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Using technology in higher education: The influence of gender roles on technology self-efficacy

Ann Hergatt Huffman [a,*], Jason Whetten [b,1], William H. Huffman [c,2]

[a] Department of Psychology and W.A. Franke College of Business, Northern Arizona University, Flagstaff, AZ 86011, United States
[b] Department of Psychology, Northern Arizona University, Flagstaff, AZ 86011, United States
[c] College of Social and Behavioral Sciences, Northern Arizona University, Flagstaff, AZ 86011, United States

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ABSTRACT

The present study examines the relationship between technology self-efficacy among university students and gender roles. Previous research has based differences in technology self-efficacy on biological sex and found significant differences. University students were asked to complete a survey dealing with gender roles and technology self-efficacy. The current study shows that gender roles, specifically masculinity, is the source of this difference in technology self-efficacy, and not biological sex alone. Further, masculinity predicts technology self-efficacy above and beyond what can be explained by other contributing factors such as previous computer hassles and perceived structural technology support.

1. Introduction

Great scientific advances have prompted the development of technologically driven teaching strategies in university settings (Surry, Ensminger, & Haab, 2005). Integration of instructional technology is one of the most important issues for educational reform (American Psychological Association, 2008; Peng, 2006). Although the use of technology in learning has been shown to increase intrinsic motivation, enhance critical thinking and develop a more global perspective (Speaker, 2004), many students do not learn the skills needed to master technology as quickly as others (McCoy, 2010). This is concerning because the perceived ability that students have when using technology is a vital aspect in their frequency of use of technology.

Technology use in its many forms is continuing to grow in schools, businesses and homes. However, the progression towards expanded use has not always moved as quickly. In a 1987 study, 58% of teenagers aged 14–18 had never used a computer (Durndell, Macleod, & Siann, 1987) and in 1993, only 27% of children indicated that they used a computer at home (Dorman, 1998). In a more recent census, 68.7% of households used the internet at home (US Census Bureau., 2009) and 83.9% of students used a computer on a weekly basis to complete assignments (Sax, Astin, Korn, & Mahoney, 2003). Although the use of technology has increased overall, there continues to be differences between segments of our population (e.g., minority, women, older) reporting less computer use than others (Lebens, Graff, & Mayer, 2009; Levin & Barry, 1997; Yardi & Bruckman, 2012).

The goal of the current research is to investigate what factors lead to differences in computer self-efficacy between men and women. Specifically, we propose that gender roles, a variable that affects the attitudes and expectations of men and women, mediate the relationship between sex and computer self-efficacy. Based on modern theories of gender roles (Wood & Eagly, 2002) and self-efficacy (Bandura, 1982), we suggest that technology self-efficacy relies less on biological sex and more on societal based gender norms. Specifically, we propose that educators and researchers need to look beyond biological sex and use gender as a factor to understand how students' perceive their own ability and attitude in regards to the use of technology in the classroom.

2. Literature review

2.1. Technology self-efficacy

There have been a number of studies that have investigated the acceptance or rejection of technology (e.g., Cooper, 2006; Dorman, 1998; Durndell et al., 1987; Huffman & Huffman, 2012; Young, 2000) and perceived technological ability (e.g., Arthur, 1991; Coffin & MacIntyre, 1999; Peng, 2006). One reason frequently given for a student's negative perceptions of technological ability in the classroom is that they suffer low technology self-efficacy (Igbaria & Iivari, 1995). Self-efficacy is defined as the "generative capability in which cognitive, social and behavioral sub-skills must be organized into integrated courses of action to serve innumerable

* Corresponding author. Tel.: +1 928 523 5881; fax: +1 928 523 6777.
E-mail addresses: ann.huffman@nau.edu (A.H. Huffman), jasonlwhetten@gmail.com (J. Whetten), bill.huffman@nau.edu (W.H. Huffman).
[1] Fax: +1 928 523 6777.
[2] Tel.: +1 928 523 9508; fax: +1 928 523 7185.

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purpose" (Bandura, 1982, p. 391). In other words, self-efficacy is the personal belief a person maintains as to how well they can perform a task. Technology self-efficacy is the belief that one has the sufficient and correct abilities and skills to be successful when dealing with a technology related task (McDonald & Siegall, 2001). Since self-efficacy in general is related to actual behavior (Bandura, 2012) it is important in trying to understand whether students will be likely to use technology in support of their education.

