At the Intersection of Gender & Technology: A Meta-Analysis

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ABSTRACT

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With the proliferation of novel technology-infused learning environments, there is a need to further our understanding of their impact on learners, the learning process, and the learning outcomes for diverse student bodies in various study programs. Investigating gender differences in usage and attitudes towards different technologies is important because educational institutions, especially public ones, are seen by policy makers as structures that aim to reform societal inequalities.

The objective of this dissertation is to conduct a systematic review of the literature to establish the relationship between (a) gender and Information and Communication Technologies (ICTs) usage and (b) gender and attitudes towards the use of ICT, in the context of formal educational settings from elementary to postsecondary levels. This dissertation takes an in-depth look at ICT attitudes in learning by avoiding treating it as one indivisible construct. I subdivided the attitudinal construct into the different theoretical frameworks embedded in the literature related to technologies in pedagogical settings. These include Computer Anxiety, Negative Attitudes Towards ICT, Computer Confidence, Perceived Ease of Use of ICT, Perceived Usefulness of ICT, Perceived Satisfaction with ICT, Positive Attitudes Towards ICT, Motivation to Use ICT, Computer Self-efficacy, Intention to Use ICT, and Mixed Perceptions Towards ICT.

After a systematic literature review, I synthesized the results of 213 studies and used random-effects meta-analytic techniques to evaluate gender differences across students' reported usage and attitudes towards ICT in learning. Findings of this dissertation reveal significant gender differences between female and male students' reported usage of ICT and attitudes towards ICT in favor of males. Average effect sizes ranged from small to moderate. The highest average effect size belonged to the construct of Computer Confidence where male students typically reported higher confidence with computers, with .38 standard deviations above the female students. The lowest effect size belonged to the construct of Perceived Satisfaction with

ICT where male students typically reported higher perceived satisfaction with ICT, with .05 standard deviations above the female students.

A number of contextual factors impacted the results of the outcomes to differing degrees. These include 'research country', 'grade level of students', 'technology type surveyed', 'questionnaire used', 'ethnicities', 'subject matter', 'participation rate', 'sampling selectivity', 'competency', 'publication date', 'technology acceptance model', 'class context', and 'socioeconomic status'.

This dissertation concludes with educational implications and suggestions for future research investigating gender differences in students' usage and attitudes towards ICT in learning. Considerable effort should be made by researchers to contextualize the studies as possible and as such, I recommend that gender should not be researched as a homogeneous independent variable. After all, gender is embedded in many other variables, in the same way that it is embedded in the many structures of society. Gender therefore needs to be researched with other intersecting demographics, including but not limited to participants' home country, ethnicity, age, and socioeconomic background.

Intersectionality is a theory and a methodology that is suited to addressing the complexities of gender differences concerning the usage of and attitudes towards ICT. It imparts differences and particularities in social statuses in the hope of militating against those silent prejudices that result in social inequities. This theory allows us to inspect social demographic variables as they truly are: complex and interwoven. Adopting this theory does not mean that each study investigating gender differences needs to include all possible demographic variable interactions. However, it invites social scientists to be more comprehensive in their sampling selections and to be more aware of the complexity of social phenomena. Last but not least, intersectional methods require more than just an analysis of statistical interactions among social groups. They need to analyze the fundamental and significant impacts of these interactions.

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DEDICATION

To Ziad, Jad, and Ghia. To you I dedicate this dissertation.

Ziad. You made all of this possible.

Ghia and Jad. Armed with patience, persistence, and self-confidence, you can achieve anything you want in this life.

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CHAPTER I

Introduction

Technology is key to meeting globalization needs, advancing Canada's economic status, promoting political accountability, and enhancing learners' educational opportunities (Information Technology Association of Canada, 2013). Moreover, the knowledge and communication breakthroughs that a society can achieve using information and communication technologies (ICT) are vast. As Korunka and Hoonakker (2014) claim:

> "There is no doubt that the development and implementation of information and communication technology during the last decades has had – and still has – a major impact on all levels of society" (p. 1)

Internet-related technologies have brought about changes in almost every aspect of human behavior, but nowhere more profoundly than in the production, consumption, and communication inherent in social life (Gane, 2005). Accordingly, educational institutions in Québec are investing in ICT tools in an attempt to develop citizens who are ready to face the challenges of the 21st century, where media, manufacturing industries, and commerce have become increasingly technology-oriented (Fusaro et al., 2012; Raby, Karsenti, Meunier, & Villeneuve, 2011). Indeed, the integration of ICT into educational settings has reached a point where one is hard-pressed to find a classroom without any digital technology. Not surprisingly, the Minister of Education, Recreation and Sport (MELS*)* acknowledges the role of technology in the delivery of quality education and advocates for the integration of information and communication technologies in its educational policies and curricula (Culture Education Agreement, 2013).

The rapidity of technological change requires that the integration of ICT is constantly evaluated in educational settings in order to understand students' receptivity towards these technologies, as well as how such technologies are adopted and used (e.g., Elgort, Smith, & Toland, 2008; Ellison & Wu, 2008; Farmer, Yue, & Brooks, 2008; Liu, Kalk, Kinney, & Orr, 2010). Several scholars have published studies on gender differences as it relates to attitudes and usage of technologies in learning environments (Baxter, Hungerford, & Helms, 2011; Crouteau, Venkatesh, Beaudry, & Rabah, 2015; Huffman, Whetten, & Huffman, 2013; Joiner et. al., 2011; Saleem, Beaudry, and Croteau, 2011; Venkatesh, Crouteau, & Rabah, 2014). The intersection between gender and ICT in educational settings has furthermore proven to be complex. Much evidence lends support to these gender-based differences within postsecondary settings (Huang, Hood, & Yoo, 2013; Jones, Johnson-Yale, Millermaier, & Pérez, 2009; Kay & Lauricella, 2011; Selwyn, 2007).

Overall, researchers have found that male university learners report higher levels of experience and competency in utilizing computers (Bunz, Curry, & Voon, 2007; Gardner, Sheridan, & Tian, 2014; Kay & Lauricella, 2011) and are more positive about using them for learning (Alon & Herath, 2014; Li & Kirkup, 2007) than their female counterparts. Nevertheless, there have been some studies that document no digital difference for gender in postsecondary settings (Ghatty, 2014; Morris, & Chikwa, 2014) and others that cite female undergraduate students as having more self-efficacy in using technology (Joiner et al., 2011). However, these outcomes are somewhat infrequent. Some scholars, such as Joiner, Stewart, and Beaney (2015), even propose that digital inequalities among university students are shifting from unequal access to differentiated use.

Some researchers claim that gender differences relating to higher education students' perceptions and usage of technology are diminishing (Zhou, 2014). Others document minor differences, even though males still perceive themselves as more proficient and confident, if less anxious, where technological tools are concerned (Barker & Aspray, 2006; Kay, 2008; Sanders, 2006). More remarkably perhaps, Ono and Zavodny (2003), go so far as to suggest that the gendered digital divide no longer exists in the USA. Such an assertion is by no means new. In 1997, Durndell and Thomson's narrative review of related research in educational settings compared primary studies from the 1980s and 1990s and found a perceptible narrowing of the gender-based digital divide in both usage and knowledge of technology (Durndell & Thomson, 1997).

Nevertheless, to turn our attention away from the gender-based digital divide is probably unwise since it manifests itself in different forms (Hargittai & Shaffer, 2006). In fact, Joiner et al. (2015) identify at least two types of digital divides: a primary divide, relating to disparities in access to technology, and secondary digital divide, referring to differences in the use of and attitudes towards technology. According to US-based surveys undertaken between 2000 and

2013 (Pew Internet & American Life Project, 2014), males and females have overall enjoyed equal access to technology since 2007: a finding corroborated by surveys conducted in the UK between 2003 and 2013 by the Oxford Internet Institute (Dutton & Blank, 2011).

Much research has revolved around the primary digital divide. Although disparities in access may no longer be an issue, the same is not true of the secondary digital divide. According to Cheong's (2007) study of 716 male and female students in higher education settings, offering a society equal access to technology does not automatically guarantee equal levels of technological self-efficacy or ICT use. The researcher found that both ICT-related self-efficacy and technology use were lower among female students.

It is also important to remember that the digital divide extends far beyond the question of access to ICT tools. Men and women's differentiated attitudes towards using ICT tools also a play key role during learning and when making career choices (Buche, Davis, & Vician, 2007; Huang, Cotten, & Ball, 2015). Gender-based differences surrounding attitudes towards technology and the perceived efficacy and benefits of the tools used within the learning environments therefore remain critical areas of study (Hargittai & Shafer, 2006). Moreover, uncovering the dynamics between gender and students' ICT usage and perceptions is vital because there is a consistent pattern of fewer women seeking professions in ICT-related fields (Statistics Canada, 2013). Statistics Canada's recent report, *Gender Differences in Science, Technology, Engineering, Mathematics and Computer Science (STEM) Programs at University*, indicates that although more female students are registered in university programs, female learner figures show low enrolment in highly scientific and technological career programs (Statistics Canada, 2013). Furthermore, according to the National Household Survey, registration figures in STEM fields reveal 39% of university graduates are women, as opposed to 66% in non-STEM programs (Statistics Canada, 2013). In STEM fields, 23% of those are enrolled in engineering and 30% in math and computer science programs (Statistics Canada, 2013). That these crucial vocations are not attracting half of Canada's labor force capacities represents a significant loss to the entire nation. There is therefore still an immense amount of work to be done regarding women's enrolment in STEM programs of study.

Problem Statement

With the proliferation of novel technology-infused learning environments, there is a need to further our understanding of their impact on learners, the learning process, and the learning outcomes for diverse student bodies in various study programs. Also, an understanding of the factors that might be impacting on the relationship between gender differences in ICT usage will be useful in guiding classroom-based or institution-based changes that address all students' needs equally. Ultimately, measuring the factors that affect this relationship allows us to build curricula and pedagogical programs that facilitate gender equality (Hohlfeld, Ritzhaupt, & Barron, 2013). Building information societies and knowledge-based economies that will succeed in advancing societies cannot be achieved without the empowerment and equitable development of all members of the society. For societies to improve, all stakeholders need to have a chance to participate. Developing women's usage and attitudes towards ICT may not be the solution to gender inequality in society, but is one step towards confirming women's agencies and capabilities. Without confirming all stakeholders' abilities, there will be no equal opportunities. To succeed in this highly competitive, globalized world, we need to make sure that we are all developing our human potential to the full in an era that is increasingly dependent on technology.

With the continuous progress and development of technology, the digital divide that once alluded to disparities concerning ICT access has, over time, been extended to incorporate attitudes towards and utilization of ICTs. It is only through rigorous research and reliable data that we may begin to address the issue of gender inequality from an ICT perspective. The gender digital divide may indeed no longer be a problem of ICT access, even if the constant development of ICT tools means one can never be entirely sure.

Given the conflicting evidence contained within the existent research literature, it is evident that the influence of gender differences on the usage of and attitudes towards information and communication technologies remains unclear. Therefore, a validated research framework, such as a meta-analysis, is essential to clarify the underlying relations between gender and pertinent technology-related influences. Systematically reviewing studies on students' attitudes towards technology use, as well as aspects of the adopted research design, the number of participants, their age, and other research elements, could highlight factors that impact the connection between gender differences and technology in educational settings.

Purpose Statement

Since primary research points to conflicting evidence as to the effect of gender on ICT use and attitudes in formal education settings, the objective of this dissertation is to conduct a systematic review of the literature to establish the relationship between (a) gender and Information and Communication Technologies (ICTs) usage and (b) gender and attitudes towards the use of ICT, in the context of formal educational settings ranging from elementary to postsecondary levels.

Study Rationale

Meta-analysis, or the "analysis of analyses", permits researchers to thoroughly review empirical literature within a defined field by systematizing and statistically bringing together the outcomes of multiple studies with comparable evaluations in a manner that is not only transparent and replicable, but also capable of ensuring cross-study comparison (Glass & Hopkins, 1970; Light & Pillemer, 1984). It is a well-known fact that one study alone cannot provide definitive evidence. Therefore, the synthesis of research provides broader-based evidence in which one can draw conclusions since together the studies cover a bigger portion of the population (Cooper, Hedges, & Valentine, 2009; Hedges & Olkin, 1985; Hunter & Schmidt, 2004).

Meta-analysis is a research methodology that rests on synthesizing results of individual quantitative empirical research that have the same research question (Glass, McGaw, & Smith, 1981). It is a helpful technique to use when studies in a particular field are yielding conflicting outcomes (Camilli, Vargas, & Yurecko, 2003). Findings usually speak to higher sample sizes and statistical power than in individual empirical research studies and can be generalized to other settings and populations (Thompson, 1999).

Meta-analysis is a comprehensive strategy that synthesizes the literature in a certain field across various settings or populations or both, and is used to explain what was done, how it was done, and what the resulting outcomes were, in order to determine future recommendations. In that way, the external validity of a meta-analysis is higher than that of individual empirical studies that conduct research with one sample generalized to one population.

Glass (1976) defines meta-analysis as "the statistical analysis of a large collection of analysis results from individual studies for the purpose of integrating the findings. It connotes a rigorous alternative to the narrative discussions of research studies, which typify our attempt to make sense of the rapidly expanding research literature" (p. 3). Meta-analysis is not the only way of reviewing empirical studies. Just like narrative reviews, which review and report the literature, methodology, and outputs of research studies, it has all the advantages of a research synthesis. However, meta-analysis also adds transparency and consistency to the calculation of statistical information and aggregation of effect sizes needed to generalize findings. It also makes recommendations for future directions in the field. Thus, there is less likelihood of reviewer bias that can occur while conducting narrative reviews.

Meta-analysis examines studies and analyzes their outputs by using standardized statistical approaches that take into consideration all the measurements and range of values included in the research (Lipsey & Wilson, 2001). Moreover, by systematically aggregating individual results, meta-analyses lay claim to increased statistical power, enable the calculation of estimated overall effect sizes, and allow for a more sophisticated understanding of cross-study variation in effect sizes. Meta-analytic procedures also test the robustness of these estimated overall effect sizes and offer researchers a means to determine causal mechanisms for variability due to moderating factors.

Lipsey and Wilson (2001) enumerate several benefits of meta-analysis such as being able to tackle information from different sources in an organized and systematic way. Meta-analysis can be a highly complex operation that can integrate a large number of related statistical relationships. Furthermore, it has superior statistical power because of its ability to bring together the effect sizes from various studies. Finally, the reader can quickly evaluate the importance of the results because of the rigor and comprehensive nature of the meta-analysis itself. The accuracy and breadth of meta-analytic outputs encourage the use of the research design across various disciplines, including the social sciences (Cooper, Hedges, & Valentine, 2009). Within the domain of psychology and education, the frequency of published meta-analyses as a research framework has increased yearly since 1990 (Williams, 2012). As of 2014, PsycINFO and ERIC databases combined hold more than 10,000 meta-analyses. That being said, meta-analysis, like any other research method, is not free of weaknesses, and these will be addressed in the methodology section.

This dissertation searched and located all possible empirical literature surveying gender differences as it relates to differing attitudes towards and usage of ICT. Details of the selected studies and literature searches are found in Chapter III of this dissertation. Previous scholars have published meta-analyses in an attempt to synthesize the growing body of research addressing gender and computer usage and gender and attitudes towards technology (Li, 2006; Liao, 1999; Whitley, 1997). The most recent of these is Li's (2006) meta-analysis of gender-based behavior differences among students from elementary to postsecondary levels using computer-mediated communication (CMC). Findings of this meta-analysis provided evidence of stereotypical gender patterns in virtual environments. A total of 321 independent effect sizes were extracted from 50 studies of gender-differentiated use of CMC among 63,889 individuals. The findings indicate higher levels of collaboration (d = -0.09) and person-orientation (d = -0.13) among female participants. Furthermore, male participants enjoyed using technology more (d = 0.24), were more confident about using CMC (d = 0.18), and utilized more authoritative statements than their female counterparts (d = 0.20) when using CMC.

Similarly, Liao (1999) conducted a meta-analysis to review systematically primary research studies on gender differences among users of technologies regarding their attitudes towards computers. The overall sample comprised 106 studies, from which 489 effect sizes (ESs) were extracted. The overall ES retrieved was 0.192. Findings suggested that females have lower positive attitudes towards technology than males. When the overall ES was changed to percentiles, 58 studies favored males with regard to positive computer attitudes, whereas only 50 studies favored women. Of the nine moderating variables tested, one variable (type of attitude) showed a statistically significant result when comparing means measuring sex stereotypes (F (6, 232) = 2.554, p < .05). Attitudes towards technology were measured on scales such as liking, anxiety, perceived usefulness, belief, confidence, and stereotype towards computer use. In sum, the authors concluded that the resulting male and female differences regarding attitudes towards ICT on a sex-related stereotype could be the distinguishing differential upon which the gendered digital divide rests. Furthermore, Liao (1999) concluded that gender differences regarding attitudes towards technology still prevailed.

Whitley (1997) also conducted a meta-analysis on gender differences among students from elementary to postsecondary levels concerning the usage of and attitudes towards ICT. The overall sample included 82 studies, representing a total of 104 effect sizes and 40,491 participants. Results indicated that males displayed greater sex-role stereotyping of computers than females ($d = 0.541$). Females also exhibited lower computer self-efficacy ($d = 0.406$), and less positive affect towards ICT in learning environments than males ($d = 0.259$). Whitley found that age was the most salient moderating variable impacting on the relationship of gender and ICT. Post-hoc comparisons revealed that high school learners had a mean effect size larger than other age groups ($d = 0.396$). As for computer-related behaviors, gender comparisons showed smaller differences concerning computer usage behavior ($d = 0.326$) and prior experience with computers ($d = 0.208$).

In my review of these three meta-analyses on gender and computer usage and attitudes towards computers, I found that none of the studies followed the meta-analysis literature search procedures recommended by the Campbell Collaboration (Hammerstrøm, Wade, & Jørgensen, 2010). In their methodological sections, for example, the authors make no mention of how they actually arrived at their lists of studies or grey literature (i.e. research that has not been published in scholarly journals such as dissertations or conference proceedings).

In light of the above, my study expands on existing meta-analyses by synthesizing studies researched after 2005. Furthermore, this dissertation aims to add to the methodology of the meta-analyses mentioned by following the standard set of procedures recommended by the Campbell Collaboration (Hammerstrøm, Wade, & Jørgensen, 2010) to ensure the validity of the approach and to apply a rigorous methodological research design. I aim to bring the state of knowledge in the field up-to-date and demonstrate if gender difference in usage and attitudes towards information and communication technologies in educational settings is backed by empirical evidence. During this process, I also test for variables that may be moderating the relationship between gender and computer usage and gender and attitudes towards information and communication technologies.

Research Question

In order to establish the relationship between students' gender and the usage of and attitudes towards ICT in formal educational settings, a meta-analysis was conducted to review the literature systematically and thereby answer the following research question:

> Are there gender differences with regard to the usage of and attitudes towards ICT utilized in formal educational settings?

However, this study not only answers the question of if there are gender differences regarding students' utilization of ICTs or attitudes towards it. It also explores what variables may be adding to these differences. To make recommendations concerning optimal use of ICT, researchers need to explore possible indicators that might be impacting the relationship between gender and ICT usage and attitudes towards it.

Study Significance

My dissertation synthesizes an area of educational literature that has not been synthesized to this extent before. It informs us about the field of research investigating gender and attitudes towards and gender and the usage of information and communication technologies. It attempts to clarify the underlying relations between gender and pertinent technology-related influences. In addition, because of the systematic nature of the literature searches, my dissertation informs readers about the type of research questions posed by scholars studying gender and technology, and how much attention researchers pay to the attitudinal aspect versus the actual use of technology in learning environments.

Study Limitations

There are several limitations to this dissertation. First, studies exploring gender differences are limited to non-randomized experiments and surveys, as the researched independent variable, in this case, gender, can never be a randomized variable. Secondly, causal assumptions can never be verified. Finally, research on technology and gender issues may relate to many different topics and to various dimensions, including, but not limited to, online gaming and feminist technology studies. However, these issues are beyond the scope of this dissertation.

Terminologies

Given the vastness of the field of technology integration in education, it is necessary to explain the terminology used in this dissertation, especially as it relates to technology. A number of keywords are used interchangeably in different literary publications to denote terms related to the information and communication technologies. The keywords are as follows: Educational Technology, Asynchronous Communication, Audiovisual Communications, Audiovisual Instruction, Computer Uses in Education, Computer Assisted Instruction, Computer Attitudes, Online Courses, Courseware, Virtual Classrooms, Web-based Instruction, Laptop Computers, Information Technology, Technology Integration, Technology Uses in Education, Handheld Devices, Electronic Equipment, Computer Games, and Computer Peripherals.

Contributions

This systematic review may be especially relevant to practitioners, policy-makers, and researchers. Firstly, its findings may help broaden educators’ knowledge of research within the field and thereby lead them to implement evidence-based changes to their teaching. My results may also assist policy-makers who are called upon to make far-reaching decisions regarding the adoption of innovations. Lastly, the findings potentially offer a valuable source of information to other scholars, not only because they might serve to illuminate the current state of play within research in the field, but also because they articulate the criteria that need to be satisfied for any empirical work to be incorporated into such a review. Also, the findings of this research may prove useful in guiding classroom-based or institution-based changes that increase academic achievement for all students.

Dissertation Format

Each subsequent chapter of this dissertation encompasses a major phase of the meta-analysis. Chapter II gives a review of the relevant literature on gender and students' ICT usage, and their attitudes towards it. Chapter III describes the research design and the methodology of the study. It starts with an overview of the research questions and the methods used to meta-analyze the studies, including systematic searches of the literature, calculation of effect sizes, and models used to analyze the data. Chapter IV presents the findings of the systematic review. Chapter V discusses the findings and their implications. Finally, Chapter VI makes recommendations for future survey research addressing gender differences and perceptions towards technologies.

CHAPTER II

Relevant Literature

This chapter summarizes the background literature on students' perceptions of the integration of ICT in educational settings. It covers the research around gender and students' attitudes towards and usage of ICT in learning environments.

Gender Differences and Usage of and Attitudes towards ICT

Ever since their arrivals in classrooms, researchers have been studying gender differences among university students concerning their use of and attitudes towards ICT (Huffman et al., 2013; Joiner et al., 2005). Through surveys, Huffman et al. (2013) investigated the effect of gender roles on perceptions of computer self-efficacy among male and female university students. They found that gender roles, specifically masculinity, account for gender-based differences in computer self-efficacy. Unlike their female counterparts, male participants had the necessary beliefs, attitudes, and motivations towards technology that are essential to complete a computer task.

In a study on how Internet use can be predicted by gender, Internet anxiety, and Internet identification, Joiner et al. (2005) found several gender-based differences. The researchers distributed a survey relating to undergraduate students' online experiences, Internet anxiety, and Internet identification, and analyzed the answers of 608 students (490 females, 118 males). Not only did their findings reveal that web pages tended to be owned by men, but that, in general, men used the internet more often than females, especially when it came to accessing game websites or other specialist websites, or to downloading online material. Moreover, women used the Internet for communication purposes less often than males. Correlational analyses showed a significant positive relationship between Internet identification and total Internet use. However, a significant negative relationship was observed between Internet anxiety and total Internet use. After controlling for Internet identification and Internet anxiety, a significant negative correlation was found between gender and Internet use. Overall, the three predictors accounted for 40% of the variance in general Internet use, such that Internet identification accounted for 26%, Internet anxiety for 11%, and gender for 3%.

Reasons for gender disparity in the use of and attitude towards ICT have been variously attributed to differences in self-efficacy beliefs about computer technology, computer anxiety, and feeling less accustomed to digital technology (Jackson, Ervin, Gardner, & Schmitt, 2001). In a review of two decades' worth of research into the digital divide between genders across all ages and international boundaries, Cooper (2006) concludes that females are more disadvantaged than males when it comes to learning how to use computers and learning with the aid of computers. Studies demonstrate that this holds true irrespective of age or geographical location. Furthermore, Cooper (2006) argues that computer anxiety is the direct consequence of gender-based differences in computer attitudes and computer performance. According to Cooper (2006), this divide is the result of deep-seated female computer anxiety, originating in infant socialization patterns and the stereotypical belief that computers are boys' toys. The author proposes a model of the digital divide in which gender stereotypes, attribution models, and the threat of stereotyping are explored as precursors of computer anxiety. The first precursor relates to influences in the immediate environment such as family members and teachers exhibiting traditional gendered behavior and expectations. The second pertains to the influence of the general sociocultural environment on stereotypical behaviors, whether these are related to technology performance or not. The third aspect refers to differences between men and women and the way in which they attribute their achievement and failures. Women are more likely to exhibit internal attribution to their failures when they cannot manipulate a technological tool. Cooper also argues that when gender stereotypes, patterns of attribution, and threats of stereotyping interact with technological performance expectancy in educational settings, women feel more anxious manipulating ICT tools (Cooper, 2006). Female learners with elevated anxiety could end up feeling negative about ICT, and this might subsequently affect their academic performance (Joiner et al., 2005).

That being said, there have been some studies that report no gender differences concerning attitudes towards ICT (Compton, Burkett, & Burkett, 2003; Ghatty, 2014; Havelka, 2003; Morris & Chikwa, 2014). Havelka's (2003) US-based study of undergraduate business students (n = 324) and their use of a management information system (MIS) investigated the relationship between individual characteristics and self-efficacy. In the first week of an introductory MIS course, two validated measures were used to assess students' software self-efficacy beliefs (Martocchio & Webster, 1992) and their level of computer anxiety, which were based on Heinssen, Glass, and Knight's (1987) Computer Anxiety Rating Scale (CARS). Findings showed that business majors had significantly different software self-efficacy ratings with MIS, with economics majors reporting the highest levels of self-efficacy and management and general business majors reporting the lowest. Interestingly, however, self-efficacy levels were not found to be significantly different for men and women: a finding that perhaps brings into question earlier commonly held beliefs about gender-based differences surrounding computer use.

Ghatty's (2014) study investigated differences in learning outcomes, attitudes, and self-efficacy among a sample of fifty-eight science majors (36 men and 22 women) taking an introductory physics laboratory course. Students assigned to the control group conducted the first experiment in a traditional physics lab, whereas those in the experimental group carried out the experiment in a virtual lab. For the second experiment, the groups were asked to switch laboratories. During the study, students completed the Learner's Assessment Test (LAT), Attitudes Toward Physics Laboratories (ATPL), and Self-Efficacy Survey (SES). Findings revealed that while learning outcomes were significantly higher for the first experiment in the virtual lab, the type of lab instruction did not result in significant differences. Furthermore, although students demonstrated greater positive affect for conducting experiments in the virtual lab, there were no gender-related differences concerning learning outcomes or self-efficacy.

A recent study at a UK university (Morris & Chikwa, 2014) found no significant gender-based differences ($p = .514$) between first-semester undergraduate students ($n = 108$) who used screencasts (47 females and 13 males) and those that did not (40 females and eight males). The use of screencasts was shown to exert a moderate but significant impact on knowledge acquisition, with the majority of students reacting positively to their use. However, questionnaire data revealed that students believed screencasts should complement rather than supplant traditional lectures, and be used to summarize main points briefly or to provide further information about difficult topics. Furthermore, students cited two major reasons for not using them: a failure to understand the screencasts' purpose and a conflict between the tools' functionality and their self-assessed learning style.

In a study by Compton et al. (2003), male and female college students completed a survey based on the computer aversion scale that investigates reinforcement expectations for computers (Reinforcement), outcome expectations for computers (Outcome), and efficiency expectations for computers (Efficacy). Findings revealed that the overwhelming majority of male and female students (*n* = 697) reported similar computer knowledge and comfort levels. Most of the students (*n* = 579) attended one of three college types: a liberal arts college, a business college, or a community college.

A few studies claim more positive ICT usage and attitudes among female students, although such findings are relatively infrequent. For instance, Aesaert and van Braak (2015) investigated the relation of gender and skills in using ICT by undergoing a performance-based assessment to measure competencies. The sample consisted of 378 secondary learners from different educational institutions in Belgium. Findings indicated that overall students experience challenges when it comes to higher-order ICT competencies related to communication skills. In addition, results showed that overall girls exhibit higher technical competencies when utilizing ICT than boys. Joiner et al. (2011), meanwhile, investigated gender difference among 138 undergraduate mechanical engineering students on the beneficial effects of playing Racing Academic, a digital game used to support their learning, and where gamers have to design and race cars. Pre-test and post-test results revealed no female or male differences concerning the beneficial effects of the game. Nevertheless, female students expressed more positive attitudes towards this game than did male students and were more motivated to use it to learn concepts.

Other researchers in North America claim that the gender-based digital divide relating to access is disappearing because of society's considerable exposure to ICT. For example, Ono and Zavodny (2003) analyzed adult users data from surveys conducted between 1997 and 2001, producing Internet usage trends and regression models that took into account respondents' socioeconomic status. Findings suggested women were considerably less likely to access the Internet around the mid-1990s, but that this was no longer true by the turn of the millennium. The authors, therefore, concluded that gender-based inequalities surrounding Internet access were no longer perceived as an issue.

Despite these claims, for scholars to turn their attention away from the gender-based divide is premature and not recommended. Currently, the term 'digital divide' denotes a particular division between those who have access to technology and those who do not. In reality, differential usage and perceptions are embedded within the divide (Comunello, 2010). Thus, the gender digital divide is not that simple. It is more nuanced and multifaceted than the basic question of access to technologies. Indeed, men and women's attitudes to the Internet, notably the frequency and different ways with which they use it, along with their accompanying level of perceived efficiency and usefulness, may play key roles in learning and should consequently merit consideration. In fact, the gender-based digital divide might explain why gender attitudes towards technology are still being researched. It may also explain why new empirical research findings claim that the gender divide still exists in attitudes towards using digital technologies for learning (Huang, Hood, & Yoo, 2013; Saleem, Beaudry, & Croteau, 2011).

In a survey study conducted among 432 college students regarding the influence of computer anxiety on perceptions about Web 2.0 applications for learning, Huang et al. (2013) found male and female students differed significantly in their use of various Web 2.0 applications, including blogs, wikis, social networking tools, and online video sharing tools. Although females reported more anxiety using Web 2.0 applications, this was not true of social networking tools, nor of online video sharing, which according to the authors may foster the use of Web 2.0 applications among females.

