EJSIT
European Journal of Science, Innovation and Technology
ISSN: 2786-4936
www.ejsit-journal.com
Volume 5 | Number 2 | 2025

The Role of Gender in Technology Adoption and Diffusion in the United States

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ABSTRACT

The purpose of this paper is to explore gender differences between men and women in the use of information and communication technology, with special focus on the frequency and intensity of use. Put in another way, to determine whether gender makes a difference in computer and internet use between men and women. Further, it explores whether differences in internet and computer use, "gender bias" or "gender gap" in technology use does indeed exist between the genders. Moreover, this research helps to inform whether such disparities have changed in recent years, reasons for concern, by how much, factors that are responsible and what should be done to eliminate gender-gap in technology adoption and usage. While reviewing numerous and available literature on gender and technology adoption and diffusion, necessary to contribute to knowledge on the subject, this research concludes that there exists gender-gap in computer and internet use in favor of males over females because of differences in factors such as socialization, modeling, anxiety or levels of comfort in technology-use and gender-related stereotypes. This research concludes with the recommendation of proper mitigation policies, steps and actions necessary to drastically reduce or eliminate the gender gap in technology adoption and usage that include but not limited to early socialization for girls, early exposure of girls in STEM fields, involvement of more females in technology training and deployment of high skilled and achieving females in engineering and computer fields as role models and mentors for aspiring females in the computer fields and related industries.

Keywords: Information Communication Technology (ICT), Gender Gap, Digital Divide, Internet Anxiety, Cyber Community, Gender Roles, Feminine Content, CompuServe, Software, STEM, Stereotypes, Technology Adoption, Technology Diffusion, and Technological Standard

INTRODUCTION

Access to technology (computers and the internet) should be equal and in no way based on one's gender. But gender bias to information communication technology appears to be a global reality, including in the United States. Gender bias has been defined by Eck et al. (1999) as "the preference for or favoring of one sex over the other in computer use and/or access, software use and/ or manufacturing, and internet use and content."; and or "preference for or favoring of one sex over the other in computer use and/ or access" According to Eck et al. (1999), the presence of gender gap and gender bias in access to technology reflect the following conditions in a societal setting:

- When there is disparity in the participation rates between women and men in science and math courses.
- When males outnumber females in computer science course enrollment.
- There is a variation in the ratio of males to females who heavily use computers.
- The application and use of software and games tend to favor males over females.
- When variations in computer use patterns and perceptions emerge- such as females viewing the computer as a tool to accomplish tasks whereas males see it as an instrument for recreation.

In almost every case, victims of gender bias in technology use have been women. Evidence is not far-fetched. More light is even shed by a study in 2009 by the U.S. Department of Commerce which looked at the gender gap in computer use, through the prism of the ratio of women versus men who are employed in STEM occupations in 2009. This is relevant because STEM fields are highly integrated programs with a high degree and intensity of computer use.

The study found that in among those studied in the entire STEM fields, 5,640 (76%) were male while 1,790 persons (24%) were female. Computer science and mathematics fields had 2, 534 males (73%) but 926 (27%) were female. For those employed in Engineering, 2,079 (86%) were men while 330 (14%) were women. With respect to those in Physical and Life sciences, 553 (60%) were male, while 374 (40%) were female. In terms of holding managerial positions in STEM fields, 474 (75%) were male STEM managers, while 157 (25%) were female STEM Managers.

Evidence from the U.S. Commerce Department study of 2009 shows clear evidence of gender gap in the use of information communication technology based on employment in STEM fields that rely heavily on computer and internet use skills. The purposes of this study are to:

- Explain what we mean by gender gap in computer use.
- Lay out any empirical evidence that exists relative to gender gap and gender bias.
- Reasons why gender gap exists between men and female in terms of access to computer and the internet.
- Discuss the differences and similarities between how males and females perceive as well as use technology.
- Suggest ways to bridge the technology gap between men and women.

BARRIERS, OBSTACLES AND IMPEDIMENTS TO TECNOLOGY ADOPTION

For educational technology to be adopted, several actions are needed. According to Wright (2014), the barriers, hurdles or impediments to educational technology adoption in the developing world include power, Internet connectivity and bandwidth, quality training and support of teachers or instructors training, and the sustainability of technology implementations.

Electrical Power Shortage

Electrical power is needed to run technological devices and until power is widely available, reliable, and affordable for many for many, educational institution technology to operate effectively. Most people living in poor and marginalized communities do not have easy access to electrical power. In poor communities, most people could not afford to purchase various electronic gadgets, and access to power is necessary to improve their lives because they would be able to easily read and access educational information.