In addition to the relationship between self-efficacy and behavior, technology self-efficacy is important for several additional reasons. Many students are entering college and the workforce without basic computer knowledge or skills (Isman & Celikli, 2009). This lack of experience with technology directly affects the students' level of technology self-efficacy (Gist & Mitchell, 1992; Isman & Celikli, 2009) and those with lower technology self-efficacy are more likely to experience higher levels of anxiety related to technology use in both the classroom and workplace (Shu, Tu, & Wang, 2011). Further, technology self-efficacy has been shown to be a significant predictor of a student's future academic and career trajectories (Vekiri & Chronaki, 2008). Both of these issues could have unintentional consequences. That is, if there are sex or gender differences in technological self-efficacy, then women or less masculine people are more likely to have lower performance and/or the resultant lower paying jobs.

2.1.1. Sex differences and technology self-efficacy

Overall, researchers have demonstrated that males have more positive attitudes toward computers when compared to females (Coffin & MacIntyre, 1999; Whitley, 1997). Males appear to report lower levels of anxiety around technology (Coffin & MacIntyre, 1999; Cooper, 2006), more comfort in using computers (Young, 2000) and are shown to be more knowledgeable about all aspects of computers (Durndell et al., 1987). However, there has been some research that reports no sex differences (Compton, Burkett, & Burkett, 2003; Havelka, 2003), or even some that reported positive outcomes for females (Colley, Gale, & Harris, 1994; Compton et al., 2003; Ray, Sormunen, & Harris, 1999), yet these findings are much less common. It should also be noted that research has shown that this digital divide or "computer gender gap" (Young, 2000, p. 205) is an international phenomenon and that the differences between men and women's self-efficacy and attitude toward computers is consistent throughout the world (Cooper, 2006). We propose that sex differences continue to exist in relation to technology self-efficacy.

Hypothesis 1. Biological sex is related to technology self-efficacy such that men report higher levels of technology self-efficacy than women.

2.1.2. Gender roles as an explanatory variable between sex and technological ability

Although it appears that there are differences between males and females computer self-efficacy, there is less known about why these differences may occur. We suggest that it is the influence of gender roles with which males and females are exposed that affects their perceptions of their technological ability. That is, we propose that gender is a more appropriate construct to assess than biological sex in examining differences in technology self-efficacy. Biological sex is generally viewed as the biological differences in males and females of a species. Gender however is defined as "cultural and is the term to use when referring to men and women as social groups…" (American Psychological Association, 2001, p. 63). The term gender also refers to those behaviors that are culturally appropriate to males or to females (Unger, 1979). Gender then becomes a matter of a social phenomenon and an accumulation of experiences rather than simple biology (Unger, 1979).

Gender is divided into social roles pertaining to both males and females. Gender roles are an important variable because they provide a better designation of one's sexual identity and they better describe attitudes and behaviors (Adler, Kless, & Adler, 1992). Gender role theory states that gender roles are used to place men and women in different social structures and provide expectations for each sex to have characteristics that equip them for tasks their sex usually performs in their society (Wood & Eagly, 2002). For example, the needed skills, motives and values to accomplish tasks generally completed by women are incorporated into the female gender role. Over time, these roles become engrained into a given society and guide social behavior (Eagly, Wood, & Diekman, 2000). Gender can be expanded to include assumptions made by others about a particular gender or self-imposed ideas about how a man or woman should function in a given society (Unger, 1979). Men are typically associated with being more skilled with technology. We propose that the gender role of masculinity (usually more associated with the male sex) is key to understanding technology self-efficacy. Individuals who are masculine are usually associated with traits such as independence, self-confidence, aggressiveness, and achieving (Thompson & Pleck, 1986).

Sex and gender have been used synonymously in many research studies surveying technology and technology self-efficacy (Coffin & MacIntyre, 1999; Compton et al., 2003; He & Freeman, 2010); however, sex and gender are very different terms that if not treated separately can yield widely discrepant research outcomes. Gender differences can be seen in some educational subject matters in which people's expectations are influenced by sex. For example, reading and writing are often seen as a feminine dominated domain while math, science and sports are perceived as being more masculine dominated (McGeown, Goodwin, Henderson, & Wright, 2011). It is important to note that these differences are not due specifically to the biological sex of the individual, but instead to the gender roles attached to their sex. In a study of students and reading, differences were found in masculine and feminine gender roles pertaining to motivation while no differences between males and women were found (McGeown et al., 2011). We propose that similar results can be found outside the study of motivation and reading and can be applied to the perceived ability and use of technology.