In a web-survey of 143 non-users of a self-checkout library system available at a large Canadian university, Saleem et al. (2011) researched the relationships between stable personality traits and gender with computer self-efficacy. Findings indicated that computer self-efficacy influences the perceived ease of use and usage of new ICT tools. Women participants scored higher on computer self-efficacy scores than their male counterparts. Also, results demonstrated that personality traits played a role in explaining gender differences in perceived computer self-efficacy, with extraversion more positively correlated to women's computer self-efficacy than was the case among male counterparts.

Some researchers claim that gender divisions are related to usage differences rather than to access to technology (Kimbrough, Guadagno, Muscanell, & Dill, 2013; Price, 2006). According to findings from Kimbrough et al.'s (2013) online survey of gender-based differences in mediated social interaction, female undergraduate students tend to use mediated communication more often than their male counterparts. The female respondents also demonstrated a preference for and more frequent use of text messaging, social media, and online video calls. The researchers argue these findings reflect different gender patterns in the use of mediated communication. Price (2006) researched gender differences relating to access, experience, and behavior in online courses. Using a case study methodology, Price revealed that female learners do not differ from males concerning access to technology or in their inclination to enroll in online courses. However, female students exhibited different online interaction styles to men, which could imply that different online supports are needed for male and female learners.

Given the conflicting results in the literature, I believe a meta-analysis was an appropriate research design to uncover the relationship between gender and students' technology usage and attitudes towards it. Meta-analysis allowed me to define the two groups (male and female students) that can be standardized across all studies, to gather outcomes into comparative groupings, to take into account study features and moderator variables, and to pool a standardized measure of study result across studies to obtain a more exact quantitative evaluation of effect.

Syntheses of Attitudes Towards ICT

When embarking on the literature review needed for this dissertation, I noted that attitudes towards ICT embed different theoretical constructs and that there are numerous types of ICT attitudes. Different constructs extending from negative attitudes (e.g. computer anxiety) to positive attitudes (e.g. computer confidence), as well as attitudes that measure the level of perceived usefulness and perceived satisfaction with technologies in learning environments could be used to denote attitudes towards ICT. Consequently, several scholars differed on how they synthesized literature related to ICT usage and ICT attitudes.

One such example is Whitley (1997)[1], who reported the following measures concerning students' attitudes and behaviors towards technology in learning. Attitudes towards computers were grouped under five different categorizations based on the following justifications:

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[1] For details and findings of Whitley (1997), please refer to Chapter I.

1. Affect measures: affective measures related to computers including anxiety, liking, and fear

2. Belief measures: perceived effects of computers on individuals and their surroundings

3. Self-efficacy measures: individuals' feelings of confidence and self-efficacy when manipulating computers

4. Mixed content measures: included more than one of the before-mentioned categories (such as affect, belief or self-efficacy measures) because individual effect sizes could not be extracted for individual categories

5. Sex-role stereotype measures: perceived effects of gender roles and stereotypes on computer manipulation

Li's (2006)[2] meta-analysis of gender-based behavior differences among students from elementary to postsecondary levels using computer-mediated communication (CMC) reported three different attitude outcomes towards ICT in learning. These included the following:

1. Enjoyment measures: an individual's level of satisfaction or liking of computer-mediated communication

2. Confidence measures: perceived self-efficacy and confidence levels when using computer-mediated communication

3. Negative attitudes: perceived levels of apprehension, anxiety or difficulty when using computer-mediated communication

Lastly, Liao's (1999)[3] meta-analysis on gender differences among users of technologies regarding their attitudes towards computers reported seven types of attitudes towards computers. They are as follows:

1. Anxiety: perceived levels of worry or concern when manipulating computers

2. Belief/Usefulness measures: perceived levels of satisfaction when manipulating computers

[2] For details and findings of Li (2006), please refer to Chapter I.

[3] For details and findings of Liao (1999), please refer to Chapter I.

3. Confidence measures: perceived levels of self-efficacy and confidence when manipulating computers

4. Liking measures: perceived levels of enjoyment when using computers

5. Ability-related Stereotype: all stereotypes related to abilities to use computers

6. Gender Stereotype: gender role effects on computer usage

7. Mixed Results: two or more of the categories mentioned above were mixed because effect sizes could not be computed separately

ICT Attitudes and Different Theoretical Constructs

Next, I reviewed the studies included in this meta-analysis and synthesized what the published literature reported in terms of the theoretical anchors measuring attitudes towards ICT in learning environments. The following list of constructs represent the various attitudes towards ICT in educational settings as utilized in the empirical studies included in this meta-analysis.

Computer Anxiety

Computer anxiety refers to a feeling of apprehension or anxiety toward using computers (Bozionelos, 2001). In rare cases, it may be caused by clinical physiological reactions such as the so-called computer phobia observed among a minority of computer users (Beckers, Rikers, & Schmidt, 2006). More commonly, however, computer anxiety is affective in nature and reflects an apprehension that makes the user feel as if she will be humiliated, look stupid, or even damage the computer (Bozionelos, 2001). Such a psychological state of affect is expected to have a substantial impact on one's perception of self-efficacy and have an impact on computer-related behaviors (Maricutoiu, 2014). Previous empirical studies have described the relationship between computer anxiety and computer self-efficacy as negative and strong as well as one that influences one's behavioral intention to use computers (He & Freeman, 2014). Also, Richter, Naumann, and Groeben (2010) demonstrated how low computer anxiety was found to be a component of computer literacy. Their survey findings report a negative relationship between computer anxiety and theoretical and practical knowledge of computers.

Maricutoiu's (2014) meta-analysis synthesized 38 correlational studies exploring the antecedents and consequences of computer anxiety. Significant findings reveal that trait anxiety ($z = .25$), neuroticism ($z = .24$), and openness to experience ($z = .25$) were the antecedents of computer anxiety. However, ease of use of computers ($z = -.39$) and intention to use computers ($z = -.26$) were consequences of computer anxiety.

Similarly, Huang, Hood, and Yoo (2013) used survey responses from 432 college students to 'Web 2.0 for learning' in order to assess students' anxiety levels towards computers and demonstrate how they affect their attitudes to Web 2.0 applications for learning. Based on the Unified Theory of Acceptance and Use of Technology (UTAUT) model, the study pointed to gender discrepancies when manipulating Web 2.0 applications such as blogs, wiki, social networking tools, online video sharing tools, online games, and immersive virtual environments. While women proved more anxious about wikis, online games, and immersive virtual environments, gender differences did not seem to play a part in college students' use of social networking and online video sharing tools.

Computer Confidence

Various scholars have researched the association of computer confidence with gender. For example, Zhou (2014) and Chang et al. (2014) found that men have more confidence in utilizing technologies. It has been suggested this could be due to the influence of gender stereotyping that categorizes technology and computing as male-dominated subject areas (Hwang, Fisher, & Vrongistinos, 2009; Joiner et al., 2011) or a result of female students avoiding courses that require strong technological skills (Li & Kirkup, 2007).

Motivation to Use ICT

As a construct, motivation to use ICT has been theorized and researched by several scholars in the field. For instance, Davis and Warshaw's (1992) Motivation Model (MM) suggests that information technology adoption and use are determined by extrinsic and intrinsic motivations. Extrinsic motivation refers to that of an individual wanting to engage in an activity because she believes it will contribute towards "valued outcomes that are distinct from the activity itself such as improved job performance, pay, or promotions" (Davis & Warshaw, 1992, p. 1110). Intrinsic motivation refers to that of an individual wanting to engage in an activity "for no apparent reinforcement other than the process of performing the activity per se" (Davis & Warshaw, 1992, p. 1112).

Recently, McGill's (2012) study aimed at establishing if the use of robotics motivates students to learn how to program in computer science classes. Using Keller's Instructional Materials Motivation Survey, McGill investigated the responses of 32 computer science students, 13 females, and 19 males. The results demonstrated how the use of robotics positively affected the subjects' motivation to study programming in a computer science course, with no ramifications on relevance, confidence, or satisfaction with the course. The findings also showed that students' motivational levels to use robotics are not influenced by gender, practical self-recognition, or interest in programming.

Nichol's (2008) research looked at 187 student athletes who were enrolled in e-learning college courses with the aim of assessing their perseverance during such courses. The authors utilized and empirically evaluated the e-Learning Persistence Model (e-LPM), founded on constructs such as students' attitude towards computers, their intrinsic and extrinsic motivation, and perceived satisfaction in e-learning courses. Responses were analyzed quantitatively through ordinal logistic regression, ANOVA, chi-square and *t*-test statistical models. Results of this research indicated that gender differences exist with regards to motivation to persevere during courses taught by innovative technological tools. Moreover, both intrinsic and extrinsic motivation were higher in female college student athletes.

Positive Attitudes and Negative Attitudes Towards ICT

Positive and negative attitudes towards ICT may be defined as measurable effects that indicate if an individual likes or dislikes working with computers and using ICT in learning. In the 1980s, Lloyd and Gressard established the Computer Attitude Scale (CAS) as a reliable instrument for measuring different types of attitudes toward learning about and using computers, including both positive and negative attitudes (Lloyd & Gressard, 1987). Research data collected over the years from multiple groups of subjects utilizing CAS has indicated gender and age differences when it comes to positive and negative attitudes towards computers (Liao, 2000).

Liao's (2000) meta-analysis, *A Meta-Analysis of Gender Differences on Attitudes Toward Computers for Studies*, used Lloyd and Gressard's CAS survey and consisted of synthesizing the results of twenty-eight empirical studies. The weighted average effect size for all 28 studies was somewhat modest ($d = 0.273$), confirming that males have more positive attitudes towards computers than females. Findings of this meta-analysis point to a definite inequality and difference between genders in attitudes towards computers. Females had fewer positive attitudes when compared to their male counterparts. In his conclusion, Liao indicates that CAS meta-analysis findings offer a good insight into general positive and negative attitudes. Nonetheless, he advises future researchers to differentiate further between elements of positive and negative attitudes in order to pinpoint exact theoretical constructs embedded within them (Liao, 2000).

Perceived Satisfaction

As a construct, gender differences in terms of students' perceived satisfaction with technology in learning have been researched by various scholars in the field (Gonzalez-Gomez, Guardiola, Rodriguez, & Alonso, 2012; Hung, Chou, Chen, & Own, 2010; Lu & Chiu, 2010). Lu and Chiou (2010) claim that perceived satisfaction with technological learning tools is greater among male than female students. Nevertheless, other research studies report that gender has no effect on perceived satisfaction towards technology utilized in learning environments (Hung et al., 2010). Gonzalez-Gomez et al. (2012) surveyed a dataset of 1,185 students who participated in a course that used technological tools for learning at the Universidad de Granada in the 2008–09 and 2009–10 academic years. Their findings present us with new evidence on gender differences regarding student perceived satisfaction with innovative technological teaching. The researchers studied how gender differences influence specific aspects of students' overall learning evaluation, concluding that female students were more satisfied with technological learning in the class than their male counterparts. Furthermore, they also found that female students placed more importance on the planning of learning, as well as on being able to contact the teacher in various ways.

Computer Self-Efficacy

In the context of technology studies, computer self-efficacy (CSE) refers to an individual's perception of her ability to use technology to achieve a particular goal (Compeau & Higgins, 1995). It is seen as referring to people's judgment of their capabilities to use computers. Information systems researchers have developed the construct of computer self-efficacy as a factor in deciding whether or not to use computers and facilitating the acquisition of many of the skills associated with effective computer use (Lee & Huang, 2014). Researchers such as He and Freeman (2014) indicated that when compared with male college learners, female students, due to their limited exposure to computers, have lower computer self-efficacy towards computers and felt anxious about them.

Computer self-efficacy has been shown to significantly predict an individual's intention to use computers (Compeau, Higgins, & Huff, 1999; Munro, Huff, Marcolin, & Compeau, 1997; Ong & Lai, 2006). There is also evidence that computer self-efficacy significantly affects perceived usefulness, ease of use, and computer anxiety (Venkatesh, 2000). In a study by Chau (2002), business students perceived computer self-efficacy as exerting a small, negative effect on perceived usefulness of computers but not perceived ease of use. However, Ramayah and Aafaqi (2004) found that university students' computer self-efficacy levels significantly impacted perceived usefulness and ease of use with regards to e-library usage but not their usage behaviors of the tool.

Buse's (2009) research sheds light on exposure to video games and what postsecondary students engaged in both computer-related disciplines (CRD) and non-computer-related studies (NCRD) believed about the idea of being successful with computers. A "Computer Self-Efficacy" scale, originally created by Cassidy and Eachus, was used to examine these beliefs. The participants of this study consisted of 379 undergraduate students, divided into four groups – CRD female, CRD male, NCRD female, and NCRD male – at five southern state universities. Participants were assigned to a group based on their gender and subject of study. Predictive influence of Computer Self-Efficacy (CSE), Video Game Play (VGP), exposure to and preferences of the CRD and NCRD group were measured through logistic regressions, chi-square tests, and *t*-tests to compare and contrast the two groups. Findings revealed that there is no marked difference between male and female CSE levels. This study demonstrated that although more men than women play video games, the difference is not an indicator of discrepancies between male and female CSE scores. While CRD for women appears related to their VGP, no VGP exposure or preference variables could serve as an answer to female CSE levels.

Similarly, Gibbs (2013) surveyed students in an introductory computing class at a university located in the United States in 2012 to investigate the link between computer self-efficacy levels and gender. Researchers devised questionnaires to measure the students' levels of confidence and knowledge about computers. The findings showed that when it comes to computer self-efficacy, gender difference does not play a significant part.

Intention to Use ICT, Perceived Usefulness of ICT and Perceived Ease of Use

Intention to use computers, their perceived usefulness, and perceived ease of use are constructs utilized in different technology acceptance models that investigate how users accept and use technological tools. Various models of these information system theories have been applied to research users' attitudes and use of technological devices in academic and non-academic settings such as organizational contexts (Sumak, Hericko, & Pusnik, 2011). The following section lists the most widely used forms of technological acceptance models.

One of the most established models is the Technology Acceptance Model (TAM). Davis (1989) seeks to formulate the causal mechanisms behind acceptance or rejection of an information technology. He proposes that two behavioral beliefs, perceived usefulness (i.e. to what extent one believes technology will improve one's job performance) and perceived ease of use (i.e. to what extent one believes technology will be effort-free) are major predictors of an individual's intention to use information technology and their usage behavior towards it. Davis suggests, moreover, that perceived usefulness is the most robust predictor of intention to use an information system.

TAM2 was developed by Venkatesh and Davis (2000). It retains four of the original TAM Model constructs – Perceived Usefulness, Perceived Ease of Use, Intention to Use, and Usage Behavior – while also incorporating the following constructs: subjective norm, voluntariness, image, experience, job relevance, output quality, and result demonstrability. Subjective norm describes the "perceived social pressure to perform or not to perform the behavior" (Ajzen, 1991, p. 188). Voluntariness denotes the degree to which an individual believes adoption is non-mandatory (Agarwal & Prasad, 1997; Hartwik & Barki, 1994; Moore & Benbasat, 1991). The image relates to the extent to which an individual believes technology will raise their social status (Moore & Benbasat, 1991). Experience denotes the amassing of experience when using a particular technology. Job relevance describes the extent to which an individual believes technology is relevant to their job. Output quality denotes the degree to which an individual believes technology will help them carry out a particular set of tasks. Result demonstrability relates to the extent to which the results of using the technology are tangible and has a direct impact on perceived usefulness (Moore & Benbasat, 1991). According to Venkatesh and Davis (2000), subjective norms, image, job relevance, output quality, and result demonstrability all have a stronger direct impact on usage intention than perceived usefulness and perceived ease of use for mandatory systems. Furthermore, their expanded model demonstrates the effect of experience and voluntariness on a student's intention to use technology.

According to the Theory of Reasoned Action (TRA), an individual's behavior is predicted by their intentions, which are themselves influenced by a person's attitude toward the behavior and subjective norms surrounding its performance (Fishbein & Ajzen, 1975). The theory assumes that individuals essentially make rational decisions, assessing their behavior beliefs while forming an attitude towards the behavior. Attitude refers to "an individual's positive or negative feelings (evaluative affect) about performing the target behavior" (Fishbein & Ajzen, 1975, p. 216). Using an expectancy-value model, Fishbein and Ajzen posit that attitudes can be calculated by multiplying the strength of individual's behavior by the outcome evaluation and then adding the products of the beliefs' sets. Subjective norms refer to "the person's perception that most people who are important to him think he should or should not perform the behavior in question" (Fishbein & Ajzen, 1975, p. 302). Behavioral intention is calculated by multiplying the strength of normative belief by the motivation to act following the reference group or individual holding normative beliefs and adding the products for the set of beliefs.

Ajzen's (1991) well-established Theory of Planned Behavior (TPB) provides a theoretical framework for understanding human acceptance of information technology innovations. It builds upon TRA by including 'perceived behavioral control', a construct that refers to individuals' perceived ability to perform behavior. Thus, according to TPB, the intention to perform behavior is predicted by perceived behavioral control, attitude toward behavior, and subjective norm.

Taylor and Todd's (1995) Combined Theory of Planned Behavior/Technology Acceptance Model (C-TPB-TAM) combines TPB's predictors with TAM's perceived usefulness and ease of use constructs. The model divides the attitude, normative, and control belief structures, and is therefore also referred to as the Decomposed Theory of Planned Behavior (DTPB). Taylor and Todd break down the attitude belief into perceived usefulness, perceived ease of use, and compatibility. Normative belief is broken down into peer influence and superior impact. Control belief, meanwhile, is divided to include self-efficacy, resource facilitating conditions, and technology facilitating conditions.

The Model of PC Utilization (MPCU) devised by Thompson, Higgins, and Howell (1991) represents a rival theoretical framework to TRA and TPB. Extending Triandis' Theory of Interpersonal Behavior, which keeps cognitive and affective components of attitudes separate and posits that beliefs fall under the cognitive component of attitudes, MPCU attempts to predict PC utilization behavior. According to Thompson et al., "[behavior] is determined by what people would like to do (attitudes), what they think they should do (social norms), what they have usually done (habits), and by the expected consequences of their behavior" (1991, p. 128).

The model includes the following constructs: Job-fit, Complexity, Long-term Consequences, Affect Towards Use, Social Factors, and Facilitating Conditions. Job-fit refers to perceptions about enhanced job performance as a result of using a given technology. Complexity relates to perceptions about the difficulty of understanding and using the innovation. Long-term consequences refer to outcomes with positive future benefits. Affect towards use reflects a range of feelings, such as joy or displeasure, related to using the innovation. Social factors are defined as the "individual's internalization of the reference group's subjective culture, and specific interpersonal agreements that the individual has made with others, in specific social situations" (Thompson et al., 1991, p. 126). Facilitating conditions refer to conditions, which may exert an influence on whether or not a system is used (e.g. offering of support for PC users).

Within Innovation Diffusion Theory (IDT), diffusion refers to the process of innovation being communicated "through certain channels over time among members of a social system"

(Rogers, 2003, p. 5). This process is explained in terms of the factors that determine an individual's perception of innovation whenever a particular innovation is introduced. IDT comprises the following elements: innovation, communication channel, time, and social system. Time is believed to play a role throughout the innovation-decision process and features heavily in the innovativeness of an individual – innovators, early adopters, early majority, late majority, and laggards – as well as an innovator's rate of adoption. Adoption rate, meanwhile, is determined by five perceived characteristics of innovation: relative advantage, compatibility, complexity, trialability, and observability. These characteristics are defined as follows: relative advantage refers to the extent to which an innovation is perceived as superior to its predecessor; compatibility is the extent to which an individual believes an innovation corresponds to their values, experiences, and needs; complexity describes the extent to which an individual believes an innovation is difficult to understand and use; trialability refers to the extent to which an innovation can be tried out for a limited period; and observability denotes the extent to which other individuals are able to perceive the payoffs of using an innovation.

Sumak et al. (2011) synthesized 42 empirical research studies within the field of user technology acceptance to sum up the existing evidence on e-learning technology acceptance. Results of this synthesis indicate that the TAM is the most widely utilized acceptance theory in e-learning acceptance scholarly studies. Sumak et al. also claim that the perceived ease of use, as well as perceived usefulness, are factors that have an equal effect on the attitudes of subjects towards using technology. In their conclusion, the authors discuss TAM's validity and suggest it can utilize learners as respondents within a study of e-learning acceptance when analyzing students' opinions about the use and intention to use innovative technological tools in learning (Sumak et al., 2011).

Summary

In light of the literature reviewed and different theoretical constructs embedded in attitudes towards ICT, this meta-analysis will explore students' reported usage of ICT and discuss the aforementioned constructs (i.e. computer anxiety, computer confidence, perceived ease of use, perceived usefulness, perceived satisfaction, positive attitudes, negative attitudes, intention to use ICT, perceived usefulness of ICT, and perceived ease of use) as sub-constructs of attitudes towards ICT in learning environments. This will permit the synthesis of ICT usage and attitudes surveyed in the literature. A detailed discussion of the methodological framework used in this meta-analysis is provided in Chapter III.

CHAPTER III

Research Methodology

Meta-analysis is a research method that allows the synthesis of quantitative studies from numerous individual primary studies that examine the same concept (Glass, McGaw, & Smith, 1981). Meta-analysis is especially valuable as a research design when a traditional literature review indicates conflicting results because the statistical technique means conclusions can be drawn with more certainty (Camilli, Vargas, & Yurecko, 2003). When carrying out a meta-analysis, single study results are aggregated and changed to a standardized common metric called an effect size. This is followed by a thorough investigation on moderators possibly impacting on those results.

In the introductory chapter, I enumerated the advantages of meta-analysis. In this chapter, I will discuss the criticisms of meta-analysis, as research needs to take into consideration the advantages and the disadvantages of using a methodological research design. In this chapter, I will also be discussing the methodological procedures adopted in this study.

Pros and Cons of the Methodology

Meta-analysis, just like any other research methodology, has its advantages as well as a list of disadvantages and criticisms directed against it. Advantages of the methodology were covered in Chapter 1 of this dissertation. In this section, I will address the major arguments against the methodology.

One of the most obvious criticisms of meta-analysis is that it allegedly assesses study results that have little to do with each other by grouping outcomes achieved through a variety of methods and arrived at with varying objectives. However, both Cooper and Hedges (1994) and Glass et al. (1981) argue that when the objects of one's investigation are very similar, it is acceptable to combine data from different studies. According to Cooper and Hedges (1994), such combinations form an integral part of synthesis and are not exclusively limited to meta-analysis.

The solution is to select studies between which the relationship is clear and whose objectives can be encompassed within one main scope of enquiry.

Hedges and Olkin (1985) suggest meta-analytic researchers should categorize the studies they use in terms of relevance or importance of ideas to the topic being investigated. In this way, they can begin their inquiry by looking at the major issue and then move on to secondary concepts. Cooper and Hedges (1994) have also created research frameworks to tackle the problem formulation stage and combine seemingly different concepts under one broad subject to be meta-analyzed.

According to Rosenthal (1979), another difficulty with meta-analysis is the so-called 'file-drawer problem', or the fact that publishers might be keener to publish studies with statistically significant findings and therefore potentially more meaningful results. This issue is commonly referred to as 'publication bias' and is not something that only relates to meta-analysis. It is also known to affect many other research designs and there are ways of correcting it. One way of dealing with the issue of publication bias is to use a non-statistical approach in which appropriate sampling procedures allow for the inclusion of not-yet-published papers, dissertations, books, and other irregular sources. These could be contrasted with published materials then be coded by the researcher (Glass et al., 1981).

Nevertheless, scholars claim that most peer-reviewed journals are discerning in what they publish, which is why published materials might be more methodologically sound than not-yet-published studies (Schwarzer, 1998; Wang & Bushman, 1999). However, by using appropriate study quality measurement techniques and measuring the impact of study quality, meta-analytic researchers can deal with the 'garbage in, garbage out' phenomenon. Cooper and Hedges, in *The Handbook of Research Synthesis* (1994), present different ways of coding elements of a study in order to assess its overall quality. If a 'quality of study' moderator is created, then good quality studies can be presented separately; alternatively, a weighting scheme can be created.

Some researchers raise serious doubts as to whether the critiques of meta-analysis are justified for the simple reason that they apply to literature reviews in general rather than meta-analytic methods specifically (Schwarzer, 1998). For example, much has been written about the issue of publication bias in traditional narrative reviews (Light & Pillemer, 1984). Glass et al.

(1981) add that an accumulation of disparate studies is a common feature of any method of synthesis that draws from a variety of sources.

Stockpiling non-independent outcomes, or making use of 'lumpy data', is another critique of meta-analysis (Glass et al., 1981; Kelley, 2007). This phenomenon refers to presenting several results from the same studies, which can influence how relevant they appear and thus lead to an increase in sample size and thus distort standard error estimates. Several methods are available in the literature to correct this issue. For example, to secure independence of data, Kulik and Kulik (1989) advocate using only one averaged effect size from every study outcome included in the meta-analysis. In sum, the fact that meta-analysis has been criticized has led to its methodology being improved and as a consequence it can now be seen as thorough, robust, valid, and replicable research design.

Methodological Procedures

Conducting a meta-analysis involves following a predefined sequence of steps (Cooper, 2010; Littell, Corcoran, & Pillai, 2008). Transparency and replicability are two of the benefits of following, and then carefully reporting, the steps in a meta-analysis. To ensure that my meta-analysis is standardized, systematic, and transparent in all stages of its execution, I followed Cooper's approaches to meta-analysis reporting. Those steps are as follows:

1. Formulating the problem
2. Searching the literature
3. Gathering information from studies
4. Evaluating the quality of studies
5. Analyzing and integrating the outcomes of research
6. Interpreting & synthesizing the evidence
7. Presenting and discussing the results

As such, this chapter will outline steps one to five, including meta-analysis research questions, defining terms and variables, inclusion and exclusion criteria of the selected studies, procedures followed to conduct literature searches, study quality measurements, coding of study features and moderator variables, extraction of effect sizes, and establishing inter-rater reliability. Chapter IV and Chapter V of this dissertation will outline Step 6 and Step 7 respectively.

Formulation of the Problem

In this part of my inquiry, I formulated the problem, identified the research question, operationalized the variables researched, and established inclusion/exclusion criteria. This meta-analysis was designed to answer the question: Are there gender differences with regards to usage of and attitudes towards ICT utilized in learning environments? In addition, my meta-analysis addressed attitudes towards technology by dividing them into the different theoretical constructs of attitudes found in the literature and explained in Chapter II under the section titled *ICT Attitudes and Different Theoretical Constructs*. Therefore, I answered the original research question, in the context of formal educational settings, by dividing it into the following 12 sub-questions:

Are there gender differences with regards to students' reporting of ICT usage?

Are there gender differences with regards to students' reporting of computer anxiety?

Are there gender differences with regards to students' reporting of negative attitudes towards ICT?

Are there gender differences with regards to students' reporting of computer confidence?

Are there gender differences with regards to students' reporting of perceived ease of use of ICT?

Are there gender differences with regards to students' reporting of perceived usefulness of ICT?

Are there gender differences with regards to students' reporting of perceived satisfaction with ICT?

Are there gender differences with regards to students' reporting of positive attitudes towards ICT?

Are there gender differences with regards to students' reporting of motivation to use ICT?

Are there gender differences with regards to students' reporting of computer self-efficacy?

Are there gender differences with regards to students' reporting of intention to use ICT?

Are there gender differences with regards to students' reporting of mixed perceptions towards ICT?[4]

Inclusion and exclusion criteria: Initially studies for inclusion were chosen based on their abstracts alone. Once all articles had been collected the articles were examined more closely and selected for inclusion based on the following criteria:

1. Contained direct measures of learners' usage/attitudes towards technology
2. Contained information on female as well as male learners
3. Date of publication was 2006 or more recent
4. Contained sufficient statistical information for effect size extraction
5. Contained sufficient description of research procedures

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[4] I added this outcome to denote the studies that measured students' perceptions towards ICT by asking questions and reporting results that may have been related to more than one of the categories of attitudes mentioned above.

Failure to meet any of these criteria led to study exclusion, and the reasons for rejection were documented.

In order to test the reliability of the process of inclusion/exclusion, the author and another coder worked independently and rated 100 selected studies based on their abstracts on a scale from one to three, where the rating of two at the midpoint warranted study inclusion. Disagreements were resolved through discussion between the two coders. The interrater agreement for reviews of the first 100 studies at abstract level was more than 90% (9 disagreements in total). Given results, reliability in coding was established, and I coded the rest of the abstracts on my own.

Basic set of exclusion criteria:

DFD – does not fit dimensions
IRR – irrelevant outcomes or population
IED – insufficient empirical data
ISD – insufficient statistical data
IUA – inappropriate unit of analysis
NIB – not institutionally-based
RA – review articles
MA – meta-analyses
DOA – descriptive or opinion articles
OF – only females
NS – not students

Systematic Literature Search Strategy

A critical stage of a meta-analysis is the literature search and retrieval. The researcher searches the literature, identifies, and retrieves the relevant studies. At this stage, the researcher is advised to consult a librarian to make sure that the search constitutes a comprehensive and systematic review of literature databases (Littell, et al., 2008). That is why, in this study, comprehensive literature searches were designed with the help of an information retrieval specialist. This allowed me to identify and retrieve the maximum amount of primary empirical quantitative studies relevant to the major research question and thereby reduce publication bias (Bernard et al., 2014).

In this dissertation, I also followed the Campbell Collaboration recommendations for information retrieval methods (Hammerstrøm, Wade, & Jørgensen, 2010). Comprehensive searches were conducted in a variety of international databases within the field of education. These including the following: ERIC database, PsycINFO, Communication Abstracts, Academic Search Complete, EdITLib, Communication & Mass Media Complete, Education Source, and Gender Studies Database.

Communication & Mass Media Complete (CMMC) is a comprehensive database that offers the full content of more than 500 journals on communication, mass media, linguistics, discourse, rhetoric, sociolinguistics, communication theory, language, logic and, organizational communication. The journals included date back to 1915.

Education Source is one of the most comprehensive databases of resources addressing the issues of pedagogic research for teaching and learning purposes. Its database includes articles that date back to 1929, full-text reports for more than 2,000 journals, 550 books and monographs, and 1,200 education-related conference papers.

The Gender Studies Database is a database covering a full range of gender studies that include, but are not limited to, studies relating to the field of education. It incorporates links to the abstracts or full-text reports to more than one million journal articles dating back to 1972.