Colleges and institutions willing to support educational technology initiatives face the challenges of how power will be provided to computer devices and solar power. Thus, power

generation has become one of the necessary initiatives to implement.

Such an initiative will undoubtedly increase the number of people who will be able to access electricity in marginalized communities.

Lack of Internet Connectivity

The potential to increase Internet connectivity is enhanced substantially and drastically pursuant to the laying and planned installation of marine telecommunication cables. However, communities that seem to show limited business demand for Internet services, such as Historical Black Colleges and Universities (HBCUs), are more likely to have trouble increasing Internet access. The major challenge facing poor and marginalized communities and institutions is delivery and guarantee of internet connectivity to colleges, dormitories, and homes at a reasonable cost. Furthermore, the bandwidth must be capable of carrying compressed videos so that people can have access to the wide variety of educational materials available in a video format and be able to exchange reasonable quality photographs and video clips. Increased Internet accessibility and increased broadband, and bandwidth are unlikely to occur without commitment by governments and the involvement of private enterprise like mobile phone operators. Broadband access to the Internet will be considered a basic human and educational right.

Lack of Training and Professional Development

Electrical power, Internet bandwidth, and electrical devices may all be present, but instructors need to know how to use them effectively. Teachers trained in a world with limited technology find it difficult to use technology to engage and support learning, particularly during the height of the Covid-19 pandemic that gave impetus as well as codified virtual or online education. At this time, there was a major transition from face-to-face or traditional educational, business and community engagements to those of virtual or online globally.

The training and professional development opportunities that are provided to teachers help them to grasp the concepts behind teaching technology, to have hands-on experience using the technology, as well as revise or develop one lessons that they can use when they return to their classrooms or operate virtually or in an online environment. Such training sessions should be held to enable teachers to locate, adapt, and translate open educational resources for their learners so that at the end of the training sessions, a greater number of participants will increase their knowledge and better apply what they have learned. Teachers should also support on-going training and support from mentors. In such conditions, government agencies are needed to foster a quality learning environment, as well as provide funding for many people to receive training that may transition.

Into or embrace blended learning environment that fosters the development of local learning communities so that learners can obtain the traditional face-to-face learning approach.

Sustainability

The goals of effective educational technology are likely to address issues like how technology or instructional methods to improve learning and how technology could be sustained. There should be efforts to guarantee that new instructional methods designed and introduced to learning are supported, implemented, and sustained. Such implementation of educational technology should not only facilitate and support effective teaching and learning but rather serve as a guardrail to challenges that arise during the implementation and sustenance of technology.

Until the issues of electrical power, internet connectivity, training and professional development and sustainability are addressed in a significant manner, educational technology and progress will be slowly realized in the global community.

WHY THE GENDER GAP IN INFORMATION COMMUNICATION AND TECHNOLOGY (ICT) USE

The reasons for gender gaps and disparities in ICT use are supported by a multitude of empirical research and evidence. Sakamoto (1994) found that in a group of grade school-goers who were defined as "heavy" computer users, the ratio of males to females using computer was 1:4. Not only did the gender gap in computer use continue, but the study also revealed that the gap continued into the high school and college years of the students. This shows that computer use attitudes instilled in children are reinforced in their adult years or as they mature to adulthood, showing the importance of socialization associated with computer and information communication technology use.

Another study by Wilder, Machie and Cooper (1985) attributed gender gap in technology use to differences in interest, preference and pedagogy by teachers. The researchers argued that teachers and the educational institutions tend to influence the gender gap in ICT use by virtue of the fact that separation of students as far back as kindergarten was partly to blame, thereby planting different expectations in them; as well as the fact that boys are more attracted to computer games and mechanical toys, while girls are more likely to gravitate toward playing social games and playing with dolls. Other researchers such as Swanson (1999) argue that lack of female role models account for why women are less likely to use computer and information communication technology than their male counterparts. The study also shows that girls who were exposed to female role models in science and technology fields, especially when exploring their career opportunities and choices were more likely to develop higher expectations as well as pursue careers in such fields.

For Canter (1991), the family unit constitutes the greatest influence in the academic life of children. Parents views regarding gender and gender roles tend to send strong attitudinal and expectation signals to males and females about their environment; and that these attitudes are reflected in the choices of careers and preferences that their children engage in. Parents should therefore expose their children to technology in their early years, regardless of their gender; explain to them the relevance of computers and the internet in their daily lives, as well as in other varieties of activities such as work and fun; provide them with opportunities to use computers by buying technology products that interest their daughters.