Lazarus and Folkman's (1987) theory of emotion gives an appealing explanation for why people accept or reject technology and provides some insight in understanding gender differences related to technology self-efficacy. Lazarus and Folkman (1987) proposed that emotions can be divided into two parts. During the first component, or primary appraisal, a person determines whether or not the task or object is a threat or challenge. The secondary appraisal leads to the individual asking if there are any actions that can be taken to improve the situation or the relationship with the object or task. This primary and secondary appraisal system can be applied to the use of technology with the distinction most evidently seen in the initial appraisal of technology. Men view computers as something to be commanded while women view computers as something to be used (Ray et al., 1999). This difference in view directly affects the primary appraisal of technology, as men do not view a computer or other parts of technology as a threat. Coffin and MacIntyre (1999) offered one explanation for this phenomenon. They proposed that this non-threatening perception of technology is due to men being more motivated by extrinsic goals and therefore are naturally more encouraged by initial contact with technology. When men do not see technology as a threat, their secondary appraisal is focused on improving their relationship with technology and not coping with it. Women, on the other hand, view technology negatively during the primary phase, spend more time in secondary appraisal finding ways to cope or confirming their initial negative beliefs.

Although Lazarus and Folkman's (1987) theory proposes a probable *reason* for technology self-efficacy that can be applied to gender differences, stereotype threat (Steele & Aronson, 1995; Steele, 1997) theory provides more context for understanding *why* such gender differences in technology ability and self-efficacy may exist. Stereotype threat is the fear that one will confirm a negative stereotype about one's own group and that they will be negatively judged because of it. Whenever a negative stereotype about a certain group applies, members of these groups often fear being reduced to nothing but that stereotype (Steele, 1997). The anxiety and threat felt by those who experience stereotype threat does not originate from internal doubt about ability, but from their "identification with the domain and the resulting concern they have about being stereotyped in it" (Steele, 1997, p. 614). These negative attitudes about one's ability can lead to a self-fulfilling prophecy and promote further negative outcomes.

When a person is confronted with a task in which they are expected to do poorly (due to a negative stereotype) a person will try harder to complete the task and therefore increase their mental workload and possibly perform poorly (Croizet et al., 2004). Society as a whole views technology as a domain dominated by men (Peterson, 2010; Prescott & Bogg, 2011; Ray et al., 1999) and therefore women are often stereotyped as being technologically inept. Cockburn (2009) stated that "people are gendered by the jobs they do and in turn jobs are actively gendered by virtue of who does them" (p. 271). He further states that through technology, which is applied everywhere, femininity is diminished. An excellent manifestation of this is that men buy more, play more often and for longer periods of time on video games, computer games and online games on both computers and wireless devices than women at all ages (Entertainment Software Association., 2010). Most children's first experience or interaction with computers comes from video games, which are seen to be a mostly male driven activity (Cooper, 2006). Additionally, most technological work fields have fewer women than men (Lee, 2003; McClelland, 2001). Some researchers report that the reason most women feel that they do not belong in technology related fields is because computers are closely related to other negative stereotypical fields for women such as math and science (Agosto, 2004; Ray et al., 1999). This assumption of disinterest is often interpreted incorrectly by teachers who may then steer women away from technology driven courses and careers (Ray et al., 1999). Although these teachers and students acknowledge that women have computer skills, more credit and a higher status is given to men than women for completing similar tasks (Abbiss, 2011). Blum (1999) described how males dominate online discussions in chat rooms and forums and abuse women with negative comments pertaining to their technological skills. Further, in a study of technology, Thornham and McFarlane (2011) found that boys used phrases like "I'm such a girl" when they made mistakes in technological tasks. This type of language reinforces negative stereotypes of women and technology. All of these factors may lead women to feel they are technologically incompetent and therefore leads to stereotype threat behavior.

These theories offer explanation for the gender divide in the acceptance and use of technology in the classroom. Previous research that has centered on sex as the key variable in technology self-efficacy (e.g., Coffin & MacIntyre, 1999; Compton et al., 2003) has missed the vital influence of gender roles in defining ones' technology self-efficacy. In summary, we propose that gender roles are a factor in perception of technological ability and explain the sex-technology self-efficacy relationship.

Hypothesis 2. Gender roles mediate the relationship between sex and technology self-efficacy.