The Education Resources Information Center (ERIC) database is one of the largest online computerized libraries of educational research and data. ERIC is supported by the Institute of Education Sciences of the United States Department of Education. An advantage of ERIC is its grey literature collection, which is fully accessible and comprises items such as conference papers, unpublished theses, dissertations, and reports. ERIC has more than 336,000 full-text reports dating back to 1967.

PsycINFO is a database with a comprehensive collection of behavioral and social science research findings relating to psychology, educational psychology and related fields in and out of the academic domain. It boasts nearly 2,500 journals indexed, as well as books, book chapters, dissertations, and other research reports. References in PsycINFO go back to the 19th century.

Communication Abstracts is a database, which can be used as a rich reference tool when researching communication and media studies and related fields. It offers more than 307,000 full-text reports and it covers at least 330 journals in the communication and media field.

Academic Search Complete offers an expansive collection of the most pertinent academic resources with a special focus on STEM research as well as on the social sciences and humanities. It has more than 7,700 full-text reports with references that go back as far as 1887.

EdITLib is an online database of more than 200,000 indexed documents that include journal articles, paper presentations, theses and dissertations, proceedings, and research reports on the topic of Educational Technology and E-Learning. References go back to the 1980s.

To be comprehensive in the search strategy employed and to reduce publication bias, I also explored bibliographic databases, grey literature resources, research organizations and dissertation abstracts. The latter was achieved using the ProQuest Dissertations & Theses database, which is supported by University Microfilms International and provides access to all American theses and dissertations at accredited institutions in the USA. In addition, I carried out additional searches on the Internet (using large search engines such as Google) and examined conference proceedings from major conferences. Finally, I used a 'branching' technique in order to find any studies that may have been missed. 'Branching' involves looking at reference lists of articles that have already been found as well as conducting searches to see who cited which articles and to identify important articles on the topic.

Initially, a pilot search was conducted on the ERIC database to ensure that a comprehensive amount of studies were found. The terms 'gender' or 'women' were paired with a group of keywords to target perceptions, attitudes, efficacy or anxiety. Different combinations of words were used based on what was found in each database to accommodate for differences in the bank of studies in each database. For the technology concept, ERIC Descriptors (official subject headings) were used since terms like 'computer' and 'technology' can appear in many different contexts. Using descriptors increases the likelihood that technology is the focus of the article. In addition, all results were limited to studies published in or after 2006.

The initial search returned over 743 abstracts. Random abstract reviews of the initial search resulted in only 20% of the studies meeting the inclusion criteria. Therefore, the first ERIC database search was narrowed down to denote ERIC Descriptors for 'gender differences' and ‘computer attitudes’, to exclude ‘professional development’ or ‘teacher training’, and to limit document type outputs to research reports. The second ERIC search gave 549 abstracts. Random abstract reviews gave back 30% includes. At this point, descriptors and subject headings for all key terms used were explored. The third search gave 347 results. Random abstract reviews of the initial search gave back 40% includes. However, many of the results accepted for inclusion in the second ERIC database search were not found in the third ERIC database search.

Consequently, after three literature search trials, a more open approach, such as the one utilized in the second ERIC database search, were adopted so that no studies were lost and the search for pertinent literature remained comprehensive. Thus, exhaustive sets of search terms for all of the variables were formulated with some variations to account for varying terminology across different fields and databases, including Google search results. These terms can be seen below, while the results of the individual search trials can be found in Appendix A.

Terms used to search for gender. ‘Gender’ OR ‘Women’ OR ‘Gender Differences’ OR ‘Gender Issues’ OR ‘Females & Males’ OR ‘Group Differences’ OR ‘Human Sex Differences’ OR ‘Sex Roles’ OR ‘Human Females & Human Males’ OR ‘Group Differences’ OR ‘Male & Female’ OR [‘Men OR Male* OR Masculin*AND Women OR Female* OR Feminin*’] OR ‘Gender Differences in Communication’ OR ‘Gender Identity in Communication’ OR ‘Gender differences in education’ OR ‘Gender Differences in Education Research’ OR ‘Gender Identity in Education’ OR [‘Women Education’ OR ‘Women Education Graduate’ OR ‘Women Education Higher’ OR ‘Women Education Research’ OR ‘Adult Education of Women’] AND ‘Men Education’ OR ‘Men in Education’ OR ‘Male College Students’] OR [‘Women AND Men’].

Terms used to search for technology: ‘Educational Technology’ OR ‘Asynchronous Communication’ OR ‘Audiovisual Communications’ OR ‘Audiovisual Instruction’ OR ‘Computer Uses in Education’ OR ‘Computer Assisted Instruction’ OR ‘Computer Attitudes’ OR ‘Online Courses’ OR ‘Courseware’ OR ‘Virtual Classrooms’ OR ‘Web Based Instruction’ OR ‘Laptop Computers’ OR ‘Information Technology’ OR ‘Technology Integration’ OR ‘Technology Uses in Education’ OR ‘Handheld Devices’ OR ‘Electronic Equipment’ OR

‘Computer Games’ OR ‘Computer Peripherals’ OR ‘Electronic Learning’ OR ‘Computer* OR ‘Information Technolog*’ OR ‘Media Programs in Education’ OR ‘Multimedia Systems in Education’ OR ‘Educational Innovations’ OR ‘Instructional Innovations’ OR ‘Instructional Systems’ OR ‘Virtual Classrooms’ OR ‘Electronic Classrooms’ OR ‘Teaching Machines’ OR ‘Programmed Instruction’ OR ‘Teaching Aids & Devices’ OR ‘Asynchronous Learning’ OR ‘Audiovisual Education’ OR ‘Audiovisual Research’ OR ‘Education Audio-visual Aids’ OR ‘Audiovisual Materials’ OR ‘Audiovisual Education’ OR ‘Computer Assisted Instruction’ OR ‘Intelligent Tutoring Systems’ OR ‘Integrated Learning Systems’ OR ‘Computers in Education’ OR ‘Educational Technology’ OR ‘Technology Study & Teaching (Higher)’ OR ‘Information Technology’ OR ‘Study & Teaching’ OR ‘High Technology & Education’ OR ‘Educational Technology Planning’ OR ‘Information Technology’ OR ‘Computer Systems’ OR ‘Use of Technology’

Terms used to search for usage and attitudes: ‘Perception’ OR ‘Attitude’ OR ‘Efficacy’ OR ‘Anxiety’ OR ‘Usage’ OR ‘Computer Attitudes’ OR ‘Preferences’ OR ‘Self Efficacy’ OR ‘Use Studies’ OR ‘Attitudes’ OR ‘Perception*’ OR ‘Expectations’ OR ‘Usage of’ OR ‘Computer Anxiety’ OR ‘Attitudes Toward Computers’ OR ‘Computer Users’.

Results of Literature Searches

In this meta-analysis, I began with a batch of 1,064 studies that were scanned at an abstract level and ended up with 213 studies, which I included in the final sample. The list of levels here below outlines the stages of literature retrieval.

Stage 1 literature retrieval results: Potential studies identified and screened at the abstract level comprised 1,064 studies. An original pool of 1,064 abstracts (from ERIC and other databases) identified through literature searches were screened at the abstract level to determine which full-text reports should be the subject of additional scrutiny. For the first round of reviews, the two coders working independently coded the first 100 articles. Interrater agreement for 100 article reviews at abstract level was more than 90% (9 disagreements in total). Given these results, reliability in coding was established and I coded the rest of the abstracts on my own.

Stage 2 literature retrieval results: Excluded studies at abstract level comprised 587 studies. Of the studies produced by the initial search, 342 studies were excluded because they had irrelevant outcomes or dimensions which did not fit. Thirty-five studies were excluded because they were review articles and hence I had not been able to retrieve effect sizes for them.

Also, a number of studies, such as studies based national census data, were excluded in order to maintain statistical independence of the data. One hundred and seventy studies targeted the wrong population, either not students, or only females, or teachers. Thirty-five studies had dates outside the range of acceptable years. Lastly, 5 studies were unavailable for retrieval.

Stage 3 literature retrieval results: Articles retrieved for detailed evaluation comprised 477 articles. Articles which warranted closer examination were retrieved and screened at full-text retrieval. Two coders working independently coded the first 50 articles at this stage. Interrater agreement for 50 article reviews at full-text retrieval level was more than 92% (4 disagreements in total). Given these results, reliability in coding was established and I coded the rest of the full-text articles on my own.

Stage 4 literature retrieval results: Excluded studies at full article review level comprised 207 studies. Of the studies produced by the full-text retrieval stage, 94 studies did not research the appropriate dependent variable (i.e. attitudes towards or usage of ICT in learning). Forty-five studies did not contain information on female as well as male learners. Twenty-four studies did not have the appropriate independent variable (i.e. technology in learning or ICT in learning). Thirty studies were review articles that did not lend themselves to retrieval of effect size. Six studies had dates outside the acceptable range years. Eight studies were not based on empirical data.

It is important to note that at this stage the researcher noticed that a large portion of the literature investigated perceptions of ICT in learning. Ninety-four studies were rejected at this level because they were part of a category which dealt with career choices or choices for technology program enrolments. An example of such a study that was excluded is the Venkataraman, Agarwal, and Brown (2013) survey study that investigated barriers to female participation in computer science careers. Notwithstanding the importance of these studies, I did not judge these studies to be proper material for my specific meta-analysis because investigating perceptions towards an IT career is different from researching perceptions towards technology in learning. That being said, when a study investigated perceptions of a specific IT course, it was included since it related to technology in learning. An example of this is Richards-Babb and Jackson's (2011) study, which inquired as to whether learner feedback differed between male and female students enrolled in introductory chemistry classes.

Stage 5 literature retrieval results: At this stage, articles were manipulated to extract effect size data as and moderator variable coding. However, 57 studies were excluded. Forty-eight studies had insufficient statistical information for the extraction of effect sizes. Two studies targeted the wrong population (i.e. either not students, or only females, or teachers). Lastly, one study was a duplicate study, while six studies were direct observations of ICT usage. Again, while acknowledging the importance of these studies when trying to understand the differences with respect to gender and technology, all studies in this meta-analysis were survey design studies and not experimental in nature. Therefore, in order not to conflate my findings, I decided not to include this small number of studies of direct measurement of usage.

Stage 6 literature retrieval results: The final count of studies that were included in the current study is 213. For this last stage, two coders working independently coded the first 20 articles. Interrater agreement for 20 effect size extraction and study feature analyses was more than 90% (2 disagreements in total). Due to these results, reliability in coding was established and I extracted the rest of the data on my own.

Coding of Studies

As recommended by Cooper (2016), in this step I gathered information from the final set of included studies. Having carried out an overview of the literature, I selected moderator variables and study features to code for in this study. Moderators and study features are coded to search for potential variables impacting on the average effect sizes concluded. They are based on empirical findings in the literature of students' attitudes towards ICT and its usage in academic settings. These include 'publication date', 'publication type', 'estimate', 'technology surveyed', 'grade level of learners', 'class context surveyed', 'questionnaire', 'Likert', 'technology acceptance model', 'sampling approach', 'research country', 'subject matter', 'sampling selection', 'competency', 'pedagogical nature of technology', 'validity', 'reliability', 'participation rate', 'experience', 'ethnicities', 'socioeconomic status', and 'intersection' of demographics.

Research country: Setting and region were chosen as moderator variables because ICT usage and attitudes are strongly related to location. For this reason, it could be that usage and attitudes towards ICT have a different gender effect depending on the region. In fact, several studies suggest a link between setting and ICT usage and attitudes. In their study, Jackson et al. (2008) investigate four fundamental questions on gender, culture, and information technology (IT) usage. The first question is concerned with whether children in China and those in the US use computers and the Internet differently, and the second with whether they use cellphones differently. The third question inquires whether gender restrains the cultural influences of using a plethora of technologies, including computers and the Internet. The fourth and final question asks whether Chinese and American students use IT differently. The study sample consisted of 600 Chinese and 600 American participants, with an average age of 12 years. Results point to culture- and gender-based distinctions in participants' use of technology, in addition to connections between these particular differences. Regarding computer and Internet use, American students ranked higher in usage than their Chinese counterparts, among whom the female percentage ranked lowest in usage intensity. These variations may be linked to an imbalanced availability of home computers and the Internet, since Chinese participants primarily accessed these through school while American participants had a higher probability of home access. Data on gender variations in Internet use were collected from Chinese participants and indicated more intense Internet usage by males than females. Results for cell-phone use show that American females had the highest usage rates while Chinese females had the lowest. Both American and Chinese children see playing games as their main computer pursuit, with differences depending on gender and culture. Communication seemed to be the favored computer pursuit of females, particularly among American females, whereas for males it was playing online games, particularly among American males. In addition, computer skills and enjoyment were rated more positively by American participants, with similar ratings for males and females. In contrast, the Chinese sample revealed higher ratings for overall computer usage and attitudes towards technology among males than females. Furthermore, Chinese females differed in their technology use in that they were less technologically engaged, had lower ratings of their computer skills and enjoyment, and were less inclined to using the Internet for correspondence. It is feasible that these distinctions have an effect on the academic and professional opportunities of Chinese females, particularly considering the importance the 21st century workforce accords to technological dexterity (Burkhardt et al., 2003).

Similarly, Li and Kirkup's (2007) research investigated possible discrepancies between Chinese and British students regarding attitudes towards computers and the Internet, as well as gender differences within these contexts. The sample consisted of 220 Chinese students and 245 British students. Findings revealed that British students used computers to acquire knowledge more often than Chinese students while the latter showed greater levels of confidence, where computer skills were concerned. Gender also proved to be a differentiating feature. Both Chinese and British male graduates used chat rooms and email more often than women, played more computer games, and were more confident about their ability to use computers. Chinese students were more engaged in computer games and men in both groups believed that using computers was more of a male activity. Overall gender differences were more apparent among British students and the researchers concluded that gender remains an important element in forming students' opinions of computers and their use in multi-cultural environments.

Ethnicities: Scholars such as Jackson et al. (2001) claim that the digital divide no longer seems to affect women but remains an issue across racial groups. Studies investigating gender differences in computer usage and attitudes have also, therefore, investigated differences in ethnicities that could be impacting on the results. For example, in 2011, Jackson, von Eye, Witt, Zhao, and Fitzgerald investigated how using the Internet and playing video games can affect children's potential in school, while accounting for race, income, and gender. The subjects were 227 male and 255 female students, with an average age of 12 years. One-third of the sample was African-American and the remaining majority Caucasian American. To evaluate technology use, researchers required that subjects use 7-point scales to respond to questions regarding how regularly they used and played the Internet and video games respectively. Results demonstrated that high Internet use allowed children who were poor at reading to better their reading abilities. Playing video games was connected to both improved visual-spatial ability and lower GPAs. The variables of gender, income, and race individually affected Internet usage, video game playing, and scholastic achievement. However, these variables did not impact the association between technological engagement and scholastic achievement.

Spires et al.'s (2008) study aims to understand what motivates middle school students to perform well academically. Survey questions focused on students' perceptions of school, their use of technology both within and beyond the academic sphere, and their scholastic participation. The sample consisted of 4,000 students in grades 6, 7, and 8 who were registered in an after-school extracurricular class across the US state of North Carolina. The final sample was selected from 12,000 after-school students through stratified random sampling based on race, gender, grade level, geographic area, and family income. Regarding computer use at home, results showed that females reported significantly higher usage than men; at school, however, females and males reported equal computer use. Findings also revealed that students reported computer use as what they most enjoyed at school regardless of ethnic group.

Other researchers have decided to deal with the impact of ethnicities on computer attitudes by researching ethnically homogeneous populations. For example, Ghatty (2014) investigated the self-efficacy of 36 men and 22 women taking a general physics laboratory course in a historically black university college. The study examined the efficiency of a virtual science laboratory when teaching physics, in terms of learning outcomes, attitudes, and self-efficacy experienced by students. Performing experiments in virtual laboratories elicited positive responses and there seemed to be no difference in self-efficacy due to gender. Consequently, the outcomes indicated that virtual laboratories can be a valid alternative to traditional laboratories and could be of importance in online science courses.

Socioeconomic status: It has also been claimed that gender differences in attitudes towards ICT vary among individuals with different socioeconomic statuses. For example, Albert and Johnson's (2011) study found that while perceptions of e-learning systems before enrolling in an online course were more positive among working-class than middle-class students, these perceptions were similar for both genders. Similarly, Vedantham (2011) looked at the role gender plays in online video creation in terms of users' confidence, their level of self-efficacy, their feelings about computers and perceptions of ease of use and usefulness, while taking into account their socioeconomic status, ethnicity and immigrant status. The size of users' institution of learning was also considered. In conducting the investigation, Vedantham used Bandura's self-efficacy theory, Steele's stereotype threat, Abramson's learned helplessness theories, as well as TAM (Technology Acceptance Model). Similarly to earlier studies (Cohoon & Aspray, 2006; Zeldin & Pajares, 2000) and of importance to policymakers and practitioners, this study confirms that men are more active with video creation as well as editing for specified projects than women, who seem less confident with computers. Gender also played a visible role in response to the question, "I have a natural talent/ability to work with computers" (i.e. their perceived ability). This consequently indicates the need for further inquiry into stereotype threat and learned helplessness theories.

Intersection of demographics: Gender differences in usage and attitudes towards ICT may vary according to intersections between gender and different ethnicities or other demographic variables such as socioeconomic background, parental education, race, and/or sexuality. Therefore, research investigating the combined effect of race and social class on gender might reveal how women of color are particularly disadvantaged (Smith & Stewart, 1983); or even how sometimes these intersections cancel each other out because of their "subtractive effects" (Sanchez-Hucles, 1997).

Demographic variables such as socioeconomic status, ethnicity, and or sexuality of individual participants are not simply demographic characteristics that differentiate people but the essence of their political and historical realities and social existence (Cole, 2009). As such, to expose the complex reality of gender inequality, it is best to show how group characteristics intersect with each other and thereby reveal the multifaceted relationship between gender and demographic variables (Cole, 2009). Seeking those intersections when researching gender differences in perceptions or usage of ICT in learning allows us to view those variables as social phenomena that not only interact on several levels and in different directions but also affect usage and perceptions of ICT in particular ways. By exploring interactions, therefore, gender inequality becomes more than just a simple description of individual group characteristics.

Grade level of learners: Theorists have argued that variations in male and female learners' usage of and attitudes towards technology are found at different grade levels, including K–12 (Meelissen & Drent, 2008; Papastergiou, 2008), college level (Koch, Müller, & Sieverding, 2008; Tien & Fu, 2008), and university level (Ertl & Helling, 2011; Kay & Lauricella, 2011; Koch et al. 2008; Meelissen & Drent, 2008; Tien & Fu, 2008).

The meta-analysis by Whitley (1997) on gender differences in the usage of and attitudes towards ICT found that age was the most salient moderating variable impacting on the relationship of gender and ICT. Synthesis results indicate that high school learners had a mean effect size larger than other age groups ($d = 0.396$).

Chyung (2007) examined differences between diverse age and gender groups with regards to their self-efficacy and use of online communication tools as well as scholastic achievements in an online postsecondary context. Three dependent variables were evaluated: online performance as evaluated by the quantity of messages; self-efficacy development as evaluated by the contrast between a pre-assessment and a post-assessment; and scholastic exam results. The study spanned four semesters between Fall 2004 and Spring 2006 at a northwestern, mid-sized university in the United States, with a sample of adult learners taking the master's level online course, *Introduction to Instructional & Performance Technology*. A two-way MANOVA disclosed important central and communication impacts on the dependent variables. Older participants posted more messages, whereas younger ones demonstrated significantly more self-efficacy. Female participants showed greater improvements in self-efficacy and achieved higher final exam scores than their male counterparts. Test results also differed significantly between younger male participants and younger female participants.

Other researchers have decided to deal with the impact of grade level of learners on computer attitudes by researching specific student populations. For example, Sainz and Eccles

(2012) conducted a longitudinal study and found that differences between high school students' perceptions of ICT proficiency change over time, with boys reporting higher perceptions of ICT proficiency than girls. In contrast, Vekiri and Chronaki (2008) researched elementary level students and documented no difference between girls' and boys' perceptions of ICT proficiency.

Publication type: The notion of publication bias in research is a serious concern in meta-analysis. It is generally accepted that studies with significant results are more likely to be published than studies than studies with non-significant findings (Cornell & Mulrow, 1999). To counterbalance any possible publication bias in this study, I attempted to find grey literature as well as research articles published in scholarly journals.

Publication date: Provided the study design is sound, any study should at first glance be considered of importance. This is true whether it was conducted a decade ago or today. However, there are two reasons why publication date might moderate the relationship between usage and perceptions towards using technology in learning. The first is that with the increasing use of ICT in learning and its growing ubiquity, the access to, and the spread of technology has changed. The second reason why publication date may be relevant is that the instruments utilized in the studies have developed and improved over time.

Pedagogical nature of technology: There are many taxonomies and different approaches regarding the classification of technological tools in education. In this meta-analysis, I have relied on how Schmidt et al. (2014) measure the pedagogical impact of technology since they categorize each technology by major purpose of its use in learning. The pedagogical uses of technology are defined according to the dimensions identified in Schmidt et al.'s technology taxonomy:

1. Communication Support: Students who have greater chances of interacting with one another and/or their teacher using electronic communication systems and who do so with increased efficiency, frequency, or diversity in terms of modes used (e.g. discussion boards and email) will obtain higher scores on the Immediacy of Communication dimension.

2. Cognitive Support: Students who receive increased support through the use of technological tools that enable the analysis, reorganization and restructuring of learning materials, synthesis of information, manipulation of parameters, and clarification and connection of concepts will obtain higher scores on the Cognitive Support dimension. This dimension affects students' openness to learning materials and their degree of cognitive interaction with the content. The goal of such cognitive support is to decrease extraneous cognitive load (i.e. additional mental processing that is not relevant or necessary for the attainment of key learning objectives) and/or increase germane cognitive load by directing students' attention towards only the most relevant information (e.g. Sweller, 1999; Sweller, van Merrienboer, & Pass, 1998). There are several ways to provide this type of support. Teachers can avoid working memory overload by designing and using educational multimedia that correctly combine channels (modalities) whenever information is presented (e.g. Mayer & Moreno, 2003). They can present information that takes into account the limited capacity of working memory and enables its structured transfer to long-term memory (e.g. Cooper, 1998). Teachers can also provide additional tools to help students finish tasks that need doing but are not necessarily essential in terms of the main instructional goals. Alternatively, teachers can use tools which do not divert mental resources from key learning objectives, but rather structure information and learning activities so that they are closely in line with learning goals. Examples of cognitive support include simulations and virtual labs, as well as software that scaffold learning model processes, offer rich (adaptive) feedback, create concept maps, foster knowledge building, and decrease the cognitive load of tasks that are not central to the learning objectives.

3. Search and Retrieval Support: This dimension is characterized by tools that help students seek and retrieve knowledge such as access to web-links, search engines, databases, or additional electronic resources.

4. Presentation Support: This dimension refers to the delivery of instructional content via tools that have been specifically designed to present learning materials. These include PowerPoint (or equivalent) software, illustrations, static/moving images, and videodisks, etc.

Other researchers, such as Churchill and Wang (2014), have proposed the following classification of categories related to iPad use in the classroom:

1. Productivity Apps: These include word-processing, document annotation, and multimedia creation tools such as Mail, iAnnotate, Docs2PDF, Neu.Annotate, PDF Notes, Office2HD, iMovie, and Dragon.

2. Teaching Apps: These are designed to support teachers in the classroom, whether to help them deliver presentations, facilitate classroom management, assist with projectors, or mark books. Specific Apps include Moodle, Clickker School, TeacherPal, Prezi Viewer, Slides Share, and LanSchool Teacher.

3. Notes Apps: Notes Apps allow individuals to simultaneously take notes, make audio recordings, draw, and type. Examples include HansOn, Bamboo Paper, Penultimate, AudioNote, Draw Free, and iPocketDraw.

4. Communication Apps: These were made to support communication and social networking and include Facebook, Skype, Messages, FaceTime, and MyPad

5. Drives: Drives allow individuals to connect to the Cloud, network drives, and computers. Specific apps include Air Shawing, FileBrowser, Dropbox, ZumoDrive, Air Drive, and AirDisk.

6. Blogging Apps: Blogging Apps allow individuals to blog via their iPad and include Blogsy and Wordpress.

7. Content Accessing Apps: These apps include e-books, multimedia material, and video accessing tools such as iBooks, Kindle, YouTube, Perfect Reader, iTunes, and iTunesU.

Technology Acceptance Models: While exploring the literature, it was apparent that some studies used technology acceptance models to research users' satisfaction and intention to use ICT while others did not. Researchers have chiefly used those models within non-educational settings. In the workplace, for example, the models have been shown to reliably predict workers' productivity levels. Others have used them as part of their research with student populations for that reason (e.g. Macharia, 2014). The use of a technology acceptance model was tabulated as a moderator to measure if this impacts gender differences in terms of usage and attitudes towards ICT in learning.

Experience and competency: Research has shown that there is a link between levels of computer anxiety and levels of both computer knowledge and computer experience. Computer usage is a direct result of lower levels of fear, apprehension, and other emotional states arising from greater knowledge of and experience with computers (He & Freeman, 2014).

Computer competence is a broad concept but is closely related to notions such as computer experience, computer proficiency, computer achievement, computer skills, and computer literacy. It is typically measured on the basis of respondents' self-rated levels of confidence with computers as knowledge from one's own experience provides the most important source of information for the development of one's self-efficacy (He & Freeman, 2014).

Meanwhile, expectancy-value theory has gained currency as a lens through which to predict the adoption and use of technology (Wozney, Venkatesh & Abrami, 2006). Wozney et al. have extended expectancy-value theory to the educational domain, developing what they argue is a parsimonious model for predicting teachers' integration of technology into their pedagogical practices. Wozney et al.'s model posits that the adoption of an innovation can be predicted by its perceived value, its expected chances of success and whether or not its benefits are considered greater than the anticipated cost of implementation. According to this model, the degree to which teachers will integrate an innovation into their pedagogical practice can be determined by (a) how highly the innovation is valued; (b) how successful its implementation is expected to be; and (c) its perceived implementation costs. Expectancy, value, and cost constitute three discrete constructs within the model. Expectancy items target the perceived likelihood of successful outcomes as a result of using the innovation. Value items pertain to the perceived value of the innovation or its concomitant outcomes, from the perspective of both teacher and students. Cost items, on the other hand, examine the perceived costs of implementing the innovation such as experience and aptitude in using technologies.

Dobbs, Waid, and del Carmen's (2009) study investigates university students' perceptions of online courses by comparing students who have taken online courses with those who have not. Surveys were distributed among students registered in upper division criminology and criminal justice (CRCJ) courses at a southwest four-year university over a two-week time span in September 2007. Data were gathered from students enrolled in criminal justice courses at the university, both on campus (180 students) and through an online program (100 students). The analysis emphasizes the dissimilarities in conception between students who have experience in online courses and those who do not. Findings demonstrated that overall, students' opinions differ according to involvement in online courses, degree of online experience, age group, and gender.

Quality Assessment

The idea of incorporating moderators to assess study quality included in meta-analyses is not new. As argued by Gene Glass back in 1976, the methodological nature of studies included in a systematic survey or a meta-analysis must be analyzed. The methodological makeup of studies incorporated into a meta-analysis is vital because the quality of the studies might influence the veracity of conclusions drawn about the research question asked. However, there is still no commonly agreed-upon method. Since the studies included in this dissertation were solely survey studies, study quality was assessed by selecting moderators relating to survey design.

Petticrew and Roberts' (2008) checklist for appraising surveys requires a systematic reviewer to reflect upon five central issues: a survey's general orientation, sampling, measure(s), data collection method, and data and statistical analyses. General orientation questions ask whether the survey has been deliberately created to match the research question(s), as well as how a survey was conducted. Sampling items include questions related to the sample's representativeness and response rate, whereas measurement items target the survey's objectivity, reliability, and appropriateness, among other features. Data collection items ask whether the choice of a specific data collection method may have resulted in significant bias. Finally, Petticrew and Roberts' framework solicits judgments regarding the size of the study, the description of data contained therein, as well as the appropriateness of statistical analyses and associated biases based on quality of surveys.

Consequently, survey design and content were both taken into account and calculated as moderator variables when collecting surveys for this meta-analysis. These variables included the following: estimate calculation of effect sizes used, whether the participation rate was adequate, the survey population they were selected from, whether it was surveying general technology or a particular technology, whether the survey was related to a particular class context or a general exploratory nature, type of questionnaire used (whether already constructed or researcher-made), reported questionnaire validity, reliability, Likert scales, and sampling approach. Appendix A contains the coding sheet used when tabulating the moderator variables in this meta-analysis.

Data Analysis

Effect Size Calculations: For this analysis, I proceeded to extract summary statistics in order to calculate an estimated effect size that indicates the strength of the relationship between variables of interest (Borenstein, 2009). The effect size used in this study is Hedge's *g*. It stands for the standardized mean difference between two groups. In most cases, effect sizes were calculated using sample size, means, and standard deviations for the control and treatment groups. However, in cases where this information was not available, effect sizes were extracted using sample size, *t*-test scores or *F*-test scores, and their corresponding *p* values. An effect size calculator from the CSLP (Centre for the Study of Learning and Performance) at Concordia University was used for these calculations. Once effect sizes for all of the studies were obtained, they were analyzed using the Comprehensive Meta-Analysis^{TM} program (Borenstein, Hedges, Higgins, & Rothstein, 2015).

Estimation Model Selection: The overall effect size was calculated using a random effects model. The research questions in this study called for a random effects model because the studies differ with respect to questionnaires used, populations, and event result measures (Borenstein et al., 2009). Nonetheless, strict adherence to the random model does not take into consideration the investigation of possibly informative moderator variables, since there is no between-study fluctuation to analyze. The mixed effects model, however, permits us to investigate moderator variables. Utilizing the mixed model, I computed and reported both fixed and random effects.

To clarify the differences between average effect sizes, I also calculated the mixed-effects between-group heterogeneity, Qbetween (Q_{B}). It refers to the variation in study outcomes between studies.