Beyond the studies stated above, the National Telecommunications and Information Administration (NTIA) study titled Falling through the net II: New Data on the Digital Divide (July 28, 1998) - http://www.ntia.doc.gov) also acknowledged gender-based digital divide when they examined other demographic factors such as "household type" and "Female-headed households" which appeared to establish some moderating influence on the disparities of access to computers and information technology such as the internet between women and men. With respect to "household type", NTIA (1998) established the fact that family structure could drastically influence the gender-based bias in ICT use.

It found that households that consisted of married couples with children and those without children had telephone penetration rates of 96% and 96.7% respectively, which were above the national average. However, single parent households trailed the national average, with male headed households having telephone penetration rate of 87.1%; female-headed households 86.3%. Households composed of married couples with children were found to be roughly twice as likely to own a personal computer (PC) and have online access (internet) at the rate of 57.2% and 29.4%, respectively. This compared to single parent households headed by a male at 30.5% to 14% or a female at 25% to 9.2% or households without families at 23.5% and 18.9%, respectively.

Regarding female-headed households, the NTIA (1998) discovered that single parents and female households also lagged the national average in ICT use; trailed the telephone rate for married couples with children by 10% (86.3% to 96%). The study also found that they are

equally less likely than dual-parent households to have a personal computer (25% vs. 57%) or have online (internet) access (9.2% to 29.4%). But female-headed households living in central cities were found to be particularly unlikely to own PCs or have internet (online) access at the rate of 20.2% to 6.4%, compared to dual-parent households (52%: 27.3%) or male-headed households at the rate of 28%: 11.2%) in the same surroundings or localities.

GENDER ATTITUDES AND INTERNET USE

Numerous academic studies have demonstrated that gender remains a major predictor of computer and internet use. Research has shown that gender gap does indeed exist between men and women in their use of information communication technology (ICT). Jackson et al. (2001a), (2001b) and (2007) argued that male and female college students used internet equally with respect to frequency and intensity, but that disparities occurred in terms of how or the way they used it. For example, they noted that females were more interested in the communicative aspect of ICT use because they are more interpersonally oriented than their male counterparts who tend to be more information and task oriented than the women.

A survey conducted by Odell et al. (2000) of 843 students from eight Colleges and Universities suggests that males use the internet for a wider variety of purposes that females. For example, male college students were (36.4% to 26.6%) more likely than females to research purchases; (59.5% to 39.5%) to search for news information; (43.6% to 26.6%) to play games; (49.6% to 26.9%) to listen to or copy music on the internet; and (25.5% to 1.3%) to look for sex site online. Further, Odell et al. (2000) believed that more female college students use the internet for bulletin boards, e-mails as well as research activities than their male college student counterparts who are internet users; even though these outcomes are moderated or confounded by the presence of certain factors that include study habits, academic major and types of school attended – private or public.

Bressers and Bergen (2002) reported that in general, male college students spent considerably, more time using the internet that female college students. Also, they noted that female college students are more likely to search for information related to children and the family online than their male contemporaries; and that male students are equally more likely than females to read the online versions of their school newspapers; use the internet for games, sports, personal finances, politics and government, computing and information technology as well as “adult content”.

Consistent with the findings of Fortson et al. (2007), Bresser and Bergen contend that males and females spend approximately the same amount of time using e-mail, but with no significant difference on the amount of time devoted to such matters as shopping, academic research, job search and general information searches. In fact, the findings of Bresser and Bergen (2002) appear to contradict the conclusions drawn by Fortsen et al. (2007); Jackson et al. (2001) and Odell et al. (2000) that male and female college students tend to spend roughly the same amounts of time online. It is therefore shocking to reconcile the conclusions of Bresser and Bergen (2002) that on the whole, male college students spend more time on the internet than female college students with those of Anderson (2001) and Morahan-Martin and Schumacher (2001) that males are also more likely than females to report spending time enough on the web; to be considered internet abusers given the fact that they out-spend females on time spent using the internet. However, Cotton and Jelenewicz (2006) stated that female college students spent less time playing online games and more time using bulletin boards than their male colleagues.