Along with gender, there are many situational factors that play into the acceptance and the perception of ability to use technology. We focus on two: computer hassles and perceptions of structural technology support. Computer hassles describes factors that make the use of some type of technology challenging. For example, a computer could have a slow download time, or the software can be complicated to use. Those individuals who have increased experience with hassles related to technology are more likely to have decreased self-efficacy. This link between hassles and self-efficacy has been shown for both technology specific self-efficacy (Shu et al., 2011) and other types of self-efficacy as well (Bandura, 1977).

Another situational factor that can affect technology self-efficacy is perceived structural technology support. Structural technology support describes how well an organization (in this case, the university) provides the basic tools to use the desired technology. In a university setting this could include the provision of up-to-date equipment, an efficient computer helpdesk and/or having fast and efficient internet access. Students who perceive support from others have higher motivation to excel (Coffin & MacIntyre, 1999). This can be applied directly to technology in that those who perceive support technologically have higher success with technological tasks (Gunn, McSporran, Macleod, & French, 2003).

However, although these situational factors are important, we argue that differences in motivation may be better predicted by identifying gender traits in students rather than situational factors such as support (Mcgeown et al., 2011). Further, gender role theory (Wood & Eagly, 2002) argues that it is through this experience with a task that we form gender roles and so we argue that masculinity is as strong a predictor of perception of technological ability as other well-known predictors of technology self-efficacy. Specifically, masculine gender role predicts technology self-efficacy above and beyond variance explained by technology specific situational factors.

Hypothesis 3. Masculine gender role predicts technology self-efficacy above and beyond perceived computer hassles and perceived structural technology support.

3. Research method

3.1. Participants

Participants for this study were 750 undergraduate students (58.2% female, $M_{\text{age}} = 19.3$, $SD = 3.1$) from a medium-sized public university in the southwestern region of the US. All participants were enrolled in one of the four sections of an introductory psychology course. This class is one option for meeting required liberal studies credit and therefore provides a diverse sample of students from many different majors. University freshmen constituted 60.1% of those participating in the study and 15% were transfer students from other universities or colleges. Prior to this study, only 22.1% of participants had taken an online course.

3.2. Materials and procedure

3.2.1. Sex

Participants were asked the question: "What is your sex?" Their response choices were either "male" or "female."

3.3. Masculine gender role

We used the masculine factor of the Personal Attributes Questionnaire (Spence & Helmreich, 1978) to assess masculinity traits in men and women ($\alpha = .73$). The masculine sub-scale included seven items that presented gender role characteristics at two extremes. Respondents described themselves by choosing from a five-point scale with an extreme descriptor on each end (e.g., 1 = not at all extreme to 5 = very independent; 1 = not at all competitive to 5 = very competitive). Sample descriptors include: "Not at all competitive" to "Very competitive," and "Very passive" to "Very active."

Technology Hassles. Technology hassles was assessed using Hudiburg's (1995) Computer Hassles scale, a measure that has shown high levels of reliability ($\alpha = .95$) and validity (related to anxiety, $r = .34$) in a student population (Hudiburg). Our shortened 13-item scale included items that were germane to current technology (the original scale had 20 items) and assessed the frequency that one would experience hassles or frustrations related to technology use (current sample: $\alpha = .86$). Sample items include "The computer speed was slow," and "The computer needed updated software".

3.4. Structural technology support

Structural technology support was assessed on student perception of the degree of structural technological support they received at the university ($\alpha = .80$). The four-item Likert type scale was developed for the current study and had 5-point response choices that ranged from "strongly disagree" to "strongly agree." Respondents were also provided with an additional response item "never used" to account for students who were not familiar with the structural technological support provided at the university. Sample items included "Computers on campus provide fast and efficient internet access," and "There are ample places I can go on campus to use computers."

3.5. Technology self-efficacy

Technology self-efficacy was measured using a 9-item scale adapted from Compeau and Higgin's (1995) computer self-efficacy scale (current sample: $\alpha = .86$). The root of the questions stated, "I could successfully use new technology." This scale has shown that it is highly reliable ($r = .81$) and valid (positively related to technology use, $r = .45$; negatively related to anxiety $r = -.50$; Compeau & Higgins). A sample item was "If there was no one around to tell me what to do as I go." The five-point response item ranged from "strongly disagree" to "strongly agree."