Independence of Study Outcomes: Statistical independence was preserved by averaging effect sizes for the same construct (i.e. reported ICT usage or attitude construct) from single studies (Lipsey & Wilson, 2001). Each study, therefore, contributed only one averaged effect size either to ICT attitude and/or usage construct. For example, if a study surveyed students' reported ICT usage and computer anxiety, then two averaged effect sizes were measured to denote the two constructs researched . Following this, these effect sizes would be used to calculate the weighted individual average effect sizes of the different studies to find the weighted mean effect sizes. With this method, reports with more subjects were considered more important than those with smaller samples.

Outlier Analysis: Comprehensive Meta-Analysis (CMA) outlier analysis (i.e. one study removed) was performed on each outcome measured to ensure that the mean effect size measured was valid even after excluding studies with extreme effect sizes. When these extreme effect size values were removed, the mean effect size turned out to be comparable to the original calculated one, and that is why all studies examined, across the twelve constructs, were included in further analyses.

Summary

This chapter reviewed the methodological and data analysis procedures followed in this study, outlining the steps taken to arrive at the final count of articles included, justifying the moderators chosen to study the variables that might impact the results, and describing how the data was analyzed and the results aggregated.

CHAPTER IV

Results

This chapter examines the overall effect of gender differences concerning students' usage and attitudes towards technologies in learning environments. Results are divided into the 12 constructs of interest in this meta-analysis. These include the following: 11 computer attitude constructs (Computer Anxiety, Negative Attitudes Towards ICT, Computer Confidence, Perceived Ease of Use of ICT, Perceived Usefulness of ICT, Perceived Satisfaction with ICT, Positive Attitudes Towards ICT, Motivation to Use ICT, Computer Self-efficacy, Intention to Use ICT, and Mixed Perceptions Towards ICT), and Usage of ICT. The results of this synthesis are described, with a review of mean effect sizes, *p* values and significance, confidence intervals tests of homogeneity, in addition to *I* squared and *Tau* values. Tabulated representations of the results are also provided.

Over 1,064 abstracts were reviewed. Of these, 277 articles were selected for full-text retrieval. After reading these studies, 213 full texts were selected to extract effect sizes related to measures of students' usage of ICT and students' attitudes towards ICT. Since this study examined gender differences regarding usage and attitudes towards ICT and considered them treatment (men) vs. control (women) group differences, results favoring males were indicated by a positive value, whereas results favoring females were indicated by a negative value. Thus, positive values represented larger male effect sizes, and negative values represented larger female effect sizes. This meta-analysis followed Cohen's (1988) effect size interpretation guidelines, which consider 0.2 a small effect, 0.5 a medium effect, and 0.8 a large effect. Tables 1–12 show the overall weighted average random effects and fixed effect sizes and homogeneity statistics for each independent outcome measured.

Table 1

Overall Weighted Average Random Effects and Fixed Effect Sizes and Homogeneity Statistics for Computer Anxiety

Model	**N**	***k***	**ES (*g+*)**	**SE**	**CI$^{Lwr95\%}$**	**CI$^{Upr95\%}$**	***Q_B***	***I^2***	***Tau***
Fixed	10,466	42	-0.193*	0.020	-0.232	-0.154	134.946***	69.617	0.199
Random	10,466	42	-0.231**	0.040	-0.309	-0.153			

*z = -9.656, p < .0001; ** z = 5.826, p < .0001; ****Q(df)* = 41, p < .0001

Table 2

Overall Weighted Average Random Effects and Fixed Effect Sizes and Homogeneity Statistics for Negative Attitudes Towards ICT

Model	**N**	***k***	**ES (*g+*)**	**SE**	**CI$^{Lwr95\%}$**	**CI$^{Upr95\%}$**	***Q_B***	***I^2***	***Tau***
Fixed	11,331	18	-0.052*	0.023	-0.098	-0.007	56.621***	69.976	0.161
Random	11,331	18	-0.067**	0.053	-0.172	0.038			

* z = -2.240, $p < .05$; ** z = -1.247, $p = .212$; ****Q(df)* = 17, $p < .0001$

Table 3

Overall Weighted Average Random Effects and Fixed Effect Sizes and Homogeneity Statistics for Computer Confidence

Model	**N**	***k***	**ES (*g+*)**	**SE**	**CI$^{Lwr95\%}$**	**CI$^{Upr95\%}$**	***Q_B***	***I^2***	***Tau***
Fixed	9,154	28	0.300*	0.022	0.257	0.343	168.007***	83.929	0.272
Random	9,154	28	0.378**	0.060	0.261	0.496			

* z = 13.673, $p < .0001$; ** z = 6.313, $p < .0001$; ****Q(df)* = 27, $p < .0001$

Table 4

Overall Weighted Average Random Effects and Fixed Effect Sizes and Homogeneity Statistics for Perceived Ease of Use of ICT

Model	**N**	***k***	**ES (*g+*)**	**SE**	**CI$^{Lwr95\%}$**	**CI$^{Upr95\%}$**	***Q_B***	***I^2***	***Tau***
Fixed	9,892	21	0.247*	0.022	0.204	0.289	215.494***	90.179	0.323
Random	9,892	21	0.185**	0.078	0.032	0.337			

* z = 11.380, p < .0001; ** z = 2.374, p < .05; ****Q(df)* = 20, p < .0001

Table 5

Overall Weighted Average Random Effects and Fixed Effect Sizes and Homogeneity Statistics for Perceived Usefulness of ICT

Model	N	*k*	ES (*g+*)	SE	CI$^{Lwr95\%}$	CI$^{Upr95\%}$	Q_B	I^2	*Tau*
Fixed	37,429	69	0.081*	0.011	0.059	0.103	354.320***	80.808	0.193
Random	37,429	69	0.077**	0.029	0.021	0.133			

* $z = 7.275$, $p < .0001$; ** $z = 2.681$, $p < .01$; ***$Q(df) = 68$, $p < .0001$

Table 6

Overall Weighted Average Random Effects and Fixed Effect Sizes and Homogeneity Statistics for Perceived Satisfaction with ICT

Model	N	*k*	ES (*g+*)	SE	CI$^{Lwr95\%}$	CI$^{Upr95\%}$	Q_B	I^2	*Tau*
Fixed	18,005	28	0.063*	0.017	0.031	0.096	205.312***	86.849	0.229
Random	18,005	28	0.047**	0.050	-0.051	0.145			

* $z = 3.834$, $p < .0001$; ** $z = 0.947$, $p = .344$; ***$Q(df) = 27$, $p < .0001$

Table 7

Overall Weighted Average Random Effects and Fixed Effect Sizes and Homogeneity Statistics for Positive Attitudes Towards ICT

Model	N	*k*	ES (*g+*)	SE	CI$^{Lwr95\%}$	CI$^{Upr95\%}$	Q_B	I^2	*Tau*
Fixed	26,020	52	0.086*	0.013	0.061	0.111	308.877***	83.849	0.213
Random	26,020	52	0.098**	0.036	0.028	0.168			

* $z = 6.692$, $p < .0001$; ** $z = 2.730$, $p < .01$; ***$Q(df) = 51$, $p < .0001$

Table 8

Overall Weighted Average Random Effects and Fixed Effect Sizes and Homogeneity Statistics for Motivation to Use ICT

Model	N	*k*	ES (*g+*)	SE	CI$^{Lwr95\%}$	CI$^{Upr95\%}$	Q_B	I^2	*Tau*
Fixed	4,295	14	0.135*	0.032	0.072	0.199	54.899***	76.320	0.226
Random	4,295	14	0.143**	0.074	-0.002	0.289			

* $z = 4.188$, $p < .0001$; ** $z = 1.933$, $p = 0.053$; ***$Q(df) = 13$, $p < .0001$

Table 9

Overall Weighted Average Random Effects and Fixed Effect Sizes and Homogeneity Statistics for Computer Self-Efficacy

Model	N	*k*	ES (*g+*)	SE	$CI^{Lwr95\%}$	$CI^{Upr95\%}$	Q_B	I^2	*Tau*
Fixed	12,229	30	0.220*	0.016	0.189	0.251	75.693***	61.688	0.119
Random	12,229	30	0.225**	0.032	0.189	0.251			

* $z = 14.024$, $p < .0001$; ** $z = 7.037$, $p < .0001$; ***$Q(df) = 29$, $p < .0001$

Table 10

Overall Weighted Average Random Effects and Fixed Effect Sizes and Homogeneity Statistics for Intention to Use ICT

Model	N	*k*	ES (*g+*)	SE	$CI^{Lwr95\%}$	$CI^{Upr95\%}$	Q_B	I^2	*Tau*
Fixed	8,794	18	0.200*	0.023	0.155	0.244	205.744***	91.737	0.341
Random	8,794	18	0.152**	0.088	-0.021	0.325			

*$z = 8.759$, $p < .0001$; ** $z = 1.725$, $p =.085$; ***$Q(df) = 17$, $p < .0001$

Table 11

Overall Weighted Average Random Effects and Fixed Effect Sizes and Homogeneity Statistics for Mixed Perceptions Towards ICT

Model	N	*k*	ES (*g+*)	SE	$CI^{Lwr95\%}$	$CI^{Upr95\%}$	Q_B	I^2	*Tau*
Fixed	14,037	31	0.073*	0.018	0.038	0.108	168.853***	82.233	0.221
Random	14,037	31	0.066**	0.049	-0.029	0.161			

* $z = 4.081$, $p < .0001$; ** $z = 1.364$, $p = .173$; ***$Q(df) = 30$, $p < .0001$

Table 12

Overall Weighted Average Random Effects and Fixed Effect Sizes and Homogeneity Statistics for Usage of ICT

Model	N	*k*	ES (*g+*)	SE	$CI^{Lwr95\%}$	$CI^{Upr95\%}$	Q_B	I^2	*Tau*
Fixed	50,918	59	0.089*	0.009	0.070	0.107	598.801***	90.134	0.225
Random	50,918	59	0.075**	0.034	0.010	0.141			

* $z = 9.414$, $p < .0001$; ** $z = 2.245$, $p < .05$; ***$Q(df) = 58$, $p < .0001$

Are there gender differences with regard to the usage of and attitudes towards ICT utilized in formal educational settings?

The construct of Usage of ICT indicated a positive effect size ($g+ = 0.075$, 95% CI [0.010, 0.141]), consisting of 59 effect sizes and 50,918 participants, and had significant heterogeneity ($Q_B = 598.801$, $p < .0001$). This signifies that male students typically reported more usage of ICT with .09 standard deviations above the female students.

Attitudes towards ICT were measured in 11 separate outcomes: Computer Anxiety, Negative Attitudes Towards ICT, Computer Confidence, Perceived Ease of Use of ICT, Perceived Usefulness of ICT, Perceived Satisfaction with ICT, Positive Attitudes Towards ICT, Motivation to Use ICT, Computer Self-efficacy, Intention to Use ICT, and Mixed Perceptions Towards ICT. The results section of this meta-analysis explores the results of these constructs as independent sub-constructs of attitudes towards ICT in learning environments.

1. The construct of Computer Anxiety indicated a negative effect size ($g+ = -0.231$, 95% CI [-0.309, -0.153]), consisting of 42 effect sizes and 10,466 participants, and had significant heterogeneity ($Q_B = 134.946$, $p < .0001$). This signifies that female students typically reported higher computer anxiety, with .19 standard deviations above the male students.

2. The construct of Negative Attitudes Towards ICT indicated a negative effect size ($g+ = -0.067$, 95% CI [-0.172, -0.038]), consisting of 18 effect sizes and 11,331 participants, and had significant heterogeneity ($Q_B = 56.621$, $p < .0001$). This signifies that female students typically reported higher negative attitudes towards ICT, with .05 standard deviations above the male students.

3. The construct of Computer Confidence indicated a positive effect size ($g+ = 0.378$, 95% CI [0.261, 0.496]), consisting of 28 effect sizes and 9,154 participants, and had significant heterogeneity ($Q_B = 168.007$, $p < .0001$). This signifies that male students typically reported higher confidence with computers, with .38 standard deviations above the female students.

4. The construct of Perceived Ease of Use of ICT indicated a positive effect size ($g+ = 0.185$, 95% CI [0.032, 0.337]), consisting of 21 effect sizes and 9,892 participants, and had significant heterogeneity ($Q_B = 215.494$, $p < .0001$). This signifies that male students typically reported higher perceived ease of use when using ICT, with .19 standard deviations above the female students.

5. The construct of Perceived Usefulness of ICT indicated a positive effect size ($g+ = 0.077$, 95% CI [0.021, 0.133]), consisting of 69 effect sizes and 37,429 participants, and had significant heterogeneity ($Q_B = 354.320$, $p < .0001$). This signifies that male students typically reported higher perceived usefulness of ICT, with .08 standard deviations above the female students.

6. The construct of Perceived Satisfaction with ICT indicated a positive effect size ($g+ = 0.047$, 95% CI [-0.051, 0.145]), consisting of 28 effect sizes and 18,005 participants, and had significant heterogeneity ($Q_B = 205.312$, $p < .0001$). This signifies that male students typically reported higher perceived satisfaction with ICT, with almost .05 standard deviations above the female students.

7. The construct of Intention to Use ICT indicated a positive effect size ($g+ = 0.152$, 95% CI [-0.021, 0.325]), consisting of 18 effect sizes and 8,794 participants, and had significant heterogeneity ($Q_B = 205.744$, $p < .0001$). This signifies that male students typically reported higher intentions to use ICT, with .15 standard deviations above the female students.

8. The construct of Positive Attitudes Towards ICT indicated a positive effect size ($g+ = 0.098$, 95% CI [0.028, 0.168]), consisting of 52 effect sizes and 26,020 participants, and had significant heterogeneity ($Q_B = 308.877$, $p < .0001$). This signifies that male students typically reported higher usage of ICT, with .09 standard deviations above the female students.

9. The construct of Motivation to Use ICT indicated a positive effect size ($g+ = 0.143$, 95% CI [-0.002, 0.289]), consisting of 14 effect sizes and 4,295 participants, and had significant heterogeneity ($Q_B = 54.899$, $p < .0001$). This signifies that male students typically reported higher motivation to use ICT, with .14 standard deviations above the female students.

10. The construct of Computer Self-efficacy indicated a positive effect size ($g+ = 0.225$, 95% CI [0.189, 0.251]), consisting of 30 effect sizes and 12,229 participants, and had significant heterogeneity ($Q_B = 75.693$, $p < .0001$). This signifies that male students typically reported higher computer self-efficacy, with .22 standard deviations above the female students.

11. The construct of Mixed Perceptions of ICT indicated a positive effect size ($g+ = 0.066$, 95% CI [-0.029, 0.161]), consisting of 31 effect sizes and 14,037 participants, and had significant heterogeneity ($Q_B = 168.853$, $p < .0001$). This signifies that male students typically reported more mixed perceptions of ICT with .07 standard deviations above the female students. This outcome represented the studies that have measured students' perceptions towards ICT by asking questions and reporting results that may relate to more than one of the categories of attitudes mentioned above.

What are the moderator variables impacting the relationship between gender differences and usage and attitudes towards ICT?

Due to the heterogeneous nature of the effect sizes in the ICT usage and attitude constructs, and to help explain this variability, *analysis of variance* (ANOVA) was conducted on the hypothesized moderator variables and study features. These included 'publication date', 'publication type', 'estimate', 'technology surveyed', 'grade level of learners', 'class context surveyed', 'questionnaire', 'Likert', 'technology acceptance model', 'sampling approach', 'research country', 'subject matter', 'sampling selectivity', 'competency', 'pedagogical nature of technology', 'validity', 'reliability', 'participation rate', 'experience', 'ethnicities', 'socioeconomic status', and 'intersection of demographics'. The mixed model was used for the moderators' analyses. Tables 13–24 display the frequency tabulation results of the moderator variables for each related outcome, which was done as a first step. Tables 25-32 exhibit the final results tables of the moderator variables for each related outcome.

Table 13

Results of Frequency Tabulation of Computer Anxiety Moderator Variables

Moderator Variable	*k*
Publication Date	
2006–2010	20
2011–2015	22
Publication Type	
Refereed	32
Non-refereed	10
Estimate	
From descriptives	32
Other than descriptives	10
Technology Surveyed	
Specific technology	5
General technology	37
Grade Level of Learners	
University level	41
Not reported	1
Class Context Surveyed	
Specific class context	10
General institution-based	32

Table 13 (Continued)

Results of Frequency Tabulation of Computer Anxiety Moderator Variables

Moderator Variable	*k*
Questionnaire	
Already constructed	32
Not reported	2
Researcher-made	8
Likert	
4 Likerts	6
5 Likerts	19
6 Likerts	1
7 Likerts	4
9 Likerts	6
Not reported	6
Technology Acceptance Mdl	
Not used	31
Used	11
Sampling Approach	
Nonprobability sampling	24
Probability sampling	8
Not reported	10

Table 13 (Continued)

Results of Frequency Tabulation of Computer Anxiety Moderator Variables

Moderator Variable	***k***
Research Country	
Australia	1
Austria	1
Canada	1
China	1
Cyprus	1
England	1
Greece	1
India	1
Iran	1
Kenya	1
Kuwait	1
Malawi	1
Netherlands	1
Nigeria	1
Saudi Arabia	1
Singapore	1
Taiwan	5
Turkey	6
USA	15
Subject Matter	
NonSTEM	13
Not reported	25
STEM	4

Table 13 (Continued)

Results of Frequency Tabulation of Computer Anxiety Moderator Variables

Moderator Variable	***k***
Intersection of Demographics	
Not measured	41
Measured	1
Sampling Selection	
Sample from many	12
Sample one institution	30
Pedagogical Nature of Technology	
Cognitive	2
Communication	4
Not reported	36
Validity	
Measured	11
Not measured	31
Reliability	
0.8 and more	21
Less than 0.8	14
Not reported	7

Table 13 (Continued)

Results of Frequency Tabulation of Computer Anxiety Moderator Variables

Moderator Variable	*k*
Participation Rate	
0–29%	1
30–59%	1
60–89%	12
90–100%	4
Not reported	24
Competency	
In favor of men	7
Not reported	32
In favor of women	3
Experience	
In favor of men	1
Not reported	41
Ethnicities	
Measured	6
Not measured	36
Socioeconomic Status	
Not measured	38
Measured	4

Table 14

Results of Frequency Tabulation of Negative Attitudes towards ICT Moderator Variables

Moderator Variable	*k*
Publication Date	
2006–2010	10
2011–2015	8
Publication Type	
Refereed	14
Non-refereed	4
Estimate	
From descriptives	13
Other than descriptives	5
Technology Surveyed	
Specific technology	6
General technology	12
Grade Level of Learners	
University level	18
Related to specific class	1
General institution-based	17

Table 14 (Continued)

Results of Frequency Tabulation of Negative Attitudes towards ICT Moderator Variables

Moderator Variable	***k***
Questionnaire	
Already constructed	4
Not reported	2
Researcher-made	12
Likert	
10 Likerts	1
5 Likerts	15
7 Likerts	1
Not reported	1
Technology Acceptance Model	
Not used	18
Sampling Approach	
Nonprobability sampling	6
Probability sampling	3
Not reported	9
Subject Matter	
NonSTEM	5
Not Reported	8
STEM	5

Table 14 (Continued)

Results of Frequency Tabulation of Negative Attitudes towards ICT Moderator Variables

Moderator Variable	***k***
Research Country	
Australia	1
Finland	1
Germany	1
Malaysia	1
Norway	1
Pakistan	1
South Africa	1
Taiwan	1
Turkey	2
UAE	1
USA	7
Sampling Selection	
Sample from many	6
Sample one institution	12
Pedagogical Nature of Technology	
Cognitive	4
Not Reported	12
Presentation	2
Validity of Survey	
Measured	3
Not measured	15

Table 14 (Continued)

Results of Frequency Tabulation of Negative Attitudes towards ICT Moderator Variables

Moderator Variable	***k***
Reliability	
0.8 or more	3
Less than 0.8	5
Not Reported	10
Participation Rate	
0–29%	2
30–59%	2
60–79%	4
80–100%	5
Not Reported	5
Competency	
In favor of men	2
Not Reported	15
In favor of women	1
Socioeconomic Status	
Not measured	16
Measured	2
Ethnicities	
Not measured	13
Measured	5

Table 14 (Continued)

Results of Frequency Tabulation of Negative Attitudes towards ICT Moderator Variables

Moderator Variable	***k***
Intersection of Demographics	
Not measured	16
Measured	2

Table 15

Results of Frequency Tabulation of Computer Confidence Moderator Variables

Moderator Variable	***k***
Publication Date	
2006–2010	20
2011–2015	8
Publication Type	
Refereed	22
Non-refereed	6
Estimate	
From descriptives	20
Other than descriptives	8
Technology Survey	
Specific technology	4
General technology	24

Table 15 (Continued)

Results of Frequency Tabulation of Computer Confidence Moderator Variables

Moderator Variable	***k***
Grade Level of Learners	
University level	21
School level	7
Class Context Surveyed	
Specific class context	3
General institution-based	25
Questionnaire	
Already constructed	13
Not reported	4
Researcher	11
Likert	
4 Likerts	2
5 Likerts	19
6 Likerts	3
7 Likerts	2
Not reported	2
Technology Accept	
Not used	26
Used	2

Table 15 (Continued)

Results of Frequency Tabulation of Computer Confidence Moderator Variables

Moderator Variable	*k*
Sampling Approach	
Nonprobability sampling	11
Probability sampling	7
Not reported	10
Research Country	
Australia	2
Botswana	1
China	2
Cyprus	1
England	1
Malaysia	2
New Zealand	1
Taiwan	8
Turkey	5
UK	1
USA	4
Subject Matter	
NonSTEM	6
Not reported	17
STEM	5

Table 15 (Continued)

Results of Frequency Tabulation of Computer Confidence Moderator Variables

Moderator Variable	*k*
Sampling Selection	
Sample from many	9
Sample one institution	19
Pedagogical Nature of Technology	
Cognitive	2
Communication	2
Not reported	24
Validity	
Measured	9
Not measured	19
Reliability	
0.6–0.8	18
0.9–1	2
Not reported	8
Participation Rate	
0–29%	2
30–59%	1
60–89%	6
90–100%	6
Not reported	13

Table 15 (Continued)

Results of Frequency Tabulation of Computer Confidence Moderator Variables

Moderator Variable	***k***
Competency	
In favor of men	5
Not reported	23
Experience	
In favor of men	3
Not reported	25
Socioeconomic Status	
Not measured	26
Measured	2
Intersection of Demographics	
Not measured	27
Measured	1

Table 16

Results of Frequency Tabulation of Perceived Ease of Use of ICT Moderator Variables

Moderator Variable	***k***
Publication Date	
2006–2010	10
2011–2015	11

Table 16 (Continued)

Results of Frequency Tabulation of Perceived Ease of Use of ICT Moderator Variables

Moderator Variable	***k***
Publication Type	
Refereed	21
Estimate	
From descriptives	18
Other than descriptives	3
Technology Surveyed	
Specific technology	8
General technology	13
Grade Level of Learners	
University level	12
School level	9
Class Context Surveyed	
Specific class context	3
General institution-based	17
Not reported	1

Table 16 (Continued)

Results of Frequency Tabulation of Perceived Ease of Use of ICT Moderator Variables

Moderator Variable	*k*
Questionnaire	
Already constructed	9
Researcher-made	1
Not reported	11
Likert	
10 Likerts	1
4 Likerts	5
5 Likerts	9
7 Likerts	5
8 Likerts	1
Technology Acceptance Mdl	
Not used	13
Used	8
Sampling Approach	
Nonprobability sampling	6
Probability sampling	1
Not reported	14

Table 16 (Continued)

Results of Frequency Tabulation of Perceived Ease of Use of ICT Moderator Variables

Moderator Variable	***k***
Research country	
Belgium	2
China	1
Germany	1
Kenya	1
Malawi	1
Malaysia	1
Netherlands	3
New Zealand	1
Spain	1
Taiwan	6
USA	2
Not reported	1
Subject Matter	
NonSTEM	6
STEM	4
Not reported	11
Sampling Selection	
Sample from many	7
Sample one institution	13
Not reported	1

Table 16 (Continued)

Results of Frequency Tabulation of Perceived Ease of Use of ICT Moderator Variables

Moderator Variable	***k***
Pedagogical Nature	
Cognitive	5
Communication	3
Not reported	13
Validity	
Measured	9
Not measured	12
Reliability	
0.8 and more	13
Less than 0.8	1
Not reported	7
Participation Rate	
0–59%	1
60–89%	6
90–100%	3
Not reported	11
Competency	
In favor of men	1
Not reported	20
Experience	
In favor of men	4
Not reported	17

Table 16 (Continued)

Results of Frequency Tabulation of Perceived Ease of Use of ICT Moderator Variables

Moderator Variable	***k***
Ethnicities	
Measured	2
Not measured	19
Socioeconomic Status	
Measured	19
Not measured	2
Intersection of Demographics	
Measured	1
Not measured	20

Table 17

Results of Frequency Tabulation of Perceived Usefulness of ICT Moderator Variables

Moderator Variable	***k***	**ES (g+)**	**SE**	**$CI^{Lwr95\%}$**	**$CI^{Upr95\%}$**	**Q_B**	**df**	***p***
Publication Date								
2006–2010	36	0.070*	0.036	0.000	0.140			
2011–2015	33	0.082	0.046	-0.009	0.172			

Table 17 (Continued)

Results of Frequency Tabulation of Perceived Usefulness of ICT Moderator Variables

Moderator Variable	***k***
Publication Type	
Refereed	61
Non-refereed	8
Estimate	
From descriptives	53
Other than descriptives	16
Technology Surveyed	
Specific technology	25
General technology	44
Grade Level of Learners	
University level	47
School level	22
Class Context Surveyed	
Specific class cont.	13
General institution	55
Not reported	1

Table 17 (Continued)

Results of Frequency Tabulation of Perceived Usefulness of ICT Moderator Variables

Moderator Variable	***k***
Questionnaire	
Already constructed	30
Not reported	6
Researcher-made	33
Likert	
10 Likerts	1
3 Likerts	1
4 Likerts	10
5 Likerts	35
6 Likerts	1
7 Likerts	11
9 Likerts	7
Not reported	3
Technology Acceptance Mdl	
Not used	51
Used	18
Sampling Approach	
Nonprobability sampling	29
Probability sampling	11
Not reported	29

Table 17 (Continued)

Results of Frequency Tabulation of Perceived Usefulness of ICT Moderator Variables

Moderator Variable	***k***
Research country	
Australia	2
Austria	1
Belgium	2
Botswana	1
Canada	2
China	1
Cyprus	1
Finland	1
Germany	2
Greece	3
Jordan	1
Kenya	1
Kuwait	1
Malawi	1
Malaysia	3
Netherlands	3
New Zealand	1
Pakistan	1
Singapore	1
South Africa	1
Taiwan	14
Thailand	1
Turkey	7
UAE	1
USA	15
Not Reported	1

Table 17 (Continued)

Results of Frequency Tabulation of Perceived Usefulness of ICT Moderator Variables

Moderator Variable	*k*
Subject Matter	
NonSTEM	18
Not reported	41
STEM	10
Sampling Selection	
Not reported	1
Sample from many	26
Sample one institution	42
Pedagogical Nature of Technology	
Cognitive	9
Communication	8
Not reported	50
Presentation	2
Validity	
Measured	24
Not measured	45
Reliability	
0.8 and more	37
Less than 0.8	15
Not reported	17

Table 17 (Continued)

Results of Frequency Tabulation of Perceived Usefulness of ICT Moderator Variables

Moderator Variable	***k***
Participation Rate	
0–29%	3
30–59%	1
60–89%	19
90–100%	12
Not reported	34
Competency	
In favor of men	7
Not reported	61
In favor of women	1
Experience	
In favor of men	3
Not reported	65
In favor of women	1
Ethnicities	
Not measured	62
Measured	7
Socioeconomic St.	
Not measured	61
Measured	8
Intersection of Dem.	
Not measured	69

Table 18

Results of Frequency Tabulation of Perceived Satisfaction with ICT Moderator Variables

Moderator Variable	*k*
Publication Date	
2006–2010	12
2011–2015	16
Publication Type	
Refereed	26
Non-refereed	2
Estimate	
From descriptives	17
Other than descriptives	11
Tech. Surveyed	
Specific technology	13
General technology	15
Grade Level of Learners	
University level	20
School level	8
Class Context Surveyed	
Specific class context	5
General institution-based	22
Not reported	1

Table 18 (Continued)

Results of Frequency Tabulation of Perceived Satisfaction with ICT Moderator Variables

Moderator Variable	***k***
Questionnaire	
Already constructed	10
Researcher-made	17
Not reported	1
Likert	
4 Likerts	1
5 Likerts	18
7 Likerts	4
9 Likerts	1
10 Likerts	1
Not reported	3
Technology Acceptance Mdl	
Not used	26
Used	2
Sampling Approach	
Nonprobability sampling	10
Probability sampling	3
Not reported	15

Table 18 (Continued)

Results of Frequency Tabulation of Perceived Satisfaction with ICT Moderator Variables

Moderator Variable	***k***
Research Country	
Australia	1
Canada	2
England	2
Finland	1
Germany	1
India	1
Malaysia	1
New Zealand	1
Spain	1
Taiwan	6
Turkey	3
UAE	1
UK	1
USA	6
Subject Matter	
NonSTEM	2
STEM	8
Not reported	18
Sampling Selection	
Not reported	1
Sample from many	7
Sample one institution	20

Table 18 (Continued)

Results of Frequency Tabulation of Perceived Satisfaction with ICT Moderator Variables

Moderator Variable	***k***
Pedagogical Nature of Technology	
Cognitive	6
Communication	7
Not reported	15
Validity	
Measured	8
Not measured	20
Reliability	
0.8 or more	17
Less than 0.8	4
Not reported	7
Participation Rate	
0–29%	4
30–59%	2
60–89%	5
90–100%	4
Not reported	13
Competency	
In favor of men	1
Not reported	26
In favor of women	1

Table 18 (Continued)

Results of Frequency Tabulation of Perceived Satisfaction with ICT Moderator Variables

Moderator Variable	***k***
Ethnicities	
Not measured	26
Measured	2
Socioeconomic Status	
Not measured	26
Measured	2
Intersection of Demographics	
Not measured	28

Table 19

Results of Frequency Tabulation of Positive Attitudes towards ICT Moderator Variables

Moderator Variable	***k***
Publication Date	
2006–2010	27
2011–2015	25
Publication Type	
Refereed	44
Non-refereed	8