Other researchers have focused their research extensively on the nexus between gender-based attitudes and internet use. Several studies have shown varied concerns and perceptions toward internet use especially with regard to use and privacy among male and female college students. In a multi-year study conducted between 1997 and 1999, Sherman et al. (2000), noted

that men used technology more often than women, and had more positive attitudes about their experiences with technology than women, but only except for e-mail usage. In a similar report of Hispanic freshmen at a South-Western American University, Slate et al. (2002) concluded that men had more positive attitudes about the internet than women as well as expressed being more comfortable and less confused with their application. The researchers also found the same conclusions regarding internet use than their female contemporaries. However, the only variation in result came with female undergraduate students who expressed a more positive attitude with respect to educational uses and application of the internet than males.

The study conducted by Sherman et al. (2000) indicates that attitudinal differences existed between male and female computer users primarily due to whether they feel the internet is personally relevant to their lives. Further, their study also suggests that gender-based differences resulted between males and females as regards role models. When the participants were asked about the sex or gender of the people who most influenced them to utilize the internet, 83% replied that a male role model was their greatest influence. Approximately (47%) of the female respondents reported that their greatest influence in computer use was a male; while 53% of the females admitted that a woman was the source of their greatest influence to use the computer or go online. Thus, Sherman et al. (2000) observed that females in internet-oriented courses taught by male professors are less likely to see technology as personally relevant to their lives, than women in courses that are taught by female colleagues. They then concluded that it is very unlikely that gender gap in computer use will be reduced if the majority of professors who teach courses that integrate or incorporate technology in our colleges and universities are men.

In a subsequent study, Zhang (2002), in a comparative study of "internet anxiety" regarding computer use among college students, found that males felt more comfortable with the internet than their female counterparts. Another study by Nelson, Weise and Cooper (1991) concluded that females who dropped out of computer courses had higher computer anxiety than those who did not drop out; but that, males who dropped out experienced lower anxiety levels than those who did not drop out. The study by Whitley (1996) showed that prior experience did not mediate gender differences in anxiety, but that anxiety mediated gender differences in computer and internet behavior. Another research by King, Bond and Blandford (2002), which tracked students over a three-year period, found that girls were more anxious than boys in grade 7, lower in grade 11, but equal in grade 9. Also, Todman (2000) who conducted a survey of incoming college freshmen between 1992 and 1998 concluded that as years pass by, males tend to become less computer-anxious in contrast to females who became more computer-anxious.

Drawing from the study by Jackson (1998) on internet use, Jackson et al. (2001a) discovered that women were more likely than men to report computer anxiety; less favorable attitudes regarding computer use and less computer self-efficacy (tendency to under-estimate their technology skills regardless of what their true skills really are). Further, they argued that women are in a more general sense, more wary or uncomfortable around computers and computer use, and somehow, more likely to believe that computers are taking over than their male counterparts. This conclusion, they argue is drawn from the fact that females tend to show more reticence, reservation, reluctance and unwillingness attitude toward computer and internet use than males, in terms of their patterns of technology adoption and usage.

The investigation by Cooper (2006) which examined the impacts of gender-related stereotypes on computer performance argues that if negative stereotypes associated with female use of technology remain salient and socially reinforced, the digital divide between male and female college students would eventually persist. Moreover, McMillan and Morrison (2006) suggest that family environment may in fact reinforce gender stereotypes related to ICT perception and use. Their conclusion reflected their analyses of 72 autobiographical essays from young adult college students in which they extrapolated that in the participants' homes,

fathers were perceived as enablers of ICT use, while mothers were viewed as reluctant and unwilling in their use of information communication technology.

LITERATURE REVIEW ON GENDER AND COMPUTER USE

A myriad of surveys of scholarly sources and current research related to gender-gap in technology adoption and usage do exist and have enabled us to discover aspects of research already conducted in this area, their findings as well as pinpoint areas that need further research and attention.

Barret and Lally (1999) examined the use of computer mediated communication (CMC) in a learning environment of postgraduate distance learners and their instructors. Using a content analysis of online dialogue to investigate learning and socio-emotional behavior within the community, they found that men and women took distinct and different roles in the online learning environment. Most significant was the finding that the cognitive and learning content of online contributions by men and women was similar, but their social and interactive behaviors were found to be significantly different. That is, within a formal online learning environment, men sent on average, more messages than women; and wrote messages that were twice as long as those sent by women; and made more socio-emotional contributions than women. In contrast, women were found to contribute more socio-emotional contributions than men. Hence, the researchers concluded that the application of CMC technology to specific - learning context is likely to produce sender differences within a learning society.

Dennis et al. (1999) studied the effects of media richness on decision-making among selected teams – all male, all female and mixed gender. They relied on one form of "new media" (computer-mediated communication) that showed that participants took longer time to make decisions with computer-mediated communication. Matching richness to task resulted in better performance for all-female teams, likely because females are more sensitive to nonverbal communication and more affected by its absence in computer-mediated communication. For remaining teams, the investigators, using richer face-to-face communication did not improve performance to a greater extent for more equivocal than less equivocal tasks. Their findings tend to support media richness theory only for all female teams.