4. Results

Table 1 provides descriptive statistics, correlations and coefficient alphas for the variables of interest. All analyses were tested at the .05 significance level.

Hypothesis 1 predicted that there were sex differences in perceptions of technology self-efficacy such that men would report higher perception levels of technology self-efficacy than women. Independent samples t-tests found full support for our hypotheses with males ($M = 3.89$; $SD = 0.70$) reporting higher levels of perceived technological ability than females [$M = 3.79$; $SD = 0.53$; $t(539.25) = 2.24$].

Hypothesis 2 stated that masculine gender roles mediate the relationship between biological sex and perceptions of technology self-efficacy. To assess this mediating relationship, we used Baron and Kenny's (1986) mediation approach. Step 1 examines whether the predictor variable (sex) is related to the criterion variable (perceptions of technology self-efficacy). Results showed that sex was related to technology self-efficacy ($\beta = -.09$, $p < .05$). We then tested the relationship between the predictor variable (sex) and the mediating variable (gender roles; step 2). Results showed that they were significantly related ($\beta = -.16$, $p < .05$). Step 3 required that the mediating variable (gender roles) was related to the criterion variable (perceptions of technology self-efficacy). Results showed that they were significantly related ($\beta = .19$, $p < .05$). To show evidence of a mediated relationship, the beta for the predictor variable (sex) needs to decrease or become non-significant when the mediating variable is added to the model (Step 4). As shown in Table 2, results showed that the beta dropped and became non-significant for sex when gender role was included in the equation. We then conducted a Sobel test to further assess the presence of mediation. The Sobel test revealed support for these hypotheses with gender roles mediating the relationship between biological sex and technological perceptions of technology ability ($z = -2.37$).

Hypothesis 3 predicted that masculine gender role predicts technology self-efficacy above and beyond what can be explained by past use (H3a) and perceived support of technology (H3b). Hierarchical regression results showed that gender roles predicted the relationship with technology self-efficacy above and beyond sex, the influence of computer hassles and perceived structural technology support. Results are presented in Table 3.

5. Discussion

Technology has become a fundamental part of the educational setting since its debut in the early 1980s (Plumm, 2008). Goodman (2001) suggests that integrating technology into education can create new types of learning environments for students and will in fact enhance basic learning processes. With technology becoming so important in education, gender roles, which are important in understanding the use of technology in general, are even more crucial in explaining educational use of technology. The current study has extended beyond previous studies that have only examined biological sex (Coffin & MacIntyre, 1999; Compton et al., 2003) and has shown that gender roles have a large impact on whether technology is accepted and used by students.

Our study paralleled other research (e.g., Coffin & MacIntyre, 1999; Compton et al., 2003; Ray et al., 1999; Young, 2000) in showing that males generally report higher ratings of technology self-efficacy than females. Yet, more importantly, we found that

Table 1
Descriptive statistics, correlations, and reliability estimates for key variables.

	M	SD	1	2	3	4	5
1. Sex	1.59	0.49	–				
2. Masculine gender role	25.88	4.07	$-.16^{**}$	(.73)			
3. Computer hassles	1.54	0.42	.02	$.03^{*}$	(.86)		
4. Structural technology support	3.28	1.11	.01	$.11^{**}$	$.09^{*}$	(.80)	
5. Technology self-efficacy	3.84	0.61	$-.09^{*}$	$.19^{**}$	$-.17^{**}$	.05	(.86)

Note: $N = 750$. Reliabilities (coefficient alphas) reported on the diagonal in parentheses.
* $p < .05$.
** $p < .01$.

Table 2
Gender roles mediating the sex-perceived technology ability relationship (Hypothesis 2).

	B	SE	β
Step 1 (DV: technology self-efficacy)			
IV: Sex	−0.11	.05	−.09*
Step 2 (DV: masculine gender role)			
IV: Sex	−1.31	.30	−.16**
Step 3 (DV: technology self-efficacy)			
IV: Masculine gender role	.03	.01	.19**
Step 4 (DV: Technology self-efficacy)			
IV: Sex	−0.07	.05	−.06
IV: Masculine gender role	0.03	.01	.18**

Note: $N = 750$.
* $p < .05$.
** $p < .01$.

Table 3
Gender roles and situational factors regressing on perceptions of technological ability.