Table 19 (Continued)

Results of Frequency Tabulation of Positive Attitudes towards ICT Moderator Variables

Moderator Variable	***k***
Estimate	
From descriptives	38
Other than descriptives	14
Technology Surveyed	
Specific technology	13
General technology	38
Not reported	1
Grade Level of Learners	
University level	32
School level	30
Class Context Surveyed	
Specific class context	13
General institution-based	38
Not reported	1
Questionnaire	
Already constructed	25
Researcher-made	6
Not reported	21

Table 19 (Continued)

Results of Frequency Tabulation of Positive Attitudes towards ICT Moderator Variables

Moderator Variable	***k***
Likert	
4 Likerts	10
5 Likerts	24
6 Likerts	1
7 Likerts	7
9 Likerts	7
Not reported	3
Technology Acceptance Model	
Not used	41
Used	11
Sampling Approach	
Nonprobability sampling	25
Probability sampling	3
Not reported	24

Table 19 (Continued)

Results of Frequency Tabulation of Positive Attitudes towards ICT Moderator Variables

Moderator Variable	***k***
Research country	
Australia	1
Barbados	1
Belgium	1
Botswana	1
Canada	1
China	1
Finland	1
Greece	1
India	1
Israel	1
Kenya	1
Kuwait	1
Malaysia	1
Netherlands	3
New Zealand	1
Singapore	1
Spain	1
Taiwan	6
Thailand	1
Turkey	2
UAE	1
UK	1
USA	21
Not reported	1

Table 19 (Continued)

Results of Frequency Tabulation of Positive Attitudes towards ICT Moderator Variables

Moderator Variable	*k*
Subject Matter	
NonSTEM	13
Not reported	30
STEM courses	9
Sampling Selection	
Sample from many	19
Sample one institution	32
Not reported	1
Pedagogical Nature of Technology	
Cognitive	5
Communication	6
Presentation	2
Not reported	39
Validity	
Measured	17
Not Measured	35
Reliability	
0.6–0.8	29
0.9–1	4
Not reported	19

Table 19 (Continued)

Results of Frequency Tabulation of Positive Attitudes towards ICT Moderator Variables

Moderator Variable	***k***
Participation Rate	
0–29%	2
30–59%	3
60–89%	13
90–100%	6
Not reported	28
Competency	
In favor of men	5
Not reported	43
In favor of women	4
Experience	
In favor of men	2
In favor of women	1
Not reported	49
Ethnicities	
Not measured	40
Measured	12
Socioeconomic St.	
Not measured	47
Measured	5
Intersection of Dem.	
Not measured	49
Measured	3

Table 20

Results of Frequency Tabulation of Motivation towards ICT Moderator Variables

Moderator Variable	***k***
Publication Date	
2006–2010	8
2011–2015	6
Publication Type	
Refereed	12
Non-refereed	2
Estimate	
From descriptives	13
Other than descriptives	1
Technology Surveyed	
Specific technology	3
General technology	11
Grade Level	
University level	11
School level	3
Class Context	
Specific class context	1
General institution-based	12
Not reported	1

Table 20 (Continued)

Results of Frequency Tabulation of Motivation towards ICT Moderator Variables

Moderator Variable	***k***
Questionnaire	
Already constructed	6
Researcher-made	8
Likert	
4 Likerts	1
5 Likerts	8
7 Likerts	3
9 Likerts	1
Not reported	1
Technology Acceptance Mdl	
Not used	12
Used	2
Sampling Approach	
Nonprobability sampling	8
Probability sampling	2
Not reported	4
Subject Matter	
NonSTEM	1
STEM	3
Not reported	10

Table 20 (Continued)

Results of Frequency Tabulation of Motivation towards ICT Moderator Variables

Moderator Variable	***k***
Research Country	
Canada	1
Cyprus	1
England	1
Greece	1
Israel	1
Kuwait	1
Malawi	1
Taiwan	1
Turkey	2
UAE	1
USA	3
Sampling Selection	
Sample from	3
Sample one	10
Not reported	1
Pedagogical Nature of Technology	
Communication	3
Not reported	11
Validity	
Measured	3
Not measured	11

Table 20 (Continued)

Results of Frequency Tabulation of Motivation towards ICT Moderator Variables

Moderator Variable	***k***
Reliability	
0.8 or more	6
Less than 0.8	6
Not reported	2
Participation Rate	
0–59%	3
60–89%	7
Not reported	4
Competency	
In favor of men	1
Not reported	13
Experience	
In favor of men	1
In favor of women	1
Not reported	12
Ethnicities	
Not measured	13
Measured	1
Intersection of Demographics	
Not measured	14

Table 20 (Continued)

Results of Frequency Tabulation of Motivation towards ICT Moderator Variables

Moderator Variable	***k***
Socioeconomic St.	
Not measured	13
Measured	1

Table 21

Results of Frequency Tabulation of Computer Self Efficacy Moderator Variables

Moderator Variable	***k***
Publication Date	
2006–2010	18
2011–2015	12
Publication Type	
Refereed	21
Non-refereed	9
Estimate	
From descriptives	22
Other than descriptives	8
Technology Survey	
Specific technology	8
General technology	21
Not reported	1

Table 21 (Continued)

Results of Frequency Tabulation of Computer Self Efficacy Moderator Variables

Moderator Variable	*k*
Grade Level of Learners	
University level	29
School level	1
Class Context Surveyed	
Specific class context	5
General institution-based	25
Questionnaire	
Already	19
Not reported	4
Researcher	7
Likert	
3 Likerts	1
4 Likerts	2
5 Likerts	12
6 Likerts	3
7 Likerts	8
Not reported	4
Technology Acceptance Mdl	
Not used	23
Used	7

Table 21 (Continued)

Results of Frequency Tabulation of Computer Self Efficacy Moderator Variables

Moderator Variable	*k*
Sampling Approach	
Nonprobability sampling	11
Probability sampling	5
Not reported	14
Research Country	
Canada	1
China	1
England	1
Greece	1
Kenya	1
Malaysia	1
New Zealand	2
South Africa	1
Spain	1
Taiwan	7
Turkey	5
USA	8
Subject Matter	
NonSTEM	2
Not reported	20
STEM	8

Table 21 (Continued)

Results of Frequency Tabulation of Computer Self Efficacy Moderator Variables

Moderator Variable	***k***
Sampling Selection	
Sample from many	15
Sample one institution	15
Pedagogical Nature of ICT	
Cognitive	4
Communication	3
Presentation	1
Not reported	22
Validity	
Measured	12
Not measured	18
Reliability	
0.8 and more	20
Less than 0.8	3
Not reported	7
Participation Rate	
0–29%	2
60–89%	9
90–100%	5
Not reported	14

Table 21 (Continued)

Results of Frequency Tabulation of Computer Self Efficacy Moderator Variables

Moderator Variable	***k***
Competency	
In favor of men	1
Not reported	27
In favor of women	2
Experience	
In favor of men	3
Not reported	25
In favor of women	2
Ethnicities	
Not measured	25
Measured	5
Socioeconomic Status	
Not measured	23
Measured	7
Intersection of Demographics	
Not measured	29
Reported	1

Table 22

Results of Frequency Tabulation of Intention to Use ICT Moderator Variables

Moderator Variable	***k***
Publication Date	
2006–2010	6
2011–2015	12
Publication Type	
Refereed	16
Non-refereed	2
Estimate	
From descriptives	12
Other than descriptives	6
Technology Surveyed	
Specific technology	6
General technology	12
Grade Level of Learners	
University level	14
School level	4
Class Context Surveyed	
Specific class context	3
General institution-based	15

Table 22 (Continued)

Results of Frequency Tabulation of Intention to Use ICT Moderator Variables

Moderator Variable	***k***
Questionnaire	
Already constructed	8
Not reported	4
Researcher-made	6
Likert	
5 Likerts	10
7 Likerts	5
Not reported	3
Technology Acceptance Mdl	
Not used	10
Used	8
Sampling Approach	
Nonprobability sampling	8
Probability sampling	3
Not reported	7
Subject Matter	
NonSTEM	1
STEM	3
Not reported	14

Table 22 (Continued)

Results of Frequency Tabulation of Intention to Use ICT Moderator Variables

Moderator Variable	*k*
Research Country	
Belgium	1
Canada	1
China	1
Iran	1
Kenya	1
Malaysia	1
New Zealand	1
Spain	1
Taiwan	3
Turkey	2
UAE	1
USA	4
Sampling Selection	
Sample from many	4
Sample from one institution	14
Ped. Nature of ICT	
Cognitive	2
Communication	4
Not reported	12
Validity	
Measured	9
Not measured	9

Table 22 (Continued)

Results of Frequency Tabulation of Intention to Use ICT Moderator Variables

Moderator Variable	***k***
Reliability	
0.8 or more	11
Less than 0.8	5
Not reported	2
Participation Rate	
0–29%	1
30–59%	2
60–89%	4
90–100%	2
Not reported	9
Competency	
In favor of men	2
Not reported	15
In favor of women	1
Experience	
In favor of men	2
Not reported	15
In favor of women	1
Ethnicities	
Not measured	16
Measured	2

Table 22 (Continued)

Results of Frequency Tabulation of Intention to Use ICT Moderator Variables

Moderator Variable	***k***
Socioeconomic Status	
Not measured	15
Measured	3
Intersection of Demographics	
Not measured	18

* $p < .05$; ** $p < .01$; *** $p < .001$; ****$p < .0001$

Table 23

Results of Frequency Tabulation of Mixed Perceptions Towards ICT Moderator Variables

Moderator Variable	***k***
Publication Date	
2006–2010	14
2011–2015	17
Publication Type	
Refereed	27
Non-refereed	4
Estimate	
From descriptives	21
Other than descriptives	10

Table 23 (Continued)

Results of Frequency Tabulation of Mixed Perceptions Towards ICT Moderator Variables

Moderator Variable	*k*
Technology Surveyed	
Specific technology	9
General technology	22
Grade Level of Learners	
University level	21
School level	10
Class Context Surveyed	
Specific class context	1
General institution-based	30
Questionnaire	
Already constructed	15
Researcher-made	1
Not reported	15
Likert	
2 Likerts	1
3 Likerts	1
4 Likerts	1
5 Likerts	23
7 Likerts	4
Not reported	1

Table 23 (Continued)

Results of Frequency Tabulation of Mixed Perceptions Towards ICT Moderator Variables

Moderator Variable	***k***
Technology Ac. Md.	
Used	9
Not used	22
Sampling Approach	
Nonprobability sampling	10
Probability sampling	7
Not reported	14
Research Country	
Australia	2
Canada	3
China	1
England	1
Germany	2
Iran	1
Malaysia	2
Netherlands	1
Oman	1
Saudi Arabia	2
South Africa	1
Spain	1
Taiwan	3
Turkey	4
UAE	1
USA	5

Table 23 (Continued)

Results of Frequency Tabulation of Mixed Perceptions Towards ICT Moderator Variables

Moderator Variable	***k***
Subject Matter	
NonSTEM	6
Not reported	18
STEM	7
Sampling Selection	
Sample from many	11
Sample one institution	20
Pedagogical Nature of Technology	
Cognitive	7
Communication	1
Not reported	23
Validity	
Measured	10
Not measured	21
Reliability	
0.8 or more	15
Less than 0.8	11
Not reported	5

Table 23 (Continued)

Results of Frequency Tabulation of Mixed Perceptions Towards ICT Moderator Variables

Moderator Variable	***k***
Participation Rate	
0–29%	5
30–59%	2
60–89%	7
90–100%	5
Not reported	12
Competency	
In favor of men	5
Not reported	24
In favor of women	2
Experience	
In favor of men	2
Not reported	29
Ethnicities	
Not measured	29
Measured	2
Socioeconomic St.	
Not measured	25
Measured	6
Intersect of Dem.	
Not measured	30
Measured	1

Table 24

Results of Frequency Tabulation of Usage of ICT Moderator Variables

Moderator Variable	***k***
Publication Date	
2006–2010	32
2011–2015	27
Publication Type	
Refereed	51
Non-refereed	8
Estimate	
From descriptives	25
Other than descriptives	34
Technology Surveyed	
Specific technology	12
General technology	47
Grade Level of Learners	
University level	36
School level	23
Class Context Surveyed	
Specific class context	7
General institution-based	52

Table 24 (Continued)

Results of Frequency Tabulation of Usage of ICT Moderator Variables

Moderator Variable	*k*
Questionnaire	
Already constructed	20
Not reported	11
Researcher-made	28
Likert	
2 Likerts	1
3 Likerts	1
4 Likerts	10
5 Likerts	22
6 Likerts	3
7 Likerts	5
8 Likerts	2
9 Likerts	1
Not reported	14
Technology Acceptance Mdl	
Not used	54
Used	5
Sampling Approach	
Nonprobability sampling	19
Probability sampling	13
Not reported	27

Table 24 (Continued)

Results of Frequency Tabulation of Usage of ICT Moderator Variables

Moderator Variable	***k***
Research Country	
Australia	3
Austria	1
Canada	3
China	3
England	1
Finland	1
France	1
Germany	3
Greece	1
Israel	1
Kenya	1
Korea	1
Kuwait	1
Netherlands	1
New Zealand	1
Norway	1
Philippines	1
Spain	2
Sweden	2
Taiwan	6
Turkey	3
UAE	1
UK	2
USA	17
Not reported	1

Table 24 (Continued)

Results of Frequency Tabulation of Usage of ICT Moderator Variables

Moderator Variable	*k*
Subject Matter	
NonSTEM	10
STEM	10
Not reported	39
Sampling Selection	
Sample from many	27
Sample one institution	32
Pedagogical Nature of Technology	
Cognitive	7
Communication	4
Not reported	47
Presentation	1
Validity	
Measured	14
Not measured	45
Reliability	
0.8 and more	22
Less than 0.8	8
Not reported	29

Table 24 (Continued)

Results of Frequency Tabulation of Usage of ICT Moderator Variables

Moderator	***k***
Participation Rate	
0–29%	5
30–59%	7
60–89%	12
90–100%	6
Not reported	29
Competency	
In favor of men	11
In favor of women	2
Not reported	46
Experience	
In favor of men	4
In favor of women	1
Not reported	54
Ethnicities	
Not measured	50
Measured	9
Socioecon. Status	
Not measured	47
Measured	12
Intersect of Demo	
Measured	4
Not measured	55

Analysis Results of Moderator Analyses

After conducting the frequency tabulation of moderator analyses, I followed it up with the recoding of some variables before conducting the ANOVA results analysis. The recoding was necessary to make sure that results that turned out to be significant were indeed significant and not signaling a false significant difference because of a moderator sub-level containing one single cell[5]. In addition, I attempted to remove the 'Not Reported' coding that may have contributed in creating a false significant difference between multi-levels of moderators[6] where there may not have been otherwise. These steps were taken to ensure significant results as well as to refine and increase statistical power for sub-levels in each construct analyzed. Tables 25–36 show the results of moderator' analyses corresponding to each related outcome.

Table 25

Results of Mixed Effects Analysis of Computer Anxiety Moderator Variables

Moderator Variable	***k***	**ES (g+)**	**SE**	**$CI^{Lwr95\%}$**	**$CI^{Upr95\%}$**	**Q_B**	**df**	***p***
Technology Surv.								
General	5	-0.715****	0.182	-1.071	-0.358			
Specific	37	-0.189****	0.038	-0.263	-0.114			
Total between						8.020	1	0.005
Questionnaire								
Already constructed	32	-0.300****	0.050	-0.398	-0.201			
Researcher-made	8	-0.103*	0.047	-0.196	-0.010			
Total between						8.129	1	0.004
Research Country								
NonUSA	26	-0.198****	0.048	-0.293	-0.103			
USA	16	-0.297****	0.070	-0.435	-0.160			
Total between						1.345	1	0.246

* $p < .05$; ** $p < .01$; *** $p < .001$; ****$p < .0001$

[5] Number of cells in a meta-analysis should not be less than two as recommended by Valentine et al. (2010).

[6] A multi-level moderator signifies a moderator with more than 2 levels.

Table 25 (Continued)

Results of Mixed Effects Analysis of Computer Anxiety Moderator Variables

Moderator Variable	***k***	**ES (g+)**	**SE**	**CI$^{Lwr95\%}$**	**CI$^{Upr95\%}$**	**Q_B**	**df**	***p***
Pedagogical Nature of Technology								
Cognitive	2	-0.569	0.294	-1.145	0.007			
Communication	4	-0.683***	0.198	-1.072	-0.294			
Total between						0.104	1	0.747
Experience								
In favor of men	1[7]	0.265						
Grade Level of Learners								
University Level	41	-0.242****						
Likert								
5 Likerts	15	-0.022	0.056	-0.133	0.089			
7 Likerts	2	-0.216	0.215	-0.638	0.206			
Total between						0.757	1	0.384
Ethnicities								
Not measured	13	-0.119*	0.062	-0.241	0.003			
Measured	5	0.133	0.081	-0.025	0.291			
Total between						6.104	1	0.013
Reliability								
0.8 and more	21	-0.296****	0.052	-0.398	-0.194			
Less than 0.8	14	-0.247****	0.067	-0.378	-0.115			
Total between						0.335	1	0.563

* $p < .05$; ** $p < .01$; *** $p < .001$; ****$p < .0001$

[7] Although as recommended by Valentine et al. (2010), no studies with k less than 2 should be reported, I opted to report all sublevels even with k=1 for transparency and replicability purposes. That being said, no standard error and no confidence intervals are calculated.

Table 26

Results of Mixed Effects Analysis of General Negative Attitudes Moderator Analyses

Moderator Variable	***k***	**ES (g+)**	**SE**	**$CI^{Lwr95\%}$**	**$CI^{Upr95\%}$**	**Q_B**	**df**	***p***
Pedagogical Nature of Technology								
Cognitive	4	-0.219	0.166	-0.544	0.107			
Presentation	2	-0.739***	0.207	-1.144	-0.334			
Total between						3.849	1	0.052
Research Country								
NonUSA	11	-0.081	0.064	-0.206	0.045			
USA	7	-0.048	0.115	-0.274	0.178			
Total between						0.060	1	0.806
Subject Matter								
NonSTEM	5	0.183*	0.077	0.032	0.334			
STEM	5	-0.254	0.123	-0.494	-0.014			
Total between						9.118	1	0.003
Technology Surveyed								
Specific	6	-0.356*	0.157	-0.664	-0.048			
General	12	0.010	0.051	-0.090	0.109			
Total between						4.914	1	0.027
Ethnicities								
Not measured	13	-0.119*	0.062	-0.241	0.003			
Measured	5	0.133	0.081	-0.025	0.291			
Total between						6.104	1	0.013

* $p < .05$; ** $p < .01$; *** $p < .001$; ****$p < .0001$

Table 27

Results of Mixed Effects Analysis of Computer Confidence Moderator Analyses

Moderator Variable	*k*	ES (g+)	SE	$CI^{Lwr95\%}$	$CI^{Upr95\%}$	Q_B	df	*p*
Technology Surveyed								
General Technology	4	1.234**	0.407	0.437	2.031			
Specific Technology	24	0.317****	0.044	0.231	0.404			
Total between						5.026	1	0.025
Research Country								
NonUSA	24	0.335****	0.055	0.227	0.443			
USA	4	1.044**	0.350	0.358	1.730			
Total between						4.002	1	0.045
Grade Level								
University level	21	0.302****	0.052	0.200	0.404			
School level	7	0.797****	0.216	0.374	1.221			
Total between						4.969	1	0.026
Participation Rate								
0–59%	3	0.120	0.109	-0.094	0.333			
60–89%	6	0.290*	0.126	0.042	0.538			
90–100%	6	0.866***	0.263	0.351	1.381			
Total between						7.019	2	0.030
Likert								
4 Likerts	2	0.619***	0.185	0.256	0.982			
5 Likerts	19	0.393****	0.085	0.226	0.559			
6 Likerts	3	0.391****	0.050	0.293	0.488			
7 Likerts	2	0.248	0.291	-0.322	0.818			
Total between						1.714	3	0.634

* $p < .05$; ** $p < .01$; *** $p < .001$; ****$p < .0001$

Table 28

Results of Mixed Effects Analysis of Perceived Ease of Use of ICT Moderator Analyses

Moderator Variable	***k***	**ES (g+)**	**SE**	**$CI^{Lwr95\%}$**	**$CI^{Upr95\%}$**	**Q_B**	**df**	***p***
Participation Rate								
80% and less	7	0.120****	0.031	0.060	0.181			
90–100%	3	0.494****	0.109	0.282	0.707			
Total between						10.992	1	0.001
Sampling Selection								
Sampling from many	7	0.366*	0.144	0.083	0.694			
Sampling from one institution	13	0.119	0.079	-0.036	0.275			
Total between						2.235	1	0.135
Ethnicities								
Measured	2	-0.144	0.080	-0.301	0.012			
Not measured	19	0.217**	0.081	0.038	0.351			
Total between						10.157	1	0.001
Research Country								
NonUSA	18	0.216**	0.084	0.051	0.380			
USA	2	-0.067	0.149	-0.358	0.225			
Total between						2.738	1	0.098
Class Context Surveyed								
Specific	3	0.190	0.176	-0.155	0.535			
General institution-based	17	0.211*	0.086	0.042	0.380			
Total between						0.012	1	0.913

* $p < .05$; ** $p < .01$; *** $p < .001$; ****$p < .0001$

Table 29

Results of Mixed Effects Analysis of Perceived Usefulness of ICT Moderator Analyses

Moderator Variable	***k***	**ES (g+)**	**SE**	**$CI^{Lwr95\%}$**	**$CI^{Upr95\%}$**	**Q_B**	**df**	***p***
Participation Rate								
0–59%	4	0.142	0.145	-0.142	0.427			
60–89%	19	0.003	0.035	-0.066	0.073			
90–100%	12	0.119	0.062	-0.002	0.239			
Total between						3.195	2	0.202
Research Country								
NonUSA	51	0.119****	0.033	0.053	0.184			
USA	17	-0.063	0.048	-0.156	0.031			
Total between						9.704	1	0.002
Class Context Surveyed								
Specific class context	13	-0.007	0.058	-0.121	0.107			
General institution-based	55	0.087**	0.032	0.025	0.149			
Total between						1.987	1	0.159
Sampling Selection								
Sample from many	26	0.089*	0.041	0.008	0.169			
Sample from one institution	42	0.058	0.041	-0.022	0.138			
Total between						0.286	1	0.593

* $p < .05$; ** $p < .01$; *** $p < .001$; ****$p < .0001$

Table 30

Results of Mixed Effects Analysis of Perceived Satisfaction Moderator Analyses Moderator Variables

Moderator Variable	***k***	**ES (g+)**	**SE**	**CI$^{Lwr95\%}$**	**CI$^{Upr95\%}$**	**Q_B**	**df**	***p***
Ethnicities								
Not measured	26	0.066	0.052	-0.035	0.168			
Measured	2	-0.196**	0.069	-0.332	-0.061			
Total between						9.243	1	0.002
Sampling Selection								
Sample from many	7	0.210**	0.069	0.075	0.345			
Sample from one institution	20	-0.028	0.056	-0.139	0.083			
Total between						7.150	1	0.007
Reliability								
0.8 and more	17	0.103	0.073	-0.041	0.246			
Less than 0.8	4	0.015	0.075	-0.131	0.162			
Total between						0.696	1	0.404
Likert								
4–5 Likerts	19	0.030	0.062	-0.092	0.152			
7–10 Likerts	6	0.137	0.125	-0.107	0.381			
Total between						0.588	1	0.443
Class Context Surveyed								
Specific class cont.	5	-0.211	0.144	-0.494	0.072			
General institution	22	0.070	0.054	-0.036	0.176			
Total between						3.338	1	0.068
Technology Acceptance Model								
Not used	26	0.068	0.052	-0.034	0.170			
Used	2	-0.183**	0.062	-0.304	-0.062			
Total between						9.591	1	0.002

* $p < .05$; ** $p < .01$; *** $p < .001$; ****$p < .0001$

Table 30 (Continued)

Results of Mixed Effects Analysis of Perceived Satisfaction Moderator Analyses Moderator Variables

Moderator Variable	***k***	**ES (g+)**	**SE**	**CI$^{Lwr95\%}$**	**CI$^{Upr95\%}$**	**Q_B**	**df**	***p***
Research Country								
NonUSA	20	0.100	0.061	-0.019	0.219			
USA	8	-0.069	0.083	-0.232	0.094			
Total between						2.700	1	0.100

* $p < .05$; ** $p < .01$; *** $p < .001$; ****$p < .0001$

Table 31

Results of Mixed Effects Analysis of Positive Attitudes towards ICT Moderator Analyses

Moderator Variable	***k***	**ES (g+)**	**SE**	**CI$^{Lwr95\%}$**	**CI$^{Upr95\%}$**	**Q_B**	**df**	***p***
Class Context Surveyed								
Specific class cont.	13	0.023	0.062	-0.144	0.099			
General institution-based	38	0.127**	0.042	0.045	0.209			
Total between						4.009	1	0.045
Sampling Approach								
NonProbability Sampling	25	0.172***	0.051	0.072	0.271			
Probability samp.	3	0.335*	0.148	0.044	0.626			
Total between						1.086	1	0.297
Participation Rate								
0–29%	2	0.273****	0.053	0.169	0.377			
30–59%	3	0.022	0.184	-0.382	0.338			
60–89%	13	0.136*	0.054	0.030	0.242			
90–100%	6	0.005	0.088	-0.167	0.177			
Total between						8.743	3	0.033

* $p < .05$; ** $p < .01$; *** $p < .001$; ****$p < .0001$

Table 31 (Continued)

Results of Mixed Effects Analysis of Positive Attitudes towards ICT Moderator Analyses

Moderator Variable	*k*	ES (g+)	SE	$CI^{Lwr95\%}$	$CI^{Upr95\%}$	Q_B	df	*p*
Socioeconomic Status								
Measured	5	0.297**	0.099	0.104	0.490			
Not measured	47	0.077*	0.037	0.003	0.150			
Total between						4.377	1	0.036
Research Country								
NonUSA	29	0.164	0.052	0.062	0.265			
USA	22	0.010	0.049	-0.086	0.106			
Total between						4.676	1	0.031
Subject Matter								
NonSTEM	13	-0.054	0.045	-0.142	0.034			
STEM	9	0.025	0.100	-0.171	0.222			
Total between						0.522	1	0.470
Competency								
In favor of men	5	0.243****	0.059	0.128	0.358			
In favor of women	4	-0.288***	0.054	-0.393	-0.183			
Total between						44.811	1	0.000
Publication Type								
Refereed	44	0.077	0.040	-0.002	0.157			
Non-refereed	8	0.199****	0.040	0.122	0.277			
Total between						4.652	1	0.031

* $p < .05$; ** $p < .01$; *** $p < .001$; ****$p < .0001$

Table 32

Results of Mixed Effects Analysis of Motivation to use ICT Moderator Analyses

Moderator Variable	*k*	ES (g+)	SE	$CI^{Lwr95\%}$	$CI^{Upr95\%}$	Q_B	df	*p*
Participation Rate								
0–59%	3	-0.107	0.105	-0.313	0.098			
60–89%	7	0.104	0.113	-0.116	0.325			
Total between						1.889	1	0.169
Likert								
4–5 Likerts	9	0.157	0.128	-0.094	0.409			
7–9 Likerts	4	0.177*	0.082	0.016	0.338			
Total between						0.017	1	0.896
Research Country								
NonUSA	10	0.253	0.078	0.100	0.406			
USA	4	-0.152	0.186	-0.516	0.212			
Total between						4.045	1	0.044
Grade level								
University level	11	0.067	0.083	-0.096	0.229			
School level	3	0.420**	0.160	0.107	0.733			
Total between						3.662	1	0.049
Class Context Surv.								
Specific class cont.	1[8]	0.995****						
General institution-based	12	0.084	0.074	-0.062	0.229			
Publication Date								
2006–2010	8	-0.001	0.082	-0.162	0.160			
2011–2015	6	0.364***	0.114	0.141	0.588			
Total between						6.785	1	0.009

* $p < .05$; ** $p < .01$; *** $p < .001$; ****$p < .0001$

[8] Although as recommended by Valentine et al. (2010), no studies with k less than 2 should be reported, I opted to report all sublevels even with k=1 for transparency and replicability purposes. That being said, no standard error and no confidence intervals are calculated.

Table 33

Results of Mixed Effects Analysis of Computer Self-Efficacy Moderator Analyses

Moderator Variable	*k*	ES (g+)	SE	$CI^{Lwr95\%}$	$CI^{Upr95\%}$	Q_B	df	*p*
Likert								
3–4 Likerts	3	0.030	0.087	-0.139	0.200			
5 Likerts	12	0.210****	0.052	0.107	0.313			
6 Likerts	3	0.184	0.100	-0.012	0.381			
7 Likerts	8	0.265****	0.072	0.123	0.406			
Total between						4.609	3	0.203
Research Country								
NonUSA	21	0.232****	0.036	0.160	0.303			
USA	9	0.198**	0.075	0.051	0.345			
Total between						0.161	1	0.688
Pedagogical Nature								
Cognitive	4	0.150	0.183	-0.209	0.509			
Communication	3	0.036	0.059	-0.081	0.152			
Presentation	1[9]	0.207						
Total between						0.353	1	0.553

*p < .05; **p < .01; ***p < .001; ****p < .0001

Table 34

Results of Mixed Effects Analysis of Intention to Use ICT Moderator Analyses

Moderator Variable	*k*	ES (g+)	SE	$CI^{Lwr95\%}$	$CI^{Upr95\%}$	Q_B	df	*p*
Likert								
5 Likerts	10	0.144	0.117	-0.085	0.373			
7 Likerts	5	0.371	0.192	-0.006	0.747			
Total between						1.020	1	0.313

[9] Although as recommended by Valentine et al. (2010), no studies with k less than 2 should be reported, I opted to report all sublevels even with k=1 for transparency and replicability purposes. That being said, no standard error and no confidence intervals are calculated. This level is also removed from moderator variable analysis.

