2001) (Lorence, Park, & Fox, 2006) drew attention towards racial differences regarding disparities in access and usage of ICTs.

African-American male students usage of ICT is considerably less than white American males (Jackson et al., 2008); however, opposite results were reported in case of African-American females who used ICT more than white American females. This view was challenged by (Ervin & Gilmore, 1999) by following a mixed group of students based on race and concluded that African-American students use Internet equally when compared to non-African-American students. Similarly, (Katz, Rice, & Aspden, 2001) note that digital divide related to demographic factors including race is shrinking.

Conclusions of (Prieger & Hu, 2008) suggest that racial digital divide still persists with white-Americans more likely to use Broadband Internet than minorities in United States. An alternative evidence is provided in (Park, 2015) which reports opposite results: in a sample of 800 teens aged between 12-17 in United States, it was found that females and non-white teens were better equipped with ICT skills than male natives. These confusions project a need for re-understanding the digital divide on scientific footing.

3. Methodology

The method used for this article was unstructured literature review, based on snowball sampling. (Atkinson & Flint, 2001; Biernacki & Waldorf, 1981; Goodman, 1961) Found articles were analyzed based on their abstract, and the articles bringing in new insights or dimensions to the discussion were then scrutinized in detailed way. Further sources were sought from the references each article contained. The main search tool was Google Scholar, but occasionally also other platforms were consulted when Google Scholar did not find the refereed articles, or did not provide direct access to full-text. Normal Google (not Scholar) also turned very useful when more practical-oriented material was looked after. Keywords (a sample) used in the study are summarized in Table 1.

Table 1 Sample of used keywords

why women choose ict
why men choose ict
digital divide in ict education
sex differences in ict use
gender differences in ict use
sex differences in ict education
gender differences in ict education
gender bias in ict use
gender bias in ict education

4. Literature analysis results

A rich field of literature portrays that boys are more interested in computers than girls, and so become more experience of computer use. It has repeatedly been pointed out that boys use computers more than girls, have more computer experience, spend more time using the computer, and have more interest in computer-related activities (Broos, 2005). Females used e-mail more than did males, males used the Web more than did females, and females reported more computer anxiety, less computer self-efficacy, and less favorable and less stereotypic computer attitudes (Gill, 2002).

There is some literature on how women are seen as better information workers than men. We have already seen a lot of literature proposing that women are better managers that men (Bass & Avolio, 1994; Rosener, 1997; Ruderman, Ohlott, Panzer, & King, 2002), but less evidence is given to establish their better skills in ICT work. However, (Franks, 2000) found that women are portfolio workers par excellence – that their skills and experiences (e.g. multi-tasking) make them ideally suited to the project-based enterprises of the future. Contrary evidence, or evidence that women skills are not taken advantage of, was found by (Gill, 2002) when asking media workers about their project amounts: "*The average figure of eight hides a significant gender disparity: when disaggregated by gender men had worked on an average of nine projects over the previous two years, while women had worked on an average of six."*

Studies have also found that there is no difference in use of computers in classroom environments. (Rosener, 1997) found that female and male pupils reported similar levels of enjoyment of computers, but age differences in enjoyment and gender and age differences in confidence with computers remained significant.

Clarke (Clarke, 1990) found that sex differences favour males in overall computer use, course enrolments, programming and games, although there are few sex differences in the use of computer applications. Explanations focus on sex-based differences in expected outcomes.

Gill (Gill, 2002) found that media workers are dissatisfied practical tool education universities offer, and that males say that they master more software packages than women: *"many of them were highly critical of their formal education, and had supplemented this, after leaving university, with training in specific software tools and packages, e.g. programming languages, multimedia authoring or digital editing. The workers surveyed claimed to be familiar with between six and ten packages, with men claiming greater expertise".*

Some see inequality in computer use as permanent: Sherman & al (Sherman et al., 2000) suggests that differences continue to exist between college men and women in how they experience Internet technology and assessments that the Internet will soon be gender neutral are perhaps premature. Others see the gap closing (Imhof, Vollmeyer, & Beierlein, 2007): "*Results show that the gender gap is closing as far as computer access and self-efficacy are concerned. Also, female and male students report comparable amounts of computer usage for their studies. User behavior appears to be gender-specific as males spend more time at the computer for personal purposes. There is also some evidence that male students outperform female students at a computer task (remastering of Power-Point slides)".*