Ferris et al. (1996) in their study predicted that unique characteristics of computer-mediated communication would mitigate gender differences. Thus, they reviewed literature chronicling recent increases in participation of women online. They concluded that women's communication in cyberspace often mirrors face-to-face communication, both relationally and linguistically. They however, suggested that online communities could offer women a unique communication opportunity that would eventually allow them to develop and display their cultural and relational styles.

Gruber (1999) examined the concepts of gender and race in virtual environment by presenting a case study analysis of African American women's online personalities. The study found that women's presence in college classroom environments and their online contributions to Cyber community of peers influenced the women as well as their group's perspectives on violence and gender issues. The study shows that women's interactions on a virtual forum are shaped by a multitude of factors such as socialization (upbringing), school influence, as well as determination to succeed despite their hostile environment and gender identity. Hence, they suggested that women's online habits and activities or virtual forums have significant enhancing effect on student learning, diversity and multiple perspectives in classroom learning environment.

Herring (1994) argued that researchers have been one-sided or biased in their experiments regarding men and women. Unsurprisingly, she argues, men have traditionally dominated the technology, as well as comprised most users of computer networks since their introduction; and that it was not until the 1970s, that they paid attention to the gender of

technology users. She argues that recent research has shed light on the differences that exist in the ways men and women interact online. She claimed that first, women and men have recognizably different styles in posting to the internet, contrary to the general claim and notion that computer-mediated communication neutralizes distinctions of gender. She further asserts that women and men have different communicative ethics. Put in another way, women and men value different kinds of online interactions as appropriate and desirable.

Herring (1999) in another study compared two extended interactions that took place on the internet. One was from a recreational internet relay Chat (IRC) Channel and the other from an academic Listserv discussion group. She found that the two interactions exhibited similar gender dynamics that could be described as the harassment of females by male participants. The setting of the experiment was designed in such a way as to make sure that harassment took different forms, in keeping with the possibilities inherent in the two modes of computer-mediated communication. While the female participants on IRC were kicked off the channel in the discussion group, harassers must rely exclusively on language to intimidate and silence. The rhetoric of harassment, designed to invoke the freedom of expression, constructed women's resistance as "censorship". The study concludes by showing that a rhetorical analysis of the two harassment episodes highlighted the means and strategies used to construct and maintain asymmetrical gender and power dynamics in different modes of computer-mediated communication.

Another investigator, Fortson et al. (2007) observed that although males and females depicted similar academic uses of the internet as well as rates of e-mail use, in a general sense, male college students appeared to be more likely to use the internet as an entertainment source as opposed to female students who showed more predisposition to go online primarily for educational and communicative purposes.

Rodino (1997) studied virtual environments as basis of testing theories of gender and language on the internet. She analyzed interactions in Internet Relay Chat (IRC) environment to observe the extent to which research on face-to-face talk and computer-mediated communication could describe gender and its relationship to language. She found that neither the function of expressions nor the construction of gender conforms to dualistic descriptions which were advanced by past researchers. She suggested that reframing gender as performance-oriented would assist researchers to abandon their old theories and belief about gender-based computer communication. She suggests that the way to demystify and disrupt the binary gender system would be to conceive gender as undergoing constant construction or change.

Savicki et al. (1996) conducted research that organized small but varied online task groups according to gender of group members and content and amount of cooperation required. The Gender group composition consisted of Female only (FO); Male Only (MO) and Mixed Male and Female (MIX) Group. The two task conditions comprised "feminine content"; decision making (Masculine Content/ Intellective) task. The groups agreed on the task answer using only non-synchronized computer-mediated communication. The experiment predicted that FO and MO groups demonstrate communication and satisfaction difference as a function of tasks assigned and group composition.

Also, the experiment expected to observe a relationship in which group composition was related to several group process variables in significant ways. . The research found that overall, task differences remained weak. FO groups were observed to have sent more words per message; were more satisfied with the group process and reported higher levels of group development than both the MO and MIX groups regardless of the nature of task. But both the task and gender composition variables were related to various measures of language choices. The study concluded that mixed results about gender composition and choice of language require a further examination of gender effects on computer-mediated communication when occurring in small task groups. The study suggested that the choice of language relates to task

type since generally opposite of predictions demand thorough clarification of task distinction and methodologies used; and that the significance of any results lie in the definition of the styles of communication in the computer-mediated communication context to enhance group development.