Table 34 (Continued)

Results of Mixed Effects Analysis of Intention to Use ICT Moderator Analyses

Moderator Variable	*k*	ES (g+)	SE	$CI^{Lwr95\%}$	$CI^{Upr95\%}$	Q_B	df	*p*
Sampling Selection								
Sample from many	4	0.496*	0.195	0.115	0.878			
Sample from one institution	14	0.037	0.090	-0.139	0.213			
Total between						4.599	1	0.032
Experience								
In favor of men	1[10]	-0.464*						
In favor of women	2	0.853****	0.155	0.550	1.156			
Participation Rate								
30–59%	3	0.288*	0.135	0.023	0.554			
60–89%	4	0.062	0.217	-0.363	0.487			
90–100%	2	0.839****	0.202	0.442	1.235			
Total between						7.737	2	0.021
Research Country								
NonUSA	13	0.280*	0.111	0.062	0.497			
USA	5	-0.154	0.105	-0.361	0.053			
Total between						8.024	1	0.005
Questionnaire								
Already constructed	8	-0.044	0.081	-0.203	0.115			
Researcher-made	6	0.399**	0.130	0.143	0.654			
Total between						8.315	1	0.004

* $p < .05$; ** $p < .01$; *** $p < .001$; ****$p < .0001$

[10] Although as recommended by Valentine et al. (2010), no studies with k less than 2 should be reported, I opted to report all sublevels even with k=1 for transparency and replicability purposes. That being said, no standard error and no confidence intervals are calculated.

Table 35

Results of Mixed Effects Analysis of Mixed Attitudes Moderator Analyses

Moderator Variable	*k*	ES (g+)	SE	$CI^{Lwr95\%}$	$CI^{Upr95\%}$	Q_B	df	*p*
Competency								
In favor of men	5	0.253***	0.078	0.101	0.405			
In favor of women	2	-0.146	0.088	-0.319	0.027			
Total between						11.510	1	0.001
Subject Matter								
NonSTEM	6	-0.244*	0.096	-0.432	-0.056			
STEM	7	0.177	0.140	-0.097	0.451			
Total between						6.151	1	0.013
Intersection of Dem.								
Not measured	30	0.080	0.047	-0.311	0.109			
Reported	1[11]	-0.210****						
Likert								
3–4 Likerts	3	0.074	0.231	-0.379	0.526			
5 Likerts	23	0.066	0.054	-0.040	0.172			
7 Likerts	4	0.069	0.174	-0.271	0.410			
Total between						0.001	2	0.999
Participation Rate								
0–29%	5	0.092	0.085	-0.075	0.258			
30–59%	2	0.190	0.156	-0.116	0.496			
60–89%	7	-0.187***	0.058	-0.301	-0.073			
90–100%	5	0.292****	0.056	0.183	0.401			
Total between						35.970	3	0.000

* $p < .05$; ** $p < .01$; *** $p < .001$; ****$p < .0001$

[11] Although as recommended by Valentine et al. (2010), no studies with k less than 2 should be reported, I opted to report all sublevels even with k=1 for transparency and replicability purposes. That being said, no standard error and no confidence intervals are calculated.

Table 35 (Continued)

Results of Mixed Effects Analysis of Mixed Attitudes Moderator Analyses

Moderator Variable	*k*	ES (g+)	SE	$CI^{Lwr95\%}$	$CI^{Upr95\%}$	Q_B	df	*p*
Questionnaire								
Already constructed	15	-0.041	0.064	-0.166	0.083			
Researcher-made	15	0.175**	0.062	0.053	0.297			
Total between						5.916	1	0.015
Publication Type								
Refereed	27	0.106*	0.050	0.008	0.204			
Non-refereed	4	-0.221	0.122	-0.459	0.018			
Total between						6.170	1	0.013
Research Country								
NonUSA	23	0.048	0.058	-0.066	0.162			
USA	8	0.125	0.105	-0.081	0.331			
Total between						0.408	1	0.523
Pedagogical Nature								
Cognitive	7	-0.138	0.121	-0.374	0.099			
Communication	1[12]	0.361****						
Research Country								
NonUSA	38	0.118***	0.036	0.048	0.187			
USA	20	-0.044	0.069	-0.179	0.091			
Total between						4.369	1	0.037
Participation Rate								
80% and less	24	0.008	0.052	-0.094	0.110			
90–100%	6	0.196****	0.037	0.123	0.269			
Total between						8.627	1	0.003

* $p < .05$; ** $p < .01$; *** $p < .001$; ****$p < .0001$

[12] Although as recommended by Valentine et al. (2010), no studies with k less than 2 should be reported, I opted to report all sublevels even with k=1 for transparency and replicability purposes. That being said, no standard error and no confidence intervals are calculated.

Table 36

Results of Mixed Effects Analysis of Usage of ICT Moderator Analyses

Moderator Variable	*k*	ES (g+)	SE	$CI^{Lwr95\%}$	$CI^{Upr95\%}$	Q_B	df	*p*
Publication Date								
2006–2010	32	0.177***	0.043	0.093	0.261			
2011–2015	27	-0.049	0.042	-0.131	0.034			
Total between						14.060	1	0.000
Likert								
3 Likerts and less	2	-0.192	0.485	-1.142	0.757			
4 Likerts	10	0.057	0.074	-0.089	0.202			
5 Likerts	22	0.067	0.061	-0.052	0.187			
6 Likerts	3	0.456	0.260	-0.052	0.965			
7 Likerts	5	-0.095	0.075	-0.242	0.052			
8 Likerts and more	3	0.180****	0.035	0.112	0.249			
Total between						14.709	5	0.012
Pedagogical Nature of Technology								
Cognitive	7	0.033	0.151	-0.264	0.330			
Communication	4	-0.171	0.110	-0.386	0.044			
Presentation	1[13]	-0.175						
Total between						1.189	1	0.276
Experience								
In favor of men	4	0.444****	0.016	0.197	0.691			
In favor of women	1[14]	0.393****						

* $p < .05$; ** $p < .01$; *** $p < .001$; ****$p < .0001$

[13] Although as recommended by Valentine et al. (2010), no studies with k less than 2 should be reported, I opted to report all sublevels even with k=1 for transparency and replicability purposes. That being said, no standard error and no confidence intervals are calculated. This level is also removed from moderator variable analysis.

[14] Although as recommended by Valentine et al. (2010), no studies with k less than 2 should be reported, I opted to report all sublevels even with k=1 for transparency and replicability purposes. That being said, no standard error and no confidence intervals are calculated.

Computer Anxiety Moderator Variables

The moderator variables ‘research country’ (Q_B = 1.345, *df* = 1, *p* = .246), ‘pedagogical nature of technology’ (Q_B = 0.104, *df* = 1, *p* = .747), and ‘reliability’ (Q_B = 0.335, *df* = 1, *p* = .563) had Q_B that were not significant, indicating that within chance they are equal and will not be discussed in this dissertation. Other moderators, such as ‘experience’ and ‘grade level of learners’, were disqualified from the analysis after removing the ‘Not reported’ values.

Moderators with significant Q_B results were ‘technology surveyed’ (i.e. general technology vs. specific technology; Q_B = 8.020, *df* = 1 and *p* = .005) and ‘questionnaire used’ (i.e. already constructed vs. researcher made; Q_B = 8.129, *df* = 1 and *p* = .004).

Negative Attitudes Towards ICT Moderator Variables

The moderator variables ‘Likert’ (Q_B = 0.757, df = 1, *p* = .384), ‘pedagogical nature of technology’ (Q_B = 3.849, *df* = 1, *p* = .052), and ‘research country’ (Q_B = 0.060, *df* = 1, *p* = .806) had Q_B that were not significant, indicating that within chance they were equal and will not be discussed in this dissertation.

Moderators with significant Q_B results were ‘ethnicities’ (i.e. measured vs. not measured; Q_B = 6.104, *df* = 1 and *p* = .013), ‘technology surveyed’ (i.e. specific vs. general; Q_B = 4.914, *df* = 1 and *p* = .027), and ‘subject matter’ (i.e. NonSTEM vs. STEM; Q_B = 9.118, *df* = 1 and *p* = .003.

Computer Confidence Moderator Variables

The moderator variable ‘Likert’ had a Q_B that was not significant (Q_B = 1.714, *df* = 3, *p* = .634), indicating that within chance, the effect size results of different ‘Likert’ scales are equal and will not be discussed in this dissertation. Other moderators, such as ‘experience’, were disqualified after removing the ‘Not reported’ values.

Moderators with significant Q_B results were ‘technology surveyed’ (i.e. general technology vs. specific technology; Q_B = 5.026, *df* = 1 and *p* = .025), ‘research country’ (i.e. NonUSA vs. USA); Q_B = 4.002, *df* = 1 and *p* = .045), ‘grade level’ (i.e. university level vs. school level; Q_B = 4.969, *df* = 1 and *p* = .026), and ‘participation rate’; Q_B = 7.019, *df* = 2 and *p* = .030).

Perceived Ease of Use of ICT Moderator Variables

The moderator variables ‘sampling selection’ (Q_B = 2.235, *df* = 1, *p* = .135), ‘research country’ (Q_B = 2.738, *df* = 1, *p* = .098), and ‘class context surveyed’ (Q_B = 0.012, *df* =1, *p* = .913) had Q_B that were not significant, indicating that within chance they are equal and will not be discussed in this dissertation. Moderators with significant Q_B results were ‘participation rate’ (Q_B = 10.992, *df* = 1, *p* = .001) and ‘ethnicities’ (Q_B = 10.157, *df* = 1, *p* = .001).

Perceived Usefulness of ICT Moderator Variables

The moderator variables ‘sampling selection’ (Q_B = 2.235, *df* = 1, *p* = .135) and ‘research country’ (Q_B = 2.738, *df* = 1, *p* = .098) had Q_B that was not significant, indicating that within chance they are equal and will not be discussed in this dissertation. The only moderator with significant Q_B results was ‘research country’ (i.e. NonUSA vs. USA; Q_B = 9.704, *df* = 1 and *p* = .002).

Perceived Satisfaction with ICT Moderator Variables

The moderator variables ‘reliability’ (Q_B = 0.696, *df* = 1, *p* = .404), ‘Likert’ (Q_B = 0.588, *df* = 1, *p* = .443), ‘class context surveyed’ (Q_B = 3.338, *df* = 1, *p* = .068), and ‘research country’ (Q_B = 2.700, *df* = 1, *p* = .100) had Q_B that were not significant, indicating that within chance they are equal and will not be discussed in this dissertation.

Moderators with significant Q_B results included ‘ethnicities’ (i.e. measured vs. not measured; Q_B = 9.243, *df* = 1 and *p* = .002); ‘sampling selection’ (i.e. sample from many vs. sample from one institution; Q_B = 7.150, *df* = 1 and *p* = .007); and ‘technology acceptance model’ (i.e. used vs. not used; Q_B = 9.591, *df* = 1 and *p* = .002).

Positive Attitudes Towards ICT Moderator Variables

The moderator variables ‘sampling approach’ and ‘subject matter’ had Q_B results that were not significant (Q_B = 1.086, *df* = 1, *p* = .297; Q_B = 0.522, *df* = 1, *p* = .470), indicating that within chance they are equal and will not be discussed in this dissertation.

Moderators with significant Q_B results included ‘class context surveyed’ (i.e. specific context vs. general institution-based; Q_B = 4.009, *df* = 1 and *p* = .045); ‘participation rate’, with a Q_B = 8.743, *df* = 3 and *p* = .033); ‘socioeconomic status’ (i.e. reported vs. not reported; Q_B = 4.377, *df* = 1 and *p* = .036); ‘competency’ (i.e. in favor of men vs. in favor of women); Q_B = 44.811, *df* = 1 and *p* = .0001); ‘publication type’ (i.e. referred vs. non-refereed; Q_B = 4.652, *df* = 1 and *p* = .031); and ‘research country’ (i.e. NonUSA vs. USA; Q_B = 4.676, *df* = 1 and *p* = .031).

Motivation to Use ICT Moderator Variables

The moderator variables ‘participation rate’ (Q_B = 1.889, *df* = 1, *p* = .169) and ‘Likert’ (Q_B = 0.017, *df* = 1, *p* = .869) had Q_B that were not significant, indicating that within chance they are equal and will not be discussed in this dissertation. Other moderators, such as ‘class context surveyed’, will not be discussed because the number of cells is less than two, as recommended by Valentine et al. (2010).

Moderators with significant Q_B results included ‘grade level’ (i.e. university level vs. school level; Q_B = 3.662, *df* = 1 and *p* = .049); ‘publication date’ (i.e. 2006–2010 vs. 2011–2015; Q_B = 6.785, *df* = 1 and *p* = .009); and ‘research country’ (i.e. NonUSA vs. USA; Q_B = 4.045, *df* = 1 and *p* = .044).

Computer Self-Efficacy Moderator Variables

The moderator variables ‘Likert’ (Q_B = 4.609, *df* = 3, *p* = .203), ‘research country’

(Q_B = 0.161, *df* = 1, *p* = .688), 'research country' (Q_B = 0.161, *df* = 1, *p* = .688), and 'pedagogical nature of technology' (Q_B = 0.353, *df* = 1, *p* = .553) had Q_B that were not significant, indicating that within chance they are equal and will not be discussed in this dissertation.

Intention to Use ICT Moderator Variables

The moderator variable 'Likert' (Q_B = 1.020, *df* = 1, *p* = .313) had Q_B that was not significant, indicating that within chance sub-levels are equal and will not be discussed in this dissertation.

Moderators with significant Q_B results included 'sampling selection' (i.e. sample from many vs. sample from one institution; Q_B = 4.599, *df* = 1 and *p* = .032); 'participation rate', with a Q_B = 7.737, *df* = 2 and *p* = .021; 'research country' (i.e. non USA vs. USA; Q_B = 8.024, *df* = 1 and *p* = .005); and 'questionnaire' (i.e. already constructed vs. researcher-made; Q_B = 8.315, *df* = 1 and *p* = .004).

Mixed Perceptions Towards ICT Moderator Variables

The moderator variables 'Likert' (Q_B = 0.001, *df* = 2, *p* = .999) and 'research country' (Q_B = 0.408, *df* = 1, *p* = .523) had Q_B that were not significant, indicating that within chance they are equal and will not be discussed in this dissertation. Other moderators, such as 'intersection of demographics' and 'pedagogical nature of technology', will not be discussed because the number of cells is less than two, as recommended by Valentine et al. (2010).

Moderators with significant Q_B results included 'subject matter' (i.e. NonSTEM vs. STEM; Q_B = 6.151, *df* = 1 and *p* = .013); 'participation rate' with a Q_B = 35.970, *df* = 1 and *p* = .0001; 'questionnaire' (i.e. already constructed vs. researcher-made; Q_B = 5.916, *df* = 1 and *p* = .015); 'publication type' (i.e. refereed vs. non-refereed; Q_B = 6.170, *df* = 1 and *p* = .013); and 'competency', with a Q_B = 11.510, *df* = 1 and *p* = .001

Usage of ICT Moderator Variables

The variable ‘pedagogical nature of technology’ (Q_B = 1.189, df = 1, p = .276) had Q_B that was not significant, indicating that within chance sub-levels are equal and will not be discussed in this dissertation.

Moderators with significant Q_B results included ‘research country’ (i.e. NonUSA vs. USA; Q_B = 4.369, df = 1 and p = .037); ‘participation rate’ (i.e. 80% and less vs. 90–100%; Q_B = 8.627, df = 1 and p = .003); and ‘publication date’ (i.e. 2006–2010 vs. 2011–2015; Q_B = 14.060, df = 1 and p = .0001).

Summary

In this chapter I have listed the results of the overall effect sizes of students’ Usage of ICT and their perceptions of different construct of attitudes towards ICT. I have answered the research question, ‘Are there gender differences with regard to the usage of and attitudes towards ICT utilized in formal educational settings’. I have also listed the results of the moderator variables related to the constructs researched. In the chapter that follows I will discuss the implications of the findings including significant moderators as they relate to each construct.

CHAPTER V

DISCUSSION

This chapter discusses the results of both the students' reported Usage of ICT construct and their attitudes towards ICT constructs, as measured by 11 outcomes (Computer Anxiety, Negative Attitudes Towards ICT, Computer Confidence, Perceived Ease of Use of ICT, Perceived Usefulness of ICT, Perceived Satisfaction with ICT, Positive Attitudes Towards ICT, Motivation to Use ICT, Computer Self-efficacy, Intention to Use ICT, and Mixed Perceptions Towards ICT). Further, this chapter examines the results of the moderator variables and study features related to each outcome analyzed in this meta-analysis.

Computer Anxiety

Average effect sizes for Computer Anxiety indicate there are significant minor gender differences in computer anxiety between female and male students, with women being more anxious than men. These findings mirror the meta-analysis by Whitley (1997), who found that females experience lower affect towards ICT in learning environments than males ($d = .259$). The results are also similar to findings in Chua, Chen, and Wong's (1999) meta-analysis on computer anxiety and its correlates. According to Chua et al., male university undergraduates are not as anxious as their female classmates; however, this is disputable. Given that Whitley's meta-analysis was completed in 1997, and Chua et al.'s in 1999, my findings are somewhat surprising. That is, considering the progressive development and advancement in the field of technology over the last two decades, one would expect the gender gap to have narrowed.

Findings from the study features and moderator analyses pertaining to the Computer Anxiety results offer some indication of variables that seem to impact the effect size. These variables include 'technology surveyed' (i.e. general technology vs. specific technology) and 'questionnaire used' (i.e. already constructed vs. researcher made).

From the results of the 'technology surveyed' moderator, with 'general technology surveyed' ($g+ = -0.715$, $k = 5$) and 'specific technology surveyed' ($g+ = -0.189$, $k = 37$), I conclude that a more accurate estimate of associated gender differences with specific technology is directly related to higher specificity of the type of technology being surveyed. Other researchers, such as Kay (2008), have reiterated this finding in their research. In her review on computer usage and attitudes, Robin Kay (2008) also noted that gender differences seem to lessen when scholars survey perceptions of female learners towards specific technologies. For example, Richards-Babb and Jackson's (2011) study examined how learner feedback to online homework can differ between males and females in introductory chemistry classes of over 100 students. Data were collected from CHEM 116 courses at the researchers' university between Fall 2001 and Fall 2009 through the university's Information for Decision Enabling and Analysis System (IDEAS). Data were then differentiated by both student gender and learning intervention, with in-class quizzes (used prior to Fall 2006) replaced by online homework assignments (used Fall 2006 and onwards). Before Fall 2006, the sample comprised 407 males and 438 females, while during Fall 2006 and onwards, it comprised 430 males and 480 females. After this online intervention, course success rates improved substantially for both genders, with the male average success rate advancing to double that of the females' and thus narrowing the sex gap in achievement to an insignificant margin. Self-reports of less productive learning habits by males allow for the hypothesis that online assignments could promote more productive studying in male learners. While males experienced higher achievement progress, self-reports of online assignments were perceived more positively by females. Thus, online assignments could strengthen female students' self-assurance in comprehending the course information, as well as improve absorption of course information. In conclusion, as the moderator variable findings suggest, specifying the type of technology surveyed is critical since perceptions seem to differ according to specific technologies researched.

Another significant moderator result that emerged from the analyses was the difference between two levels of 'questionnaire used', i.e. already constructed ($g+ = -0.300$, $k = 32$) vs. researcher made ($g+ = -0.103$, $k = 8$). The findings of Chua et al.'s (1999) meta-analysis point to the fact that different surveys measuring computer anxiety showed significant differences between results. For example, Chua et al. found significant combined effect size results in Lloyd and Gressard's (1984) group of survey-based studies, thus confirming that females tend to be more anxious towards the usage of computers than male learners. That being said, the synthesis of results from studies using the questionnaires devised by Raub (1981) showed no significant findings with regards to gender differences in learners' reported computer anxiety scores (Chua et. al., 1999).

Regarding quality assurance, 'questionnaire used' moderator analysis findings highlight the importance of reporting the reliability and validity measures of survey questionnaires. Here, I have attempted to gather information on reported reliability and validity measures for the construct of computer anxiety (see Table 13). Of the 42 studies synthesized, 31 did not report any questionnaire 'validity' measures, whereas seven studies did not report any reliability measures. Considering Kay's (1992) summary of 98 articles about gender and computer attitude, ability, and use, it is necessary to acknowledge that those conclusions remain true, albeit outdated. Kay (1992) reported that examined studies lacked clear and dependable measures of attitude, ability, and use. Of the 644 measures used to analyze gender differences, 24% gave estimates of reliability and 18% considered validity. It is difficult to reliably tackle the problem of gender differences and technology when the process of identifying such differences is itself incoherent and unclear. Overall, the most suitable answer to the question of which gender uses computers more and better lies in Kay's carefully worded statement: "it depends on what attitudes are measured, what skills are being examined and for what purpose the computer was being used" (Kay, 1992, p. 278).

Negative Attitudes Towards ICT

Average effect sizes for Negative Attitudes Towards ICT indicate minor significant gender differences between female and male students, with women having more negative attitudes towards ICT. Given that the construct of Negative Attitudes Towards ICT might sometimes overlap with computer anxiety construct (see Liao, 2000), these results are somewhat expected.

Findings from the study features and moderator analyses pertaining to the Negative Attitudes Towards ICT results indicate that some variables seem to impact the effect size. These variables include 'technology surveyed' (i.e. general technology vs. specific technology), 'ethnicities' (i.e. measured vs. not measured), and 'subject matter '(i.e. NonSTEM vs. STEM).

It is interesting that the technology survey results of the moderator analysis, which compare ‘general technology’ ($g+ = 0.010$, $k = 12$) with ‘specific technology’ ($g+ = -0.356$, $k = 6$), reflect the computer anxiety moderator results. This similarity emphasizes the differences in effect size measures being based on the type of ‘technology surveyed’, be it general technology (i.e. many types of technologies in learning) or specific technology (e.g. the use of clickers in the classroom). Therefore, to obtain accurate results, researchers need to emphasize and contextualize the kind of technology they are surveying.

Another significant finding from the moderator analyses was the difference between two levels of ‘ethnicities’ used, i.e. measured ($g+ = 0.133$, $k = 5$), vs. not measured ($g+ = -0.119$, $k = 13$). Unfortunately, as only five studies reported ethnicities, it was impossible to analyze measured ethnicity sub-levels and ethnicity-based gender differences on negative attitudes.

Lastly, significant findings from the moderator analysis demonstrated a difference in effect sizes between the two levels of ‘subject matter’ in the study, i.e. NonSTEM ($g+ = 0.183$, $k = 5$) and STEM ($g+ = -0.254$, $k = 5$). It seems that studies surveyed in STEM classes show a larger gender gap in favor of male learners when compared with studies surveyed in NonSTEM classes. This is in line with the published literature on learners’ enrolment in technological programs of study (e.g. computing programs). For example, Buche, Davis, and Vician (2007) reported that computer anxiety played a role in educational anxiety-related experiences, with males being less anxious than females. Therefore, the findings of my moderator analysis call for more contextualization regarding surveying technology in classrooms. This anchors the technology in specific subject matters and contextualizes gender-based technological research as it seems to have an impact on effect size. However, given that many surveys did not report ‘subject matter’ surveyed ($k = 5$ in each moderator level), results are inconclusive, and the drawing of solid implications inappropriate.

Computer Confidence

Average effect sizes for Computer Confidence show moderate significant gender differences with males reporting greater confidence with computers. Study features and moderator analyses’ findings regarding computer confidence suggest that some variables seem to impact the effect size. Here, these variables encompass 'technology surveyed' (i.e. general technology vs. specific technology), 'research country' (i.e. NonUSA vs. USA), 'grade level' (i.e. university level vs. school level), and 'participation rate'.

Significant findings from the moderator analysis demonstrated a difference between two levels of 'technology surveyed', with general technology ($g+ = 1.234$, $k = 4$) and specific technology ($g+ = 0.317$, $k = 24$) rates being similar to the findings from the aforementioned computer anxiety and negative attitudes constructs. This moderator finding also re-emphasizes the importance of scholars specifying the technology being surveyed when studying gender differences and perceptions towards technology in learning.

Findings from the 'research country' moderator analysis, featuring NonUSA ($g+ = 0.335$, $k = 24$) vs. USA ($g+ = 1.044$, $k = 4$) levels, also featured significant differences between the two levels analyzed. Liao's (2000) meta-analysis on gender differences in ICT attitudes produced similar findings, with studies using participants from different countries yielding different significant effect sizes. Liao asserts that country attributes are subject to bias especially as it relates to subject background, difference in accessibility to computers in schools, and different environmental and governmental impacts. Therefore, research with participants from various cultures can supply valuable information when it comes to specific groups selected and their feelings toward computers.

A significant finding from the moderator analysis presented a difference among levels of 'participation rate' i.e. 0–50% ($g+ = 0.120$, $k = 3$), 60–80% ($g+ =0.290$, $k = 6$), and 90–100% ($g+= 0.866$, $k = 6$). Interestingly, the results of effect size reveal an increase in males' computer confidence as participation rate increases. The more engaged the participants were in answering the surveys, the higher the gender difference values with regards to computer confidence. That being said, different levels of 'participation rate' may also be linked to sampling measures adopted (probability vs. nonprobability sampling) and hence, may impact the effect size results. For example, if the study has adopted a non-probability sampling approach (e.g. convenience sampling) because the researcher works in that educational institution, it might affect participation rate in the survey, especially if the non-probabilistic alternative is an anonymous survey sent out to community schools and the like.

Lastly, a significant finding from the 'grade level of learners' moderator analysis was the difference between university level ($g+ = 0.302$, $k = 21$), and school level ($g+ = 0.797$, $k = 7$). Results also indicate that age level of learners seems to have an impact on gender results. This reiterates results from Chua et al.'s (1999) study, which found that as they grow older, female learners tend to become more anxious about using technology in learning.

This finding also confirms the results of Barker and Aspray's (2006) review of research on computers and young women. Barker and Aspray (2006) researched students' attitudes towards computers and their use over a period of over 10 years from 1992 to 2004. The authors observed that females start to discredit the male-oriented computer culture as uninteresting and dull, and avoid computer-based career paths in favor of more socially oriented ones as early as their early teenage years. Consequently, it may serve no useful purpose to provide women with additional resources to boost their computer expertise since they view technology as something that is not connected to their lives (Barker & Aspray, 2006).

These results are further supported by Fedorowicz, Vilvovsky, and Golibersuch's (2010) descriptive study of teenagers' technology-based viewpoints, behaviors, and hobbies. Surveying over 300 teenagers enrolled in middle schools and high schools in the United States, analyses showed both similarities and differences in using technology voluntarily between male and female teenagers. Significantly, many differences relating to gender are not present in middle school, but come to light in high school. High school reveals a gender difference in reported level of skill and knowledge of computer programs, both of which are higher for males. Thus, the technological conflict with high school females lies in their supposed confidence in school-related computer use, juxtaposed with their feeling of dissatisfaction with what they have learned and their lesser knowledge of offered computer courses when compared to their male counterparts.

Similarly, You and Cheng's (2012) research investigates how confidence levels of technology use (software and programming language) vary between genders in universities. Results from the survey corroborated the suggestions that the reason levels of confidence in technology use are higher in favor of males and not females lies in the socially constructed, rather than intrinsic, nature of technology-based gender differences. The way in which society upholds particular gender roles and gender codes keeps students conveniently open to being negatively influenced. An example of this negative influence can be seen in how females dismissed their own accomplishments in technology to chance rather than aptitude. As such, the fact female learners tend to become less confident using technology in learning as they grow older could very well be explained by the impact of culture and societal norms on women's perceptions of confidence with technology use in the classroom.

Perceived Ease of Use

Average effect sizes of Perceived Ease of Use of ICT indicate small significant gender differences between female and male students, with male students reporting higher perceived ease of use with ICT than female students. Findings from the study features and moderator analyses regarding perceived ease of use results indicate that some variables like 'participation rate' and 'ethnicity' seem to impact the effect size.

One significant finding from the moderator analysis was the difference between the levels of 'participation rate' used i.e. 0–80% ($g+ = 0.120$, $k = 7$) and 90–100% ($g+ = 0.494$, $k = 3$). This echoes the moderator variable results of the computer confidence analysis. Results indicate that the more students participate in a survey, the more boys seem to favor a perceived ease of use of technology attitude.

The difference between the two levels of 'ethnicities' used i.e. measured ($g+ = -0.144$, $k = 2$), vs. not measured ($g+ = 0.217$, $k = 19$) proves to be a significant finding from the moderator analysis. This result is similar to the results of general negative attitudes towards technology. However, only two studies researching gender differences with regards to perceived ease of use of technology reported measures of participants' ethnicities. This is interesting given that investigating ethnicities and their impact is a significantly important variable when evaluating gender differences. Scholars researching gender differences in social sciences should be wary of generalizing 'gender' as a stand-alone, universally applicable variable. Instead, gender needs to be researched in tandem with other intersecting demographics, such as ethnicities of participants, age, and social class. Examples of studies that consider gender with its intersections include Hyde, Fennema, and Lamon's (1999) meta-analysis on gender differences with regards to academic achievement in mathematics. Hyde et al. reported an effect size of 0.13 for white males, with a slight advantage over white women. However, they did not find effect sizes for Hispanics ($d = 0.00$), Blacks ($d = -0.02$), or Asian Americans ($d = -0.09$). Similarly, Kling, Hyde, Showers, and Buswell's (1999) meta-analysis investigating gender differences regarding self-esteem, found that self-esteem effect sizes differed between white women (d = 0.20) and black women (d = -0.04). In my own meta-analysis, it was impossible to dig further into the impact of ethnicities due to the low number of cells; therefore, any other conclusions are inconclusive.

Perceived Usefulness

Perceived Usefulness of ICT average effect size results indicate a very small, significant gender difference between female and male students, with higher perceived usefulness of ICT in favor of male students. Findings from the study features and moderator analyses of Perceived Usefulness of ICT indicate that several variables seem to impact the effect size. Significant findings from the moderator analysis reported a significant difference between the two levels of 'research country' used, i.e. NonUSA ($g+$ = 0.119, k = 51) vs. USA ($g+$ = -0.063, k = 17), thus echoing the moderator variable results of the computer confidence construct. Furthermore, the impact of culture on gender differences in students' reports of perceived usefulness of ICT in learning is in line with the existing literature (see Karsten, Mitra, & Schmidt, 2012; Liao, 2000).