Some evidence (Torkzadeh & Koufteros, 1993) has been found to reveal that males are faster and more eager to learn about computers than women: *"Factor analysis revealed five constructs for describing patterns of computer user attitude: negative reaction to computers; positive reaction to computers; reaction to computers for children education; reaction to computer-mediated services; and reaction to computer games. Four factors show significant change in mean scores after the training courses. The attitudes changed for males more than females, indicating improvement in attitude ".* The attitude difference is also documented by (Clarke, 1990), reporting that boys still liked computers more, were more self-confident in their use and, unlike previously, sex-typed them less than girls. They also used computers more frequently out of school, particularly for playing games. There was some evidence that, as found previously, older girls held the least positive attitudes, and it is suggested that their approach to computers may be influenced by the cultural pressures of gender stereotyping. (Colley & Comber, 2003)

Gill (Gill, 2002) portrays the harsh career bath of women in new media professions: *"The reported differences started at school, with women claiming much fewer opportunities to use computers, and describing situations in which boys 'took over' the IT facilities, often intimidating female teachers. Inequalities persisted once women entered the field of new media, even when they had equivalent levels of IT skills to their male contemporaries. Women got significantly fewer of the work contracts, and those which they did were often for public sector or*

voluntary organizations rather than with commercial organizations (which went disproportionately to men). Women earned less money for their new media work than men."
Table 2 summarizes our literature review findings.

Table 2 Factors found differentiating between men and women in ICT education

Males disadvantaged	**Neutral**	**Females disadvantaged**
E-mail use (Gill, 2002)	Enjoyment of computers (Rosener, 1997)	Course enrolments (Clarke, 1990)
Computer self-efficacy (Gill, 2002)	Amount of computer usage (Imhof et al., 2007)	Games (Clarke, 1990)
Multi-tasking skills (Franks, 2000)		Overall computer use (Clarke, 1990)
		Programming (Clarke, 1990)
		Computer anxiety (Gill, 2002)
		Web use (Gill, 2002)
		Multi-tasking experience (Gill, 2002)
		Computer experiences (Broos, 2005)
		Time using the Internet (Broos, 2005)
		Interest in computer-related activities (Broos, 2005)
		Mastery of software (Gill, 2002)
		Personal computer usage (Imhof et al., 2007)
		Learning skills (Torkzadeh & Koufteros, 1993) (Clarke, 1990)
		General attitude towards computers (Clarke, 1990)

5. Conclusions

Women are clearly underrepresented in ICT work. If we take a wider perspective of media work in general, the situation might be different, but then we come to a wider concept, which borders are hard to define. There is a lot of discussion on how women might be even better ICT workers than men. Evidence or discussion on the other direction - hypothesising that men would be better suitable for ICT work than women – is hard if not impossible to find, this seems to be a taboo topic that one is not allowed to take up.
Wordwide there is a growing consensus of the current and especially future shortage of ICT workforce, take for example the examples of UK (Powell & Chang, 2016), Australia (C. A. McLachlan, Craig, & Coldwell-Neilson, 2016), Saudi-Arabia (Communications and Information Technology Commission, 2015), Belgium (Kelchtermans & Robledo, 2017), India (Agarwal & Malhotra, 2016) or South Africa (Kirlidog, van der Vyver, Zeeman, & Coetzee, 2016). To address this problem, actors at all level, including ICT management in organizations, must take activities to make sure that women have equal access to ICT profession.
Women are about half of the world population. Partly they value different things than men, and for example in marketing, reaching them might need different approaches than reaching men (Bartos, 1989; Popcorn & Marigold, 2000). These approaches might be better understood by women themselves than by men. For that reason, it is important to have gender richness in ICT workforce (as well as other richness also, and not just in ICT).

ICT work is often hectic with harried deadlines to be met. In most cases teamwork is needed. In such circumstances, social tensions might occur. Women might bring in alleviation to these stress factors through their social skills, that are anyway different from those of men, if not even better (Riggio, Tucker, & Coffaro, 1989; Sarason, Sarason, Hacker, & Basham, 1985). Wise ICT management might purposefully try to introduce women to all ICT working teams in order to enhance their social cohesion and functionality and productivity.

There seems to be a wide discrepancy between women success in ICT workplaces and ICT education. In ICT education (see Table 2) men often show more interest and motivation to work with computers, and often even superior practical skills. However, in later stages of career in practical real work, women seem to succeed as well as men or even better.

A good conclusion element is the post - feminist problem found by (Gill, 2002). She uses this notion to capture the reluctance of new media workers – men, but also most women – to understand their experiences as having anything to do with gender. Interestingly the field was perceived to be equally unproblematic for members of ethnic minorities and disabled people, suggesting that this is not just a gender issue but one that concerns structural inequalities in general.

The literature review done in this study was unstructured, and might end up to haphazard results. The study could be extended by making the literature review more structural one. On the other hand, a lot of interesting material seemed to be available outside academic sources. Some kind of wider media analysis could also cast new light to this interesting field of gender differences in ICT education.

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