Savicki et al. (1996b) studied group gender composition and their relationship with gender roles and group process functions described as task and maintenance as found on the internet. The sample for their experiment was drawn from randomly selected set of 27 online discussion groups from both commercial information services (compuserv) and the internet, using project dataset. The 2,692 valid messages were coded for language contents- fact, apology, status, and first person flaming) that had been related to gender roles in other investigations. Every message was coded in terms of the gender of its author. Their observations were consistent with the conventional belief and notion that men far outnumber women as participants in online discussion groups. Nevertheless, the investigation showed mixed results regarding the relation of language patterns and group gender makeup or composition. Although gender composition was related to patterns of computer-mediated communication in their experimental situation or context, there existed an unexpectedly high proportion of participants of indeterminate gender in the dataset. The researchers concluded that although it was difficult to test their hypothesis, their investigation was both credible and reliable, because they relied on "real life" groups in the conduct of their study.

Savicki et al. (1999) investigated the ability of readers of computer-mediated communication messages to identify the gender of the author when messages were selected for language characteristics identified in their earlier or past studies showing that gender, group composition and task type in a small task group using computer-mediated communication are associated with both group development and gender. Twenty messages from previous research were sorted into gender groups as well as into high and low communication style categories. Participants were asked about their perception of the probable gender of message of the author and their certainty of the judgment. The study found that accuracy and certainty of judgments of gender showed significant differences between gender communication style conditions. Nevertheless, overall accuracy or certainty of judgments were not related, neither was there a difference in accuracy or certainty of judgments between male and female judges. In the end, judges' accuracy followed gender stereotypes for messages sent by men but were opposed to the stereotype for messages sent by women.

Soukup (1999) explored the gender discourse of social-based computer mediated contexts. More specifically, it looked at the patterns of discourse of both sports-related (masculine-dominated) chatroom and female-based (feminine-dominated) chatroom. Relying on participant observation methodology, the researcher found that traditionally masculine and feminine forms of discourse dominated the chatrooms. Next, the groups constructed and maintained inactive forms of behavior. The findings of the study showed that masculine participants were aggressive, argumentative and power-oriented, while female participants sought relationships and intimacy; and were often dominated and overpowered by the aggressive discourse of the masculine members. The researcher concluded that these findings have significant implications for the construction of gender in cyberspace; the normative behavior of computer-mediated communication, and power and gender in the use of technology.

Stuhlmacher and Walter (1999) set to show that expectations about differences in settlement and negotiated outcomes are a result of perception, behavior, and contextual factors between men and women. In the study, opponent sex, relative power of the negotiator, potential of the task, methods of communication and years of the study were tested as potential moderators of the effect. The researchers discovered that men negotiated significantly better outcomes than women. They then concluded that even though the overall differences in

outcomes between men and women is small, none of the potential moderators reversed or eliminated the effects. They suggested that the results of their findings could help to comprehend the issues and dynamics surrounding glass ceiling, gender-based earning differentiation and women in negotiation and contract positions.

Wachte (1999) studied the effect of gender and conflict on the process and outcomes of people using various forms of communication media. The purpose of the study was to determine the effect which gender exerts on the evaluation of the capability of the communication environment to provide relational support under conditions of conflict. The researchers hypothesized or predicted that members of female-only and male-only dyads would demonstrate satisfaction differences and variants in their ratings of the communication environment as a function of their gender distinctions. In the observation, the investigator observed an interaction between media and gender concerning evaluations of the communication environment's ability to support affection, domination, similarity and trust. Nevertheless, the researcher concluded that there was no difference in performance levels across media and gender composition.

Witmer and Katzman (1997) tried to determine the gender of a message sender from cues in the message, by relying on gender-bending computer-mediated communication. Drawing on current literature, the researchers tested three hypotheses that include – women use more graphic accents than men do in their computer-mediated communication; men use more challenging language in computer-mediated communication than do women; and men write more inflammatory messages than do women. The researchers concluded that only the first hypothesis that women use more graphic accents than men do in their computer-mediated communication appeared to be supported by the result of the research; and that women tend to challenge and flame more than men do.

Yates (1997) tested recent assumptions regarding computer-mediated communication with respect to gender, identity and inequality. This is against the backdrop of different research claims that Computer-mediated communication-based interactions lack the overt structures of inequality which characterized other communicative situations. Another claim is that online equality is partly based on empirical research. Competing against this study is a growing body of research evidence on computer-mediated communication, gender and other structures of inequality that clearly show disparities or differences in access as well as in practice. By testing various claims on the issue and deploying research into the cultural aspects or dimensions of gender identities the centrality of computer-mediated communication interactions is established.