Variable	B	$SE\ B$	β	R^2	ΔR^2
Step 1: Sex	−0.12	0.05	−.10**	.01	.01**
Step 2: Computer hassles	−0.25	0.05	−.17**	.04	.03**
Structural technology support	0.04	0.02	−.07		
Step 3: Masculine gender roles	0.03	0.01	.18**	.07	.03**

Notes: $N = 750$. The B weights in the columns are from the step of entry into the model.
* $p < .05$.
** $p < .01$.

gender roles, specifically masculinity, are more predictive of higher ratings than the designation of biological sex. This finding supports gender role theory (Wood & Eagly, 2002) and provides the link between gender role theory and technology self-efficacy.

We found that gender plays a large role in explaining why biological sex is related to technology self-efficacy. This finding points back to possible explanations given by stereotype threat theory (Steele & Aronson, 1995; Steele, 1997) and emotion theory (Lazarus and Folkman's, 1987) concerning how people react to technology according to their gender roles. We have shown that although biological sex can be used to show a difference between male's and female's technology self-efficacy, this singularity is mostly explained by gender roles and not by biology.

More convincingly, gender roles were still a significant predictor after accounting for important situational items, such as computer hassles and perceived structural technology support. Although many students in today's universities come prepared with previous experience in the use of technology from home or previous schooling (Goode, 2010), masculinity continues to be a stronger predictive factor of technology self-efficacy than previous preparation or university support. We propose that this is due to gender role theory's premise that because men have more socially acceptable interactions with technology they have formed masculine gender roles that include skills, motives and beliefs necessary to complete technological tasks.

5.1. Implications

Understanding that students' attitudes about technology are based more on gender roles, and not just biological sex, impacts future studies on the use of technology in education. Prior research suggested that the difference in technology adoption and perceived skills was dependent on biological sex (Coffin & MacIntyre, 1999; Compton et al., 2003). Planned intervention was therefore limited if the variable was perceived as biological and not functional or culturally determined.

These findings are not only important theoretically, but also can be applied to educational settings and intervention strategies. Universities would benefit from implementing gender neutral interventions to ensure that students are successful in technology and have high technology self-efficacy. Gender roles that apply to students also apply to feminine teachers and faculty who may struggle with technology self-efficacy along with their same gender students. An initial step that universities could implement is ensuring of proper technology instruction of both male and female faculty. Many instructors have been given the responsibility to infuse technology into their curriculum. Yet, although instructors can see the benefits of technology, they have found it challenging to both learn technology themselves as well as teach it to students (Plumm, 2008). University administrations should ensure the proper technology instruction and possibly evaluate the technology self-efficacy of instructors. If both male and female (and masculine and feminine) teachers are prepared in how to manage and use technology in the classroom, the proper use of technology could improve the overall quality of education and adoption of technology skills (Plumm, 2008).

Universities should develop strategies to ensure that they have gender diverse instructors. Holmlund and Sund (2008), in fact, found that there was no evidence supporting the idea that same-sex teachers improve student's learning. However, they did find that matched characteristics did have an impact on teacher–student relationships. This supports our contention that it is gender roles, not sex, that can have the most impact on the educational process and technology use. This notion, coupled with the knowledge that teachers may differ in their own use and acceptance of technology based on gender (Schofield, 1995), implies that if universities want to increase student technology self-efficacy they should employ technologically competent gender diverse instructors. If students are only being taught computer skills by male or masculine teachers, they may be implicitly learning that boys and men are not only better at this type of skill, but that they should be more interested in it than girls and women (Schofield, 1995).

This strategy may also have the potential to diminish the effects of stereotype threat and emotion theory. As students are able to see successful role models or mentors, they may be more prone to become more technologically successful (Dorman, 1998; Graves, Sales, Lawrenz, Robelia, & Richardson, 2010). Further, if these role models mirror their own gender roles, students may feel more comfortable and become more confident with technology use. Similarly, trainers need to make sure that training material and style does not reinforce gendered stereotypes. The use of more feminine examples when talking about technology or directing questions and comments to both male and female students can ensure that women feel more comfortable with the technology content.

We are not suggesting that universities should attempt to change the gender role of the student or instructor, but instead change the expectation of others in regards to gender roles. We realize that this is not an easy task but there are teaching methods that attempt to do just that. For example, coupling more gender neutral topics such as education or writing with computer skills can change the learning environment to be more positive and "female friendly" (Carbonaro, Szafron, Cutumisu, & Scheffer, 2010, p. 1110).