In addition, significant 'research country 'moderator results in this construct indicate that women in the USA tend to have higher perceived usefulness attitudes than their male counterparts, also in accord with what with the literature has published. For example, Hohlfeld, Ritzhaupt, and Barron's (2013) research investigates gender differences associated with Information and Communication Technology (ICT) schooling with a sample of 1,513 eighth-grade students from public schools in Florida. Findings demonstrate important overall distinctions to the females' advantage, as their rankings for Frequency of Computer Use, Perceived ICT Skills, and Attitudes toward Computers were higher in discernment. Furthermore, females also had substantially higher results on all divisions of the performance-based Student Tool for Technology Literacy, thus negating previous research results concluding that males are more proficient with ICT and computers than females are.

Perceived Satisfaction

Perceived Satisfaction with ICT average effect size results indicate small significant gender differences between female and male students, with male students reporting higher perceived satisfaction with ICT than female students. Findings from the study features and moderator analyses of Perceived Satisfaction with ICT results suggest that several variables seem to impact the effect size. These include ‘ethnicities’ (i.e. measured vs. not measured), ‘sampling selection’ (i.e. sample from many vs. sample from one institution), and ‘technology acceptance model’ (i.e. used vs. not used).

Significant findings from the moderator analysis also revealed a difference between the two levels of ‘ethnicities’ used, i.e. measured ($g+ = -0.196$, $k = 2$) vs. not measured ($g+ = 0.066$, $k = 26$). This reflects the results of the ‘ethnicities’ moderator in perceived ease of use and general negative constructs. This also echoes the results of the literature regarding research on the impact of race on technology acceptance and usage. For example, Jones, Johnson-Yale, Millermaier, and Seoane Perez (2009) examined the relation between race, gender, and Internet usage habits of 7,241 American college students across 40 Midwestern universities. Analyses of surveys, observations, and interviews confirmed that female college students are likely to use the Internet for communication and education more often than male college students do. Concerning race, they found Hispanic students are particularly less inclined to using the Internet for their education when compared with non-Hispanic White and Black students. Furthermore, Hispanic and Black non-Hispanic college students are more likely to have had their first Internet experiences at school, compared with White non-Hispanic college students, who are more likely to have had their first Internet experiences at home. In my own meta-analysis, it is disheartening to see that only two studies in the perceived satisfaction with technology construct report ‘ethnicities’ as a variable. Consequently, I could not evaluate the sub-level of this moderator and measure the impact of type of ethnicities on perceived satisfaction with ICT.

Yet another significant finding from the meta-analysis indicates a significant difference between two levels of ‘sampling selectivity’ i.e. sample selected from many educational institutions ($g+=0.210$, $k=7$) vs. sample selected from one educational institution ($g+ = -0.028$, $k = 20$). This suggests that gender differences could very well be impacted by different survey sampling strategies. This is in agreement with Becker and Hedge’s (1984) article on the results of Hyde's (1981) meta-analysis of gender-based differences in cognitive skills. Becker and Hedges (1984) expand on the rationality and statistical methods used by Hyde (1981). The significant results reveal that gender differences are not established or fixed but constantly changing. Ultimately, discrepancies in recorded gender differences across multiple studies can be interpreted as a consequence of the dates on which the studies were published and how their samples were selected. This moderator is especially important when we are synthesizing survey data since the methodology is as significant as the quality of the data.

The moderator analysis also reported a significant difference between two levels of the 'technology acceptance model', i.e. used ($g+ = -0.183$, $k = 2$) vs. not used ($g+ = 0.068$, $k = 26$). This moderator analysis finding also speaks to the importance of survey questionnaires' reliability and validity measures being reported for quality assurance. Although different studies (e.g. Sumak et al., 2011) have established that it is acceptable to use a technology acceptance model with students, the model was originally used to measure technological-related behaviors of employees in organizations. Therefore, as researchers, we need to make sure we check the reliability and validity of the measures of attitude for the specific populations we are studying. That being said, due to the very small number of studies using a technology acceptance model ($k = 2$), these results are inconclusive.

Positive Attitudes Towards ICT

Positive Attitudes Towards ICT average effect size results demonstrate very small significant gender differences between female and male students, with male students reporting higher positive attitudes towards computers than female students. The study features and moderator analyses of Positive Attitudes Towards ICT indicate that some variables seem to impact the effect size. These include 'class context surveyed' (i.e. specific context vs. general institution-based), 'participation rate', 'research country', 'socioeconomic context', 'competency' (i.e. in favor of men vs. in favor of women), and 'publication type' (i.e. refereed vs. non-refereed).

A significant finding from the moderator analysis revealed a difference between two levels of 'class context surveyed', i.e. specific context ($g+ = 0.023$, $k = 13$), vs. general institution-based ($g+ = 0.127$, $k = 38$). Further important findings from the moderator analysis reported a difference between levels of 'participation rate' used, i.e. 0–20% ($g+$ = 0.273, k = 2), 30–50% ($g+$ = 0.022, k = 3), 60–80% ($g+$ = 0.136, k = 13), and 90–100% ($g+$ = 0.005, k = 6). This mirrors the moderator variable results of the Computer Confidence and Perceived Ease of Use of ICT constructs, in which effect sizes tend to change and fluctuate according to different study features like 'participation rate' and how many students are responding to the survey. This in turn could also be linked to survey sampling measures' adopted (probability vs. nonprobability sampling).

Another significant finding from the moderator analysis was the difference between two levels of 'research country' used, i.e. NonUSA ($g+$ = 0.164, k = 29), vs. USA ($g+$ = 0.010, k = 22). This moderator result also reflects the results of the computer confidence and perceived usefulness constructs, and affirms the impact of culture on gender differences in students' reported positive attitudes.

Furthermore, another significant finding from the moderator analysis was the difference between two levels of 'socioeconomic status', i.e. reported ($g+$ = 0.297, k = 5) vs. not reported ($g+$ = 0.077, k = 47). Socioeconomic status as defined by an individual's wages, parental education, and/or family earnings, is a well-known contributor towards ICT attitudes and usage. For example, Albert and Johnson (2011) studied how students who have not taken any online courses perceive e-learning programs differently based on socioeconomic status and gender. Survey topics were taken from a survey evaluating student fulfillment with e-learning programs after taking online courses (Wang, 2003). The results indicate that, while lacking online course experience, working-class students have more positive attitudes toward e-learning programs than middle-class students, but the margin of difference between genders is minimal. Unfortunately, given the low number of studies reporting 'socioeconomic status' in my meta-analysis, sub-level analyses could not discern the impact of students' reported levels of socioeconomic status on gender differences as they related to positive attitudes towards ICT.

Yet another significant finding from the moderator analysis was the difference between two levels of 'publication type' used, i.e. refereed ($g+$ = 0.077, k = 44) vs. non-refereed ($g+$ = 0.199, k = 8). Results indicated that dissertations and non-refereed studies tend to find men have more positive attitudes towards ICT. To arrive at any substantial conclusions with regards to this moderator, meta-analytic researchers should indicate the kind of non-refereed publications that tend to produce these results. However, in this meta-analysis further sub-level analyses were impossible given the low number of cells in non-refereed publication levels (*k* = 8).

In addition, more significant findings from the moderator analysis revealed a difference between two levels of 'competency' reported in the studies, i.e. in favor of men (g+ = 0.243, *k* = 5) vs. in favor of women (*g*+ = 0.288, *k* = 4). Given that the number of studies in each level is rather small (*k* = 4) and (*k* = 5), i.e. less than 10 percent of the whole positive attitudes sample, the only conclusion that I can draw from this categorical variable is that there might be a difference in the levels of gender differences towards positive attitudes in ICT when 'competency' is evaluated. In their research, Lee and Huang (2014) experimentally explored how gender as a controlling factor can be affected by computer competency and levels of computer anxiety. Drawing upon survey information collected from participants with computer experience in Taiwan, hierarchical regression analyses revealed a positive link between gender competency and computer self-efficacy, as well as a negative relationship between computer anxiety and computer competency. The synergetic consequences of computer anxiety and computer competency indicated an inversely proportional relationship between the two. Their results therefore demonstrate that, for female subjects, increased computer competency could lessen the damaging effects of computer anxiety.

Motivation to Use ICT

The average effect size results of Motivation to Use ICT indicate there are small significant gender differences between female and male students, with male students reporting higher motivation to use ICT than female students. Findings from the study features and moderator analyses of Motivation to Use ICT indicate some variables seem to impact the effect size. These include 'grade level of learners' (i.e. university level vs. school level), 'research country', and 'publication date' (i.e. 2006–2010 vs. 2011–1015).

A significant finding from the moderator analysis reported a difference between two levels of 'grade level of learners', i.e. university level (*g*+ = 0.067, *k* = 11) vs. school level (*g*+ = 0.420, *k* = 3), mirroring computer confidence results. It appears that with age, men become more confident than women using technology; another finding that is also well documented in the literature. In fact, in Sanders' (2006) analysis of the literature on gender and technology through 200 articles written between 1990 and 2001, she thoroughly examines elements such as influence of society (e.g., parents, media, and socioeconomic status), age, attitude, ability, use patterns, and the classroom. Sanders arrived at similar conclusions as Whitley's (1997) meta-analysis. Gender differences with regards to technology in education usage and attitudes towards it increase with age.

Another significant finding from the moderator analysis detailed a difference between two levels of 'research country' used, i.e. NonUSA ($g+ = 0.253$, $k = 10$) vs. USA ($g+ = -0.152$, $k = 4$). This moderator result also echoes the moderator variable results of the 'positive attitudes', 'computer confidence', and 'perceived usefulness' constructs. It also affirms the impact of culture on gender differences in students' reported motivation towards ICT in learning.

Furthermore, other significant findings from the moderator analysis revealed a difference between two levels of 'publication date' used, i.e. 2006–2010 ($g+ = -0.001$, $k = 8$) vs. 2011–2015 ($g+ = 0.364$, $k = 6$). It was somewhat surprising to see that recent studies show that male learners have higher confidence levels towards using ICT. Nevertheless, it is important to contextualize these findings as they relate to gender differences with regards to different kinds of technologies surveyed.

Computer Self-Efficacy

Computer Self-efficacy average effect size results also indicate small significant gender differences between female and male students, with male students reporting higher computer self-efficacy than female students. Similarly, Whitley's (1997) meta-analysis found that females exhibited lower computer self-efficacy ($d = 0.406$) and lower affect towards ICT in learning environments than males ($d = 0.259$).

It is important to note that this is the only construct among the eleven others synthesized in this meta-analysis to lose significant heterogeneity results after the second round of moderator analyses. I speculate that this could be related to the number of included studies in each moderator sub-level.

Intention to Use ICT

Intention to Use ICT average effect size results indicate a very small significant gender difference between female and male students, with male students reporting higher intentions to use ICT than female students. Findings from the study features and moderator analyses offer some indication of variables that seem to impact the effect size. These include 'sampling selection' (i.e. sample from many institutions vs. sample from one institution), 'participation rate', 'research country' (i.e. NonUSA vs. USA), and 'questionnaire' (i.e. already constructed vs. researcher-made).

A significant finding from the moderator analysis was the difference between two levels of 'research country' used, i.e. NonUSA ($g+ = 0.280$, $k = 13$) vs. USA ($g+ = -0.154$, $k = 5$). This mirrors the results of Perceived Usefulness of ICT and Computer Confidence. Unsurprisingly, culture came up as a factor that impacts the results. For example, Schepers and Wetzels' (2007) meta-analysis of past studies regarding the technology acceptance model (TAM) showed that subjective norms significantly influence perceived usefulness as well as behavioral intentions to use technology. Findings in this research also reported a difference among different countries specified as western vs. non-western, and found that perceived ease of use was more related to behavioral intentions in western countries than to perceived ease of use in non-western countries.

Further significant findings following the moderator analysis identified differences among levels of 'participation rate' used, i.e. 0–50% ($g+ = 0.288$, $k = 3$), 60–80% ($g+ = 0.062$, $k = 4$), and 90–100% ($g+ = 0.839$, $k = 2$). Similar to the results of general positive attitudes, perceived ease of use, computer confidence, and 'participation rate' results seem to fluctuate across levels of sample participation. This finding might be linked to the kind of sampling adopted when conducting the survey.

Another significant finding from the moderator analysis was the difference between two levels of 'sampling selection', i.e. sample from many institutions ($g+ = 0.496$, $k = 4$) vs. sample from one institution ($g+ = 0.037$, $k = 14$). This mirrors the results of perceived satisfaction and signals that gender differences could be impacted by survey sampling approaches.

Further, more significant findings from the moderator analysis revealed a difference between two levels of 'questionnaire used', i.e. already constructed ($g+$ = -0.044, k = 8) vs. researcher-made ($g+$ = 0.399, k = 6), as is the case with Computer Anxiety results. This is similar to the results of Schepers and Wetzels's (2007) meta-analysis of the technology acceptance model. Findings also showed the important influence of subjective norm on perceived usefulness as well as behavioral intentions to use technology. That being said, the significance of these results lies in the authors' note that their findings might be limited because of significant differences in average and statistical powers when different questionnaires were used to assess an individual's acceptance of technology, as when using the scales of Taylor and Todd (1995) vs. Fishbein and Ajzen (1975). The authors conclude that utilizing different questionnaires may have resulted in completely different effect sizes and recommend additional research examining the different questionnaires used.

Mixed perceptions towards ICT

Mixed Perceptions Towards ICT average effect size results also indicate very small significant gender differences between female and male students, with male students reporting higher mixed perceptions of computers than female students. Since this outcome denotes the studies that have measured students' perceptions towards ICT by asking questions and reporting results that may be related to more than one of the categories of attitudes mentioned above, discussing these results would not be conclusive.

Nevertheless, it is interesting to note that findings from the study features and moderator analyses of Mixed Perceptions Towards ICT already appear in different constructs and seem to impact the effect size. These include 'subject matter' (i.e. NonSTEM vs. STEM), 'participation rate', 'competency', 'questionnaire' (i.e. already constructed vs. researcher-made), and 'publication type' (i.e. refereed vs. non-refereed).

Significant findings from the moderator analysis demonstrated the difference between two levels of 'subject matter' used, i.e. NonSTEM ($g+$ = -0.244, k = 6) vs. STEM ($g+$ = 0.177, k = 7). This is similar to the results of Negative Attitudes Towards ICT, which also showed significant differences across the two moderator levels.

Similarly, there were also significant findings from the moderator analysis in the difference between levels of 'participation rate' used, i.e. 0–20% ($g+ = 0.092$, $k = 5$) 30–50% ($g+ = 0.190$, $k = 2$), 60–80% ($g+ = -0.187$, $k = 7$), and 90–100% ($g+ = 0.292$, $k = 5$). This echoes the moderator variable results of 'intention of use', 'general positive attitudes', 'perceived ease of use', and 'confidence', all of which showed significant moderator level differences.

Other significant findings following the moderator analysis revealed a difference between two levels of 'competency' reported in the studies, i.e. in favor of men ($g+ = 0.253$, $k = 5$) vs. in favor of women ($g+ = -0.146$, $k = 2$). These results resemble results of Positive Attitudes Towards ICT in their own significant moderator level differences.

Further, more significant findings from the moderator analysis indicate a difference between two levels of 'questionnaire used', i.e. already constructed ($g+ = -0.041$, $k = 15$), vs. researcher-made ($g+ = 0.175$, $k = 15$), similar to the results of Intention to Use ICT and Computer Anxiety constructs across the two moderator levels.

The last significant finding from the moderator analysis was the difference between two levels of 'publication type' used, i.e. refereed ($g+ = 0.106$, $k = 27$) vs. non-refereed ($g+ = -0.221$, $k = 4$), resembling the results of Positive Attitudes Towards ICT, which also showed significant differences between the two moderator levels.

Usage of ICT

Reported Usage of ICT average effect size results indicate very small significant gender differences between female and male students with male students reporting higher usage of ICT than female students. Findings from the study features and moderator analyses of usage of ICT results suggest that some variables seem to impact the effect size. These include 'research country' (i.e. NonUSA vs. USA), 'participation rate', and 'publication date' (i.e. 2006–2010 vs. 2011–2015).

One significant finding from the moderator analysis was the difference between the two levels of 'research country' used, i.e. NonUSA ($g+ = 0.118$, $k = 38$) vs. USA ($g+ = -0.044$, *k* = 20), which is similar to the results of intention of use, perceived usefulness, and confidence. It is important to note that country and/or culture are significant and impact gender difference results with regards to computer usage and attitudes towards it. In Karsten et al. (2012), 232 valid statistical relationships between computer self-efficacy (CSE) and seven correlates were meta-analyzed by the authors. The variables were perceived usefulness, perceived ease of use, behavioral intention, behavior, attitude, competency, and computer anxiety. Findings indicated effect size differences between USA vs. NonUSA studies. This suggests that national context moderates the relationship between CSE and attitude as well as CSE and behavioral intention.

Another significant finding from the moderator analysis was the difference between levels of 'participation rate' used, i.e. 80% and less ($g+ = 0.008$, $k = 24$), vs. 90–100% ($g+ = 0.196$, $k = 6$). Just like the results of mixed perceptions, intention of use, positives, perceived ease of use, and confidence, different types of survey participation rates may also be linked to sampling measures adopted (probability vs. nonprobability sampling), and hence may impact the effect size results.

For example, if the study has adopted a non-probability sampling approach (e.g. convenience sampling) because the researcher works in that educational institution, it might affect participation rate in the survey, especially if the non-probabilistic alternative is an anonymous survey sent out to community schools.

Furthermore, other moderator analysis revealed a significant difference between two levels of 'publication date' used, i.e. 2006–2010 ($g+ = 0.177$, $k = 32$) vs. 2011–2015 ($g+ = -0.049$, $k = 27$). Results indicate that recent publications show that women are using more technology in recent years (2011–2015) and hence suggest the narrowing of gender digital divide in terms of broad usage of technology. It would be interesting to know what kind of technologies women tend to use more so that we get a clearer picture on how the gender digital divide is narrowing in terms of ICT usage. For example, Grimsley's (2013) research explores how incorporating these new digital methods affect students, and females in particular. Specifically, the study addresses the different ways in which male and female students engage with these technologies, and how increasingly popular video podcasts affect students in a flipped writing classroom. Using a mixed-methodology research design, the researcher studied a sample of 286 students over two phases. The method used in the first phase, a quantitative survey approach, was pursued with 267 students, all of whom were registered in six Southern and Midwestern colleges across the United States during the Fall 2012 and Spring 2013 semesters. The second phase of the study involved qualitative interviews with students registered in a two-year college in Texas during the Fall 2012 semester. The combined information gathered from these two phases showed two significant findings. First, students are not comfortable composing content with Web 2.0 new media technologies despite having previous experience absorbing digital material. Second, there is still a discrepancy between male and female perceptions of and skills with technology. Furthermore, women were likely to reveal lower confidence and experience than men. For example, men were better accustomed than women to three-fourths of the 25 digital literacy methods and technologies in the study. Moreover, women reported lower experiences in comparison to men when composing texts using Web 2.0 implements, specifically when editing audio and video or developing wikis, web sites, and podcasts. Unfortunately, in my own meta-analysis, it was impossible to research the impact of specific technologies on gender differences with regards to computer usage since less than 20 percent of the studies included in the computer usage meta-analysis surveyed specific technologies (refer to Table 24).

Summary

This chapter discussed the results of the students' reported ICT usage and attitudes towards ICT constructs as measured by the different outcomes. It also discussed the results of the moderator variables and study features related to each outcome as they were analyzed in this meta-analysis.

Findings of this dissertation reveal significant gender differences between female and male students' reported Usage of ICT and attitudes towards ICT in favor of males. Average effect sizes ranged from small to moderate. The highest average effect size belonged to the construct of Computer Confidence, where male students typically reported higher confidence with computers (.38 standard deviations above the female students). The lowest effect size belonged to the construct of Perceived Satisfaction with ICT, where male students typically reported more Perceived Satisfaction with ICT (i.e. .05 standards deviation above the female students).

A number of contextual factors impacted the results of the outcomes to differing degrees. These include ‘research country’, ‘grade level of students’, ‘technology surveyed’, kind of ‘questionnaire used’, participants’ ‘ethnicities’, ‘subject matter’ surveyed, ‘participation rate’, ‘sampling selectivity’, reported participants’ ‘competency’ levels, ‘publication date’, ‘technology acceptance model’ adopted, ‘class context surveyed’, and ‘socioeconomic status’.

Upon closer examination, I found that several moderator variables contributed significantly to the explanation of the variance in effect sizes and tended to be repeated across several outputs. Of course, I am well aware that my dissertation consists of meta-analyzing 12 different outputs and thus cannot be compared directly to each other. After all, each output consists of different studies with specific particularities including various settings and populations and the like. However, I believe that the mere finding that some moderators tended to be repeated across different outputs is significant on its own- especially that the significant moderators cut across methodological, technological, and contextual settings.

For example, ‘publication date’ emerged as a significant moderator impacting the results of effect sizes across three different outputs (Motivation to Use ICT, Mixed Perceptions towards ICT and Positive Attitudes towards ICT). Also, ‘research country’ came out to be a significant moderator variable in six outputs. These include Computer Confidence, Intention to Use ICT, Motivation to Use ICT, Perceived Usefulness of ICT, Mixed Perceptions towards ICT, and Positive Attitudes towards ICT. Similarly, ‘participation rate’ was also significant across five different outputs. These include Computer Confidence, Perceived Ease of Use of ICT, Intention to Use ICT, Positive Attitudes towards ICT, and Mixed Perceptions towards ICT. The moderator ‘questionnaire construction’ was also significant and affected the effect size results across three different outputs (Computer Anxiety, Intention to Use ICT, and Mixed Perceptions towards ICT). The kind of ‘technology surveyed’ emerged as yet another moderator across three outputs (Computer Confidence, Computer Anxiety, and Negative Attitudes towards ICT).

In light of the above, to answer my research question, yes, this meta-analysis did find gender differences that range from small to moderate, and favor men over women. That being said, we need to add that I also found that gender differences with regards to usage and ICT attitudes depend on how researchers are asking the question, planning, exploring and collecting data, and implementing their survey research. Considerable effort should be made to flesh out as much context as possible when researching gender differences in students' usage and attitudes towards ICT in learning. As such, I recommend that gender not be researched as a homogeneous independent variable. After all, gender is embedded in many other variables in the same way that it is embedded in the many structures of society. Gender needs to be researched with other intersecting demographics, including but not limited to participants' home country, ethnicity, age, and socioeconomic background. The next chapter will conclude with educational implications, a new vision, and recommendations for future surveys researching gender differences in reported students' usage and attitudes towards ICT in learning.

CHAPTER VI

Educational Significance and Recommendations

This chapter offers a discussion of the educational significance and recommendations stemming from the present meta-analysis. It aims not only to re-envision gender differences as embedded in society in more complex ways than is actually represented in quantitative research, but also to suggest ways in which intersectionality theory can be used to advance gender differences in quantitative research. I begin by highlighting the shortcomings of current quantitative methodologies and the advancements in other gender difference methodologies.

I then go on to describe intersectionality theory and the role that it can play in quantitative research. Finally, I suggest a new vision of gender and technology research strategies.

Current state of Gender Research

There has been almost no substantial change during the last three decades in the quantitative methods used to study the connection between gender and ICT, but further inquiry into the data on attitudes shows a number of patterns. Contrary to what might be presumed, development of technology, the ease with which it can be used, as well as access to it have not helped narrow the gender digital divide with respect to usage and attitudes towards computers. Although men seem to be a little more positive about computers than women, conducted systematic reviews claim that there seems to be little change in gender disparities in terms of usage and attitudes towards computers (Kay, 2008; Liao, 2000; Whitley, 1997). Indeed, systematic reviews carried out over the last two decades reveal marked male bias in ICT usage and attitudes (Kay, 2008; Liao, 2000; Whitely, 1997).

Nevertheless, the often-restless qualitative and feminist research over the past years has evolved considerably with regards to gender differences. Indeed, over the past thirty years, qualitative feminist theorists have greatly modified the way they analyze and build models to delineate their interpretation and views of the factors behind female inequalities and subjugations in society. Qualitative research and feminism theories give us different perspectives, models, or lenses to see and understand women's perspectives on gender inequality. Initially, gender empowerment theorists, like liberal feminists, fought for women's equal opportunities. After that, radical feminists altered the equation and said, to fight for gender equality; one cannot fight for equal opportunity since the problem does not lie in policies, legislation, and equality of opportunities. The problem lies in the structural forces defined by the cultural and social forces that surround females. The problem also lies in the male-dominated family, religion, and even male-dominated institutions and schools. Radical feminists realized that in order to eradicate gender oppression, they need to do more than fight for equal opportunities. The radical movement wanted to restructure the patriarchal society and change it radically to reach gender equality. This movement was followed by another group of feminists, the Black Feminists, in North America. They agreed that equal employment opportunities and relationship building are all issues worth fighting for, but having said that, not all of those issues were relevant to them. Black feminists regarded oppression to be understood better when seen as a product of different prejudices. For example, for Black feminists, their oppression was doubled, combined, and multiplied due to the duality of their gender and race. Further, gender, race, class, and religion contributed to even more oppression than when each was considered alone.

In short, from the 1960s until today, qualitative feminist researchers concluded that where gender research is concerned one couldn't generalize. There are different ways in which patriarchy manifests itself; it is not a universal, homogenous concept. Different countries deal with their own cultural, familial, political, economic, and religious realities that affect gender roles in different ways for various individuals. Every gender story represents an analysis of individual events, issues, and experiences with which only certain populations might identify. As a result, researchers and gender equality reformers need to create contextualized spaces to research and construct gender stories.

I believe that this is the missing perspective regarding gender differences research and is one that could benefit the quantitative research field. Quantitative research cannot investigate gender as a homogeneous independent variable. Gender is embedded in many other variables in the same way that it is embedded in the many structures of society. Because of this, scholars researching gender differences in social sciences should be aware of generalizing 'gender' as a stand-alone variable. Gender needs to be researched in concert with other intersecting demographics, including ethnicities of the participants, their age, and/or their social class.

Not many meta-analyses have reported gender difference results accounting for moderator variables like ethnicity and socioeconomic status. Any meta-analysis investigating gender differences in social sciences needs to add contextualization variables. Such variables could be sample age of participants, race, ethnicity, income, parents' education, or any other socioeconomic status indication, such as household income. These are all possible moderator variables that may interact with gender and impact male and female relationships.

In this meta-analysis, therefore, I attempted to include contextualization variables and to study their impact on the gender results. I embarked on collecting a number of demographic variables, including experience, competency, ethnicities, socioeconomic status, and any intersection of demographics that researchers have considered when surveying gender. Alas, it was an impossible task, given that most of the surveys did not report the variables of 'ethnicities', 'socioeconomic status', 'intersection of demographics', 'competency', and 'experience' (see Tables 13–24).

Going forward, however, quantitative gender difference researchers need to enhance the reporting of gender populations by contextualizing and accounting for age, race differences, social class, as well as measuring the interactions between gender, class, and ethnicity when outputs are analyzed. Moreover, race, gender, socioeconomic status, and social class should not be treated as separate variables or categories that describe participants. Instead, gender inequalities need to be contextualized so that researchers can deliberate effectively on different forms and intensity of discrimination and consider how different intersections of demographic variables affect each other. Studying and analyzing how gender and ICT intersect with specific demographic variables present an opportunity to develop new methodologies, particularly ones that aim at social transformation.

A new vision for gender studies

We cannot address issues of social imbalance by researching gender as simply a category of women vs. men; similarly, we cannot investigate other supplementary demographics of identity such as ethnicity, socioeconomic status, and gender, just as separate variables or separate differences without any connection to each other (Bauer, 2014; Hancock, 2007; McCall, 2005).

For these reasons, I recommend adopting intersectionality theory and applying it to quantitative research investigating gender differences with regards to usage and attitudes towards ICT. According to McCall (2005), "[intersectionality] is the most important theoretical contribution that women's studies has made so far" (p. 1771). Further, intersectionality theory offers a model to comprehend and conceptualize gender inequalities as complex, different, and established in the intersections of demographics in society and the particular confluence of multiple factors that can give rise to idiosyncratic forms of gender subordination (Veenstra, 2011).

Intersectionality imparts differences and particularities in our social statuses in the hope of fighting against those silent prejudices that result in social inequities. It allows us to inspect social demographic variables as they truly are: complex and interwoven. It allows researchers to embed different theoretical strands; as such, it has the potential to unite scholars and allows them to cooperate with each other. Due to the flexible differences in gender, researchers can adopt different intersections in demographic variables as they correspond to various contexts, such as different countries, age groups, and populations. Adopting this theory does not mean that each study investigating gender differences needs to include all of the above interactions and variables. However, this theory allows researchers to be aware of any omissions of social phenomena impacting gender grouping as they choose their research population and special context. It may also encourage social scientists to be more comprehensive in their sampling selections.

Studies should therefore not only report sample ethnicities but also preferably account for family incomes to be reported because we cannot generalize findings to an entire group of people. For example, Black women coming from low-income families are not reported along with the population of black women coming from high-income families. However, when one considers intersectionality theory for investigations of gender differences in social science research and literature reviews using that particular lens, one cannot help but notice the consistently biased sampling of participants. As a result, using intersectionality theory will make researchers more aware of this issue and will most probably help them be more cognizant when selecting and reporting sampling and ethnicity. In this way, bias is reduced and no global statements are made about culturally sensitive and context-dependent variables like gender.

Adopting intersectionality when investigating studies with gender differences is not a recent innovation and has already been used by several researchers. Feminist research is the most widely recognized for applying intersectionality (Hankivsky, 2014), however, quantitative researchers, especially in psychology, are starting to adopt the theory as well (see Dubrow, 2008). Else Quest (2012) exemplifies the benefits of applying intersectionality theory when reporting her meta-analysis findings on gender differences in self-conscious emotions. For example, the findings reported show an intersection of gender and ethnicity: gender differences for the emotion of shame were greater for whites than non-whites, (d = -0.32 and -0.06, respectively). If the researcher was restricted to only reporting the overall finding of (d = -0.29) for shame, it would have obscured variations in the magnitude, masked the gender difference across ethnic groups and, in particular, masked the absence of the difference among non-whites.

With regards to using quantitative methodology, employing proper intersectional perspectives requires incorporating qualitative intersectional understandings and formulating them through concentration on power relations and inequalities. Else-Quest and Hyde (2016) coalesce multiple interpretations of intersectional approaches to culminate in three typical suppositions that formulate their article’s working definition of intersectionality. The first of these suppositions identifies that every person is portrayed by several social groups concurrently; these include race, gender, class, ethnicity, and sexual orientation. The different social groups intersect for various people such that each is experienced in relation to the others. The second supposition recognizes the inequality and power dynamics ingrained within each of these social groups, a recognition crucial to an intersectional analysis. The third and final supposition is that these groupings refer to each individual’s identities, as well as the attributes of the social commentary.