Zdenek (1999) attempted to test old hypotheses advanced by theorists such as Herring (1996) and Bruckman (1993). Bruckman (1993) had claimed that freedom from sexism and other forms of oppression are consequences of changes in online handle; a practice known as 'gender swapping". Also, it tests the postulation of Herring (1996) which asserts that communication in cyberspace reinforces existing social hierarchies, including gender differences found in face-to-face contexts. The experiment by Zdenek (1999) treated a series of talking software programs as important objects for studying how software design is implicated in the construction of gender differences. This study found that in addition to the programs' databases of gendered utterances and internal models of communicative interactions, these disparities, while negotiated and reinforced, contribute to our understanding of how and why software programs are gendered.

GENDER ROLES AND STEREOTYPES

Gender biases in internet and computer use are attributable to two main causes: (1) gender roles and stereotypes and (2) gender–based computer use patterns. These gender bias influences appear to influence the choices of males and females, but especially, the girls, in computer-related choices.

Gender roles affect men and women because males and women are judged differently based on how well they conform to traditional stereotypes. Hence the intensity and frequency in computer as well as overall performance in computer use by men and women are impacted. Kekelis et al. (2005) found that parents were less likely to give girls increased computer-related support than boys. The consequence of which is that parent's computer stereotypes in favor of their daughter as opposed to their sons encouraged their sons computer involvement while discouraging those of their daughters, according to Shashaani (1997); and that women who perceived pursuing a career in computer-related field was more appropriate for their sons than their daughters were less interested in computers (Shashaani, 1997; Shashaani & Khalili, 2001). In other words, computer attitudes were found to correlate with math, technology, science and engineering (STEM) attitudes.

Moreover, societal media have been implicated in the well-coordinated gender stereotyping according to studies by Sanders (1998) which concluded that men were 75% of the time portrayed and mentioned than women, and that gender stereotyping were as well common when discussing the technical roles of people in computer, TV, movies and internet advertising (Knupfer, 1998; Knupfer, Rust & Mahoney, 1997).

GENDER-BASED COMPUTER USE PATTERNS AND CHARACTERISTICS

Gender –based computer uses characteristics appear to explain gender-gap in computer and internet use. According to studies by Cassell and Jenkins (1998) and Goodfellow (1996), boys tend to play games at younger ages and for longer periods of time than girls. This persistence in game playing by boys over time and all the way to old age appears to boost their confidence level and thus make them less likely to drop out of computer programs as established by Kekelis et al. (2004). Furthermore, this conclusion tends to support the findings of Todman (2000) that females, more than males tend to express higher levels of computer anxiety in computer behavior.

In another study on computer use patterns, the researchers tried to determine the study habits and preferences of boys and girls. Ching, Kafait and Marshall (2002) concluded that girls chose to work on the computer in a more collaborative manner, as opposed to boys whose preferences were to work on the computer individually. In the study, girls described their ideal computer use condition as one that allows for collaboration and sharing, while the boys responded that it is one that gives them total control and power. This conclusion coincides with the one drawn by Bruner (1992); Miller, Chaila and Groppe (1996) which found that 6^{th} to 12^{th} grade female students showed preference to software programs that required them to work more collaboratively as opposed to competition.

Other studies by Sanders (1985); Cohoon (2001); and Blum (2001a) concluded that the absence of the girls' girl-friend, rather than the presence of boys in computer environment that discouraged or impeded their participation in computer experience; and that the presence of the female critical mass in computer experience was the main factors that increased women enrollment, participation, as well as retention in computer based experience among women.

Teo and Lim (1997) who studied internet users in Singapore found that males and females engage in different internet activities and for different purposes; and that while females spend more time on the internet primarily for messaging activities and promotional campaigns, males spend most of their time downloading and purchasing activities.

Lorence and Park (2007) observed a difference between male and female internet users with respect to online health information users. They found that females were heavier users than males. This finding contradicts the studies by Wolin and Karaonkar (2003) that showed that gender differences in attitudes, beliefs and behaviors toward web advertising indicated some slight differences. Hence, the investigators concluded that males are more likely to browse the internet for functional and entertainment purposes as opposed to females who are more interested in shopping.