Methods that have shown to be successful in improving technology self-efficacy are not only teacher training, but also structure equitable activities and ownership of technology (Dorman, 1998). Judson (2006) stated that more effective technology in the classroom is based on needs. As teacher and students are allowed to create customized classroom materials from technology they are more likely to feel comfortable using it (Ottenbreit-Leftwich, Glazewski, Newby, & Ertmer, 2010). Universities offering computer introduction programs and having required technology-based assignments have also been shown to increase technology self-efficacy (Arthur, 1991).

Research suggests that more exposure to an experience will increase self-efficacy (McCoy, 2010). Technology has penetrated almost every aspect of our lives; however this exposure needs to be equally positive for both genders. As suggested earlier, gender role theory shows that men and women's roles are identified by what they do most and the skills, values and beliefs needed to accomplish these tasks (Wood & Eagly, 2002). If women are not exposed to technology to an equal degree as men then they will not acquire the needed skills and values and will fail to develop the needed technology self-efficacy.

5.2. Limitations and future research

As with every study, the present study has limitations. Our research design was cross-sectional using self-report data that was collected at one time point which could lead to single source and single method bias. We should note however that our design was aligned with our research goals. Self-report, for example, is commonly used to understand constructs that are based on people's own perceptions (Barker, Pistrang, & Elliott, 2005), similar to some of our key constructs (e.g., self-efficacy, attitudes toward technology, perceived usefulness, etc.).

Although gender role theory was used as one framework to understand why sex would be related to technology self-efficacy, this study was not designed to test gender role theory. Moreover, researchers used gender role theories to explain possible explanations why the biological sex and technology self-efficacy phenomenon occurs. Lazarus and Folkman's (1987) theory of emotion along with Steele and Aronson's (1995) concept of stereotype threat were used to offer possible reasons for gender differences and technology. We gained clarity as to how these theories may affect an individual's approach to technology, but future research would profit from exploring them in greater detail.

We only examined perceptions of performance (self-efficacy) and not actual performance. It is possible that many students perform better and are technologically more savvy than they think. This concept would further support stereotype-threat theory (Steele & Aronson, 1995; Steele, 1997) that women distance themselves from technology in an attempt to appear less technological than they are. Due to this phenomenon it is possible that many women view themselves, or due to a negative stereotype *want* to be viewed, as not having technological self-efficacy.

Future research would also benefit from looking further into gender differences of applied use of specific technology categories such as online learning. Most of the findings that suggest that women have higher technological self-efficacy technology are from studies that are examining specifically online learning (Rovai & Baker, 2005). Sullivan (2001) stated that female students appear to respond more strongly towards online learning than their male counterparts. This advantage for females appears in two ways: communication and negative impersonal aspects. In other words, females felt more strongly than males that online learning's communication is an advantage and its impersonal nature is a disadvantage. These findings suggest that there are specific aspects of technology that might favor females. Future research could examine whether this extends to feminine gender roles and could examine specifically what factors related to technology seem to be most accepted by this gendered group.

Future researchers would also profit from exploring how these theories affect students of all ages and backgrounds. Currently there is a large difference in technology self-efficacy between children of varying social economic backgrounds (Lebens et al., 2009). Age also plays a large role in the acceptance and use of technology (Jones, Ramanau, Cross, & Healing, 2010). Students entering universities today have a higher level of experience and knowledge with technology than their upperclassmen and instructors (Jones et al., 2010). While this study focused on college-aged students, further research should be conducted on other ages as well, such as elementary and middle school students. Understanding the effects of gender roles on technology at earlier ages would allow educators and influential others (e.g., parents) to intervene at a time when change might be easier to manipulate.

6. Conclusion

Studies suggest that girls and women receive less education, experience and opportunities in the area of technology because it is deemed a male sex-typed subject (Altermatt, Jovanovic, & Perry, 1998; He & Freeman, 2010; Peterson, 2010). Such influences thus hold women back from technology careers that may pay better, have better benefits and have greater stability (Plumm, 2008). Biological sex, a variable in many of the studies (Coffin & MacIntyre, 1999; Compton et al., 2003), has been used as the sole indicator of behavior and attitudes toward technology. We have shown that gender roles, or more specifically, masculinity is a greater predictor of technology self-efficacy than the designation of biological sex. Universities would benefit from adjusting current teaching methods and intervention strategies to accommodate for this difference in gender. By doing this, universities can better prepare all students for greater opportunities within the classroom and in future occupations.

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