Individuals perpetuate institutions, social structures, and interpersonal interactions, all of which contrive the groupings and maintain the power imbalances and bias. However, these groupings and their importance may reject a static interpretation and instead take up an unlimited and ever-changing, ever-evolving nature. In sum, rejecting an encompassing definition that assumes the universalization of women’s inequalities is necessary and intersectionality theory helps us in doing that. Intersectionality theory implies an insight that invites researchers and scholars to approach the study of social categories with more complexity and suggests ways to bring more nuance and context to our research on the social categories that matter most in an ever-evolving and ever-changing, stratified society (Cole, 2009).

Origin and Applicaion of Intersectionality Theory

The roots of intersectional perspectives lie in critical race theory and Black feminism in particular. The manifesto drafted by a black lesbian feminist activist group in Boston known as the Combahee River Collective is frequently regarded as one of the first articulations of intersectionality. It highlighted the perspectives of black women when white women were leading the scene.

However, the origins of intersectionality can be traced even further back as demonstrated in the speeches and writings of early Black activists. Already in the late 19th century, for example, Anna J. Cooper was calling upon Black male leadership to acknowledge the existence of racialized sexist discrimination (Giddings, 1985). Around the same time, W.E.B. Dubois was arguing that an analysis of race should form part of the U.S. communist party's class-based organizing (Hancock, 2005). Nevertheless, large U.S. social movements organized according to race, class and gender, have generally paid little heed to the intersections of such categories (King, 1988). This partly explains why the plight of individuals subjected to multiple forms of sub-ordination, such as Black lesbian women, has been rarely addressed (Purdie-Vaughns & Eibach, 2008).

The term 'intersectionality' was itself coined by critical race theorist Kimberlee Crenshaw (1993). However, Crenshaw was far from alone in finding fault with discussions of sub-ordination that failed to acknowledge the importance of intersectionality (Collins, 1990; Hancock, 2007; Hurtado, 1989; Smith & Stewart, 1983). Crenshaw (1993) uses the metaphor of a four-way intersection to convey how intersecting identities can collide, such that any collision is the result of incoming traffic from either one or multiple directions. Intersectionality theory allows scholars to look into social and historical contexts of groups and how their intersections with gender relations thereby make one group more privileged or victimized than the other (Cole, 2009).

This perspective allows for the development of a new approach that takes account of people who belong to various social and racial groups to analyze how power and inequality establish, construct, and even reconstruct the attributes of those social groups. Intersectional perspectives and methods can be represented as rejecting single-axis approaches in favor of using ‘matrix’ thinking to be unrestrictive, flexible, and ‘‘biased toward realizing collective justice’’ (May 2015, p. 251). Intersectional methods are used first to analyze how various social groups converge and how power relations over time construct these groups within their different spheres and relative to different realities of oppressions; second, they are used to emancipate persons and groups from the inhibitions these social groups and their associated discriminations can inflict in this specific context and in this specific time.

Researching how gender interacts with demographic variables (such as socioeconomic status, age, or ethnicities) and how this interaction(s) influence(s) the relationship between gender and ICT allows for female subjugation to manifest itself in sociocultural contexts and for policy makers to contextualize this manifestation in society. Intersections between demographics should be considered as possible factors influencing the gender differences relationship and the connection between ICT and gender differences as well. In that respect, gender analyses focusing on intersectionality in quantitative research will help uncover the factors hidden and help with gender equity, optimizing equitable use, and empowering various populations to use technologies when learning.

How to Incorporate Intersectionality in Quantitative Research

A great deal of policy records, government policies, and research studies subsidized by non-governmental organizations are based on survey methodologies. Researchers have to improve this methodology by embedding intersectionality theory when researching gender differences as it relates to ICT usage and attitudes towards it. It becomes the duty of qualitative and quantitative researchers alike to take up theories that allow us to comprehend complex disparities among various individuals (Grabe, Grose, & Dutt, 2015). Intersectionality theory allows for both aspects of theoretical and empirical application as a “normative theory and empirical research” methodology (Hancock 2007, p. 251). It expands the concept of gender to incorporate several other demographics that have a role in tangible patriarchal relationships, such as ethnicities and socioeconomic status, and to analyze their intersecting relationships with each other.

Investigating demographic intersections that may impact gender relations, such as gender, race, and class, can add to the advancement of socially important and comprehensive approaches and more realistic outlooks of social identities (Scott & Siltanen, 2012). Investigating these intersections is vital since society is not composed of individual variables, nor can it be narrowed down to individualized categories of demographics. Instead, these variables are represented as combined and therefore have an impact on society when represented simultaneously (McCall, 2005).

When describing the particular experiences of Black women, Crenshaw (1993) stated that Black women face prejudice twice over, due to their race and their gender. For Black women, prejudice is more than the addition of racism and sexism however, as it could also include multiplicative effects. This argument has led to research into the impact of main effects since the conspicuousness of one category or identity could be foregrounded in particular circumstances (e.g., Szymanski & Gupta, 2009). However, different groupings like gender or race could very well generate contradictory outcomes that nullify one another. In light of this, when investigating gender differences pertaining to usage and attitudes towards ICT, researchers must also check intersecting effects of demographics in order to unveil their possible connection to gender.

The intersectional nature of belonging to more than one category allows for the discrepancy where one of these categories presents an individual with an advantage while another makes him or her susceptible to discrimination. For example, being white and female might be more advantageous than being black and female when measuring computer self-efficacy.

Analyses through intersectionality can focus on the statistical correspondence between any two or more categories. The intersectional investigation sets up different groups to have several main effects as well as intersecting effects that are possible through analyses of variance (ANOVA or MANOVA) or multiple regressions (Else-Quest & Hyde, 2016). Univariate and multivariate statistical tests such as ANOVA and MANOVA might, for example, produce 2 (Gender) x 3 (Race) designs with roughly equal numbers of participants in each cell or group. Supposing the outcome variable was computer self-efficacy, the analysis would examine main effects of both gender and race. From an intersectionality framework, those statistical results would be interpreted as indicating that both race and gender are linked to computer self-efficacy.

We can also use meta-analyses to check for statistical interactions. Meta-analyses employ moderator analysis to investigate the dependency or the impact of a variable on the average effect size. We can also test for gender differences in intersecting demographics by using regression models. Few gender meta-analyses have looked for variations in the magnitude of the gender differences as a function of ethnicity or other potential moderators like social class.

A notable exception is the study of Else-Quest, Hyde, and Linn (2010), who conducted a cross-national meta-analysis on gender-based differences in mathematical performance and perceptions that investigates how gender and culture can intersect. Here, the moderator analyses they used connected cross-national discrepancies in mathematical gender imbalances to gender-based cultural discrimination and unfairness. The study revealed that the insignificant magnitude of gender difference in mathematical performance was of $d = 0.01$ across 46 nations.

This variance differed cross-nationally and was estimated by gender-based access rates into secondary-level educational institutions. For example, nations with lower female high school enrolment (respective of population shares) have higher male mathematical performance based on assessments, thus demonstrating how quantitative intersectional analyses can investigate power and inequality.

In additive analysis, quantitative strategies use the added substance approach in regressions to inspect the singular impacts of different variables (e.g., demographic variables) on a given result when controlling for different variables in the model (Bauer, 2014; Dubrow, 2008). Main effects may demonstrate noteworthy differences, particularly when factors are entered alone in a regression. People in different social positions will encounter heterogeneous impacts as a result and are affected diversely by variables being tried in regression models. That being said, if researchers adopt intersectionality theory in a quantifiable study, they should not stop at the investigation of main effects but should continue to investigate the multiplicative analysis as well. In the multiplicative analysis, two-way and three-way (or more) intersections of variables are utilized to represent the impacts of classifications on a dependent variable (Bauer, 2014; Dubrow, 2008). To integrate intersectionality, one must allow demographics to converge by using intersections that permit every class of the dependent variable to have its own particular regression coefficient, and hence allow for two-way and three-way intersections, such as the intersection of gender, sexual orientation, and ethnicity (Spierings, 2012). Multiplicativity suggests that categories of social demographics interact and impact outcomes in different manners, which results in a larger range of effects than is found in the additive approach (Veenstra, 2011).

Summary

Audre Lorde (1984) asserts:

> "Differences must not be merely tolerated, but seen as a fund of necessary polarities between which our creativity can spark like a dialectic. Only then does the necessity of interdependency become unthreatening. Only within that interdependency of different strengths, acknowledged and equal, can the power to seek new ways of being in the world generate, as well as the courage and sustenance to act where there are no charters"
>
> (p. III).

The results of this meta-analysis elucidate how quantitative researchers need to deconstruct the whole gender technology methodology so as to reconstruct it with a new vision that is both more representative and more in line with other research and advancement in fields of qualitative research and gender differences. Researchers cannot keep using dated methodologies when researching gender, as it will hinder progress. We need to devise a new representative methodology or one that is more representative of advancement in gender research, advancement in technology, and connections to the world and society. This meta-analysis attempts to show us that we need to ask ourselves a different set of questions, in the hope of eventually finding gender equality and justice. I am not claiming that it will be easy to incorporate all the changes that I am recommending. It may be difficult or even costly to do so. One possible reason behind the low number of quantitative researchers adopting intersectionality is the lack of directives regarding its implementation in a statistical environment (Hankivsky, 2014), especially when investigating the intersections between demographics (Spierings, 2012). Other factors that have hampered the adoption of intersectionality by quantitative scholars are related to issues such as limited survey budgets, information accessibility, sub-level participant numbers as they relate to specific ethnicities or race, for example, and differences in interpretation of intersectional groups in society (Bauer, 2014; Dubrow, 2008; Scott & Siltanen, 2012). Nonetheless, regardless of hidden difficulties in implementing intersectionality in quantitative research, it helps distinguish complex social inequities.

Last but not least, intersectional methods require more than just an analysis of statistical interactions among social groups, and must instead go beyond this to analyze the fundamental and significant impacts of these interactions. It is important to explain the implications of statistical interactions, the techniques accountable for these interactions as well as methods that can be employed to achieve these purposes. Nevertheless, checking for statistical interactions can help immensely when comparing and contrasting demographic variables so long as researchers subsequently embark on interpreting those intersections and to analyze how and why societal inequalities fare in certain contexts.

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APPENDICES

APPENDIX A

Gender and Technology Codebook

Conducting Literature Searches and Identifying Data Sources

Comprehensive literature searches are designed to identify and retrieve primary empirical quantitative studies relevant to the major research question. A variety of international databases within the field of education and technology are to be researched. Below are the results of searches by database.

ERIC Database- First search attempt (not included in study)	**Date**	**Result**
((Gender OR Women) AND (perception OR attitude OR efficacy OR anxiety) AND (DE 'Educational Technology' OR DE 'Asynchronous Communication' OR DE 'Audiovisual Communications' OR DE 'Audiovisual Instruction' OR DE 'Computer Uses in Education' OR DE 'Computer Assisted Instruction' OR DE 'Computer Attitudes' OR DE 'Online Courses' OR DE 'Courseware' OR DE 'Virtual Classrooms' OR DE 'Web Based Instruction' OR DE 'Laptop Computers' OR DE 'Information Technology' OR DE 'Technology Integration' OR DE 'Technology Uses in Education' OR DE 'Handheld Devices' OR DE 'Electronic Equipment' OR DE 'Computer Games' OR DE 'Computer Peripherals' OR DE 'Electronic Learning'))	26/9/14	743

Limiters: Date Published: 20060101-20151231

FINAL RESULTS: 743 records

ERIC Database- Second search attempt (results included in study)	**Date**	**Result**
((DE ‘Gender Differences’ OR DE ‘Gender Issues’) OR (DE ‘Females’ AND DE ‘Males’)) AND ((perception OR attitude OR efficacy OR anxiety OR usage) OR (DE ‘Computer Attitudes’)) AND (DE ‘Educational Technology’ OR DE ‘Asynchronous Communication’ OR DE ‘Audiovisual Communications’ OR DE ‘Audiovisual Instruction’ OR DE ‘Computer Uses in Education’ OR DE ‘Computer Assisted Instruction’ OR DE ‘Online Courses’ OR DE ‘Courseware’ OR DE ‘Virtual Classrooms’ OR DE ‘Web Based Instruction’ OR DE ‘Laptop Computers’ OR DE ‘Information Technology’ OR DE ‘Technology Integration’ OR DE ‘Technology Uses in Education’ OR DE ‘Handheld Devices’ OR DE ‘Electronic Equipment’ OR DE ‘Computer Games’ OR DE ‘Electronic Learning’ OR DE ‘Computer Mediated Communication’ OR DE ‘Computer Peripherals’) Limiters Date Published: 20060101-20151231; Publication Type: Reports - Descriptive, Reports - Evaluative, Reports - Research	3/10/14	545

RESULTS: 569

NOT (‘professional development’ OR ‘teacher training’) = **545 results**

FINAL RESULTS: 545

ERIC Database- Third search attempt (not included)	**Date**	**Result**
((DE ‘Gender Differences’ OR DE ‘Gender Issues’) OR (DE ‘Females’ AND DE ‘Males’))	9/10/14	183
AND		
((DE ‘Perception’ OR DE ‘Preferences’ OR DE ‘Self Efficacy’ OR DE ‘Anxiety’ OR DE ‘Use Studies’ OR DE ‘Computer Attitudes’ OR DE ‘Attitudes’))		
AND		
(DE ‘Educational Technology’ OR DE ‘Asynchronous Communication’ OR DE ‘Audiovisual Communications’ OR DE ‘Audiovisual Instruction’ OR DE ‘Computer Uses in Education’ OR DE ‘Computer Assisted Instruction’ OR DE ‘Online Courses’ OR DE ‘Courseware’ OR DE ‘Virtual Classrooms’ OR DE ‘Web Based Instruction’ OR DE ‘Laptop Computers’ OR DE ‘Information Technology’ OR DE ‘Technology Integration’ OR DE ‘Technology Uses in Education’ OR DE ‘Handheld Devices’ OR DE ‘Electronic Equipment’ OR DE ‘Computer Games’ OR DE ‘Electronic Learning’ OR DE ‘Computer Mediated Communication’ OR DE		

‘Computer Peripherals’)

Limiters

Date Published: 20060101-20141231;

Publication Type: Reports - Descriptive, Reports - Evaluative, Reports - Research

RESULTS: 191

NOT (‘professional development’ OR ‘teacher training’) = **183 results**

FINAL RESULTS: 183

PsycINFO 17/10/14 173

(DE ‘Group Differences’ OR DE ‘Human Sex Differences’ OR DE ‘Sex Roles’) OR (DE ‘Human Females’ AND DE ‘Human Males’)

AND

(perception OR attitude OR efficacy OR anxiety OR usage) OR (DE ‘Computer Anxiety’ OR DE ‘Computer Attitudes’)

AND

(‘Educational Technology’ OR ‘Asynchronous Communication’ OR ‘Audiovisual Communications’ OR ‘Audiovisual Instruction’ OR ‘Computer Uses in Education’ OR ‘Computer Assisted Instruction’ OR ‘Online Courses’ OR ‘Courseware’ OR ‘Virtual Classrooms’ OR ‘Web Based Instruction’ OR ‘Laptop Computers’ OR ‘Information Technology’ OR ‘Technology Integration’ OR ‘Technology Uses in Education’ OR ‘Handheld Devices’ OR ‘Electronic Equipment’ OR ‘Computer Games’ OR ‘Electronic

Learning’ OR ‘Computer Mediated Communication’ OR ‘Computer Peripherals’) NOT (‘teacher training’ OR ‘professional development’)

Limiters - Publication Year: 2006-2015; Methodology: CLINICAL CASE STUDY, EMPIRICAL STUDY, -Experimental Replication, -Followup Study, -Longitudinal Study, -Quantitative Study

RESULTS: 199

AFTER DUPLICATES: 173 results

Communication Abstracts 17/10/14 24

((‘group differences’ OR ‘gender differences’) OR (‘male’ AND ‘female’))

AND

(‘perception*’ OR ‘efficacy’ OR ‘expectations’ OR ‘usage of’ OR ‘computer anxiety’ OR ‘attitudes’)

AND

‘Educational Technology’ OR ‘Asynchronous Communication’ OR ‘Audiovisual Communications’ OR ‘Audiovisual Instruction’ OR ‘Computer Uses in Education’ OR ‘Computer Assisted Instruction’ OR ‘Online Courses’ OR ‘Courseware’ OR ‘Virtual Classrooms’ OR ‘Web Based Instruction’ OR ‘Laptop Computers’ OR ‘Information Technology’ OR ‘Technology Integration’ OR ‘Technology Uses in Education’ OR ‘Handheld Devices’ OR ‘Electronic Equipment’ OR ‘Computer Games’ OR ‘Electronic Learning’ OR ‘Computer Mediated Communication’ OR ‘Computer

Peripherals"

Limiters - Publication Date: 20060101-20151231

RESULTS: 27

AFTER DUPLICATES: 24

Academic Search Complete 17/10/14 11

Academic Search Complete

(DE 'GENDER differences (Psychology)' OR DE 'GENDER differences (Sociology)') OR (DE 'WOMEN' AND DE 'MEN')

AND

(perception OR attitude OR efficacy OR anxiety OR usage) OR (DE 'COMPUTER anxiety' OR DE 'ATTITUDES toward computers' OR DE 'COMPUTER users Attitudes')

AND

'Educational Technology' OR 'Asynchronous Communication' OR 'Audiovisual Communications' OR 'Audiovisual Instruction' OR 'Computer Uses in Education' OR 'Computer Assisted Instruction' OR 'Online Courses' OR 'Courseware' OR 'Virtual Classrooms' OR 'Web Based Instruction' OR 'Laptop Computers' OR 'Information Technology' OR 'Technology Integration' OR 'Technology Uses in Education' OR 'Handheld Devices' OR 'Electronic Equipment' OR 'Computer Games' OR 'Electronic Learning' OR 'Computer Mediated Communication' OR 'Computer Peripherals'

Limiters Published Date: 20060101-20151231

RESULTS: 28

AFTER DUPLICATES: 11 Results

EdITLib 17/10/14 81

‘higher education’ (quantitative OR posttest OR ‘control group’ OR pretest) (perceptions OR attitudes OR usage OR efficacy OR anxiety) ‘gender differences’ from:2006 to:2015

RESULTS: 284

87 Selected for addition to the collection. There were 6 duplicates from previous searches, leaving **81 Records**.

<u>Communication & Mass Media Complete</u> 7/11/14 43

(((Men OR Male* OR Masculin*) AND (Women OR Female* OR Feminin*)) OR (

DE ‘GENDER differences in communication’ OR DE ‘GENDER identity in communication’))

AND

(‘Educational Technolog*’ OR ‘Asynchronous Communication’ OR

‘Audiovisual Communications’ OR ‘Audiovisual Instruction’ OR ‘Computer Uses in Education’ OR ‘Computer Assisted Instruction’ OR ‘Online Courses’ OR ‘Courseware’ OR ‘Web Based Instruction’ OR ‘Laptop Computers’ OR ‘Information Technology’ OR ‘Technology Integration’ OR ‘Technology Uses in Education’ OR ‘Handheld Devices’ OR ‘Electronic Equipment’ OR ‘Computer Games’ OR ‘Electronic Learning’ OR ‘Computer Mediated Communication’ OR ‘Computer Peripherals’ OR computer* OR ‘information technolog*’)

AND

(perception* OR attitude* OR efficacy OR anxiety OR usage)

AND

(AB experiment OR study OR ‘post test’ OR posttest OR pretest OR ‘control group’ OR quantitative*)

Limiters - Published Date: 20060101-20151231

RESULTS: 58 (43 after duplicates removed)

Education Source 7/11/14 11

((DE ‘Gender differences in education’ OR DE ‘Gender differences in education -- Research’ OR DE ‘Gender identity in education’)

OR

((DE ‘Women -- Education’ OR DE ‘Women -- Education (Graduate)’ OR DE ‘Women -- Education (Higher)’ OR DE ‘Women -- Education -- Research’ OR DE ‘Adult education of women’) AND (DE ‘Men -- Education’ OR DE ‘Men in education’ OR DE ‘Male college students’)))

AND

((AB perception* OR attitude* OR efficacy OR anxiety OR usage) OR (DE ‘Computer users -- Attitudes’ OR DE ‘Computers & college students’ OR DE ‘Computer anxiety’ OR DE ‘Self-efficacy in students’))

AND

((‘Educational Technolog*’ OR ‘Asynchronous Communication’ OR ‘Audiovisual Communications’ OR ‘Audiovisual Instruction’ OR ‘Computer Uses in Education’ OR ‘Computer Assisted Instruction’ OR ‘Online Courses’ OR ‘Courseware’ OR ‘Web Based Instruction’ OR ‘Laptop Computers’ OR ‘Information Technology’ OR ‘Technology Integration’ OR ‘Technology Uses in Education’ OR ‘Handheld Devices’ OR ‘Electronic Equipment’ OR ‘Computer Games’ OR ‘Electronic Learning’ OR ‘Computer Mediated Communication’ OR ‘Computer Peripherals’ OR computer* OR ‘information technolog*’)

OR

(DE ‘Media programs (Education)’ OR DE ‘Multimedia systems in education’ OR DE ‘Educational innovations’ OR DE ‘Instructional innovations’ OR DE ‘Instructional systems’ OR DE ‘Virtual classrooms’ OR DE ‘Electronic classrooms’ OR DE ‘Teaching machines’ OR DE ‘Programmed instruction’ OR DE ‘Teaching aids & devices’ OR DE ‘Asynchronous learning’ OR DE ‘Audiovisual education -- Research’ OR DE ‘Education -- Audio-visual aids’ OR DE ‘Audiovisual materials’ OR DE ‘Audiovisual education’ OR DE ‘Computer assisted instruction’ OR DE ‘Intelligent tutoring systems’ OR DE ‘Integrated learning systems’ OR DE ‘Computers in education’ OR DE ‘Educational technology’ OR DE ‘Technology -- Study & teaching (Higher)’ OR DE ‘Information technology -- Study & teaching (Higher)’ OR DE ‘High technology & education’ OR DE ‘Educational technology planning’ OR DE ‘Information technology’ OR DE ‘Computer systems’ OR DE ‘Computer peripherals’))

Limiters - Published Date: 20060101-20151231

RESULTS: 33 (11 after duplicates removed)

Gender Studies Database (EBSCO)	7/11/14	46

((‘gender differences’ OR ‘gender issues’ OR ‘gender identity’) OR ((Men OR Male* OR Masculin*) AND (Women OR Female* OR Feminin*)))

AND

(‘Educational Technolog*’ OR ‘Asynchronous Communication’ OR ‘Audiovisual Communications’ OR ‘Audiovisual Instruction’ OR ‘Computer Uses in Education’ OR ‘Computer Assisted Instruction’ OR ‘Online Courses’ OR ‘Courseware’ OR ‘Web Based Instruction’ OR ‘Laptop Computers’ OR ‘Information Technology’ OR ‘Technology Integration’ OR ‘Technology Uses in Education’ OR ‘Handheld Devices’ OR ‘Electronic Equipment’ OR ‘Computer Games’ OR ‘Electronic Learning’ OR ‘Computer Mediated Communication’ OR ‘Computer Peripherals’ OR computer* OR ‘information technolog*’)

AND

(perception* OR attitude* OR efficacy OR anxiety OR usage)

AND

(AB experiment OR study OR ‘post test’ OR posttest OR pretest OR ‘control group’ OR quantitative*)

Limiters - Date Published: 20060101-20151231

RESULTS: 60 (46 after duplicates)

Google Results 27/11/14 65

‘gender differences’ ‘use of technology’ (higher education or post-secondary or college or university or tertiary)

55,000 results

‘gender differences’ ‘use of technology’

69.900 results

‘gender differences’ perception ICT

178,000 results

‘gender differences’ ‘attitude toward’ ICT

304,000 results

‘gender differences’ ‘computer anxiety’

14,200 results (mainly too old)

85 Resources selected from the above searches (first 5 page of results for each reviewed). There were 20 duplicates from previous searches, leaving a total of 65 records.

<u>ProQuest Dissertations & Theses</u>	7/11/14	65

(all('gender differences' OR 'gender issues' OR 'gender identity') OR (all(Men OR Male* OR Masculin*) AND all(Women OR Female* OR Feminin*)))

AND

(ab('Educational Technolog*' OR 'Asynchronous Communication' OR 'Audiovisual Communications' OR 'Audiovisual Instruction' OR 'Computer Uses in Education' OR 'Computer Assisted Instruction' OR 'Online Courses' OR 'Courseware' OR 'Web Based Instruction' OR 'Laptop Computers' OR 'Information Technology' OR 'Technology Integration' OR 'Technology Uses in Education' OR 'Handheld Devices' OR 'Electronic Equipment' OR 'Computer Games' OR 'Electronic Learning' OR 'Computer Mediated Communication' OR 'Computer Peripherals' OR computer* OR 'information technolog*')

AND ab(perception* OR attitude* OR efficacy OR anxiety OR usage)

AND ab(experiment OR study OR 'post test' OR posttest OR pretest OR 'control group' OR quantitative*)

AND ab(colleg* OR universit* OR 'post secondary' OR tertiary OR 'higher education'))

LIMITED BY : Date: After 31 December 2006

RESULTS: 69 (65 after duplicates)

All Databases	TOTAL **1064**

Study review procedures

1) Code methodological/study features of the finding not the study
2) Each study feature can have only one code. If more than one category is applicable, the coder should select the most important one, or the first one mentioned by the author
3) When applicable, the coder should include notes regarding his/her decisions and indicate where assumptions are being made.
4) Adaptive pedagogies used should be coded separately. For instance, if a program used self-paced activities, culturally responsive teaching and multiple forms of assessment this will be reflected in the coding.
5) The percentages for more, less and equal, should be used consistently for all study features. A significant difference should be calculated according to established standards and not be based on what the author considers to be significant.

The procedure for selecting studies for the meta-analysis will be conducted in two stages. First, all studies identified through literature searches will be screened at the abstract level to determine which full-text documents should be the subject of additional scrutiny. Studies will be retrieved and subjected to a second round of reviews by two coders working independently. The inter-rater reliability for this study will be calculated via Cohen's κ. For each event, we shall subtract the 2 ratings to produce a difference score. We then sum the difference scores for each study. In this second stage the review of full-text documents will lead to decisions whether or not to retain individual studies for further review or analysis.

Basic set of exclusion criteria

DFD – does not fit dimensions

IRR – irrelevant outcomes or population

IED – insufficient empirical data

ISD – insufficient statistical data

IUA – inappropriate unit of analysis

NIB – not institutionally-based –

RA – review articles

MA – meta-analyses

DOA – descriptive or opinion articles

OF- Only females

NS- Not students

- **<u>Study Outcome Types:</u>**
    1. Usage of ICT
    2. Attitudes towards computers as measured by the following outcomes:

        Computer Anxiety

        Computer self-efficacy

        Confidence to use ICT

        Negative attitudes towards ICT

        Positive attitudes towards ICT

        Intention to use ICT

Perceived ease of use

Motivation to use ICT

Perceived Satisfaction

Perceived usefulness of ICT

Mixed perceptions towards ICT

- **Procedure of ES extraction:**

0 – calculated (using reported descriptive statistics)

1 – calculated (using reported inferential statistics. e.g. *t* value or *F* value)

2 – estimated (from partial inferential statistics, e.g. reported *p*-value), but without any assumptions

3 – estimated with some assumptions (for non-significant outcomes p-value for alpha=.05 is divided by 2, or equivalent group size assumed, when only total N is reported, etc.)

4 – ES reported by the authors (only used when nothing else is available)

5- Estimated from other indicators (e.g., correlations)

Based on the articles used in the first study, in most cases, effect sizes will be calculated using sample size, means, and standard deviations for the control and treatment groups. However in the few cases where this information will not available effect sizes will be extracted using sample size, *t* test scores or *f* test scores, and their corresponding *p* values. An effect size calculator from the CSLP (Centre for the Study of Learning and Performance) at Concordia University will be used for these calculations. Once effect sizes for all of the studies are obtained, they will be analyzed using the program Comprehensive Meta-Analysis™ (Borenstein, Hedges, Higgins, & Rothstein, 2015). The overall effect size will be calculated using a fixed effects model or random effects model. Q_T, which is a measure of heterogeneity, will also be calculated. Next, to help explain this variability, *analysis of variance* (ANOVA) is to be conducted on selected study features and moderator variables.

Study Features: Codes for Identification of studies

- **Identification Number:** Each study is identified by a reference number in the bibliography.
- **Author Name:** Each study is identified by first author's last name.
- **N for the experimental group (men)**
- **N for the control group (women)**
- **Total N** (the entire sample size)
- **The effect size** (*d*)
- **Year of Publication**

  2006–2010

  2011–2015

- **Publication type**

  Refereed

  Non-refereed

- **Estimate**

  From descriptives

  Other than descriptives

- **Technology surveyed**

  Specific technology

  General technology

- **Grade level of learners**

University level

School level

Not reported

- **Class Context Surveyed**

Specific class context

General Institution-based context

Not reported

- **Questionnaire**

  Already constructed

  Not reported

  Researcher made

- **Likert**

3 Likerts

4 Likerts

5 Likerts

6 Likerts

7 Likerts

8 Likerts

9 Likerts

Not reported

- **Technology Acceptance Model**

  Used

  Not used

- **Sampling Approach**

Non-probability sampling

Probability sampling

- **Ethnicities**

  measured

  Not measured

- **Socioeconomic Status**

measured

Not measured

- **Intersection of Demographics**

measured

Not measured

- **Research Country**

Name of country

- **Subject Matter**

Arts and Social science

STEM

Not reported

- **Sampling Selection**

Sampling from many

Sampling from one institution

- **Competency**

In favor of men

In favor of women

Not reported

- **Experience**

In favor of men

In favor of women

Not reported

- **Pedagogical Nature of Technology**

Cognitive

Communication

Presentation

Not reported

- **Validity**

Measured

Not measured

- **Reliability**

0.8 and more

Less than 0.8

Not reported

- **Participation Rate**

0–29%

30–59%

60–89%

90–100%

Not reported