Hargittai and Shafer (2006) argue that with skills forming the framework or lens through which to frame the gender debate regarding inequality in computer use. They explored gender variations in internet usage between males and females – the ability of the user's ability to effectively and efficiently locate content; and concluded that there exists a significant gap between the male and female attitudes to technological abilities; a finding that refutes those of Heimrath and Goulding (2001) that states that based on the feeling of women that the internet is complex and unstructured (difficult and unenjoyable),the internet should be only used sparingly unless under certain unavoidable circumstances, whereas the male students, unlike the females, expressed positive attitude toward searching the internet for relevant information

For Eimeren, Gerhad and Fress (2004), males more frequently use the internet during the weekends, while Winker (2005) argues that men use the internet more frequently and for longer hours (heavy users) while women's intensity of use is much lower and could be categorized as moderate users

Liu and Huang (2008) reported significant difference between male and female behavior in online reading environment. By focusing on female/ male differences in web searching materials, such as online reading environment, they discovered that female readers have a strong preference for paper as a reading medium than male readers; and in contrast, male readers appeared to have greater sense of satisfaction or utility with web-based/ online reading.

CONCLUSION AND RECOMMENDATIONS

There is consensus opinion among scholars based on empirical evidence that gender gap in the use of technology indeed exists. Put in another way women experience gender-based bias in terms of access to computers and the internet. Based on the study by NTIA (1998), women are less likely to own computers at home or even have internet connectivity. The matter even becomes worse when women single-parents and women-headed- households are thrown into the equation, mix or picture when compared with their male counterparts. Many factors outside demographic forces account for the reasons why women are disadvantage in comparison with men in terms of computer and internet use. One factor is attitude toward computer use and internet use. According to Teo and Lim (1997); Lorence and Park (2007) and Liu and Huang (2008), women use computers and the internet primarily for interpersonal relationships- messaging, promotional campaigns, chatting and shopping etc.; more males use them mainly for task and informational oriented issues- search for news, play games, copy music online, and conduct research. Men are also known to spend more time on the internet; being considered "internet abusers" than women. This reinforces the thesis of Winker (2004) that men use the internet more frequently and for longer hours (heavy users), while women's intensity of use is much more moderate. This may also account for the fact that men appear to be more comfortable on the computer than women – a condition Zhang (2002) and Todman (2000) referred to as "internet anxiety".

According to Cassell and Jenkins (1998); Goodfellow (1996); Sanders (1985); Cohoon (2001) and Blum (2001a), because males play computer games at much younger age than females, males develop (more enduring capacity) such as higher levels of confidence that pushes them to enroll in, stay and not drop out of computer programs and courses. Furthermore, lack of a critical mass (absence of fellow women) in computer experience and environment

was known to be a determinant factor in the decline of female enrollment, participation and retention in computer courses.

The next factor that drives gender gap in technology use is gender roles and stereotypes. Males and females are judged differently based on how well they conform to traditional stereotypes. As observed by Kekelis et al. (2005); Shashaani (1997) and Shashaani and Khalili (2001), parents are more likely to give boys computer-related support than to their daughters. The consequence is that daughters are less encouraged than their brothers in a typical family to be interested in or even consider pursuing computer-related careers.

Furthermore, gender stereotyping is prevalent in the media whenever technical roles of people in computer and internet advertising are under discussion. As Sanders (1998) found, men are 75% of the time portrayed and mentioned compared with 25% for women.

To bridge the gender gap in computer use, the following recommendations are hereby proposed:

- Change the content of computer games and other technology contents and applications to encourage female involvement at younger ages by manufacturers.
- Parents and educators should provide computer-oriented programs and experiences that will engage girls as well as emphasize interaction and exercises that enhance computer and internet skills.
- Reorient educational experiences in ways that will provide increased exposure of girls in STEM fields through enhanced math and science curricula.
- Improve and change the public and societal stereotype perceptions of computer scientists/ field as “misfits”, “geeky computer nerds”, “all male-field” and “nothing but programming”.
- Increase the number of women that enroll and participate in STEM field/ critical mass.
- Showcase appropriate and successful female mentors and role models for prospective girls in the engineering and computer fields.
- Improve the accessibility of technology training for many women, through targeted programs to support struggling families. For example, provide subsidized childcare or credits to especially single parents and female headed households who fall behind the national average in computer ownership and internet access.
- Improved preparation and encouragement of women in STEM areas/ fields.
- Equalizing opportunities across gender by elimination of bias and discrimination in hiring, promotion and advancement of women, knowing full well that on the average women are paid less in salary/income even in their areas of expertise; are less likely to be employed full-time and are more likely to work part-time than their male counterparts.

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