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# **GENDER GAP IN INFORMATION TECHNOLOGY (IT) MAJORS: A PRELIMINARY STUDY ON CROSS-CULTURAL PERSPECTIVE**

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## **Abstract**

*Students choose information technology (IT) majors because of three interrelated attributes: personal values, academic reputation, and socio-economical influences. The study proposes that these views explain the gender gap between male and female students in IT majors. By empirically examining these different views through a field survey, our pilot study reveals that Thai female students have higher external locus of control and parental influence, and lower perception of career opportunities. The results may help improve the recruitment strategy and offer ideas to increase female IT students in the United States and Thailand.*

**Keywords:** *attitude, career, collectivism, education, gender, individualism, information technology, pilot study, parental influence, recruitment, Thailand, United States*

# 1 INTRODUCTION

A gender gap exists in choosing Information Technology (IT) majors in many countries (James et al., 2006), including the United States. Although the proportion of female students dominates male students in overall college enrollment (Mather and Adams 2007), the statistical reports have shown fewer woman enrolling in IT majors (Francis, 2007). Our experience indicates that, at least in the United States, Information Technology (IT) is a male-dominated discipline; and this trend is unlikely to change. However, female students generally prefer IT majors in Thailand—swaying the momentum from male to female dominance field of study. Female students in science and engineering do not fare worse than their counterpart in terms of academic performance (Sonnert and Fox, 2012). It is evident that there could be some distinctive social, economical or cultural drivers that inhibit, or perhaps encourage, career decisions among genders.

Furthermore, the nature of how IT is being taught is rapidly changing. As a field of study, IT by nature is interdisciplinary, requiring both of art and science to achieve the best academic and career result. Reflecting on this concept, many IT schools have started to give lower priority to hard sciences by turning to soft sciences, i.e., communication arts, management sciences, sociology, psychology, etc., as compulsory subjects. IT is embedded in other fields of studies as well, making it a supporting discipline for other non-IT majors. This could be the reason why female students are attracted to IT majors; the increment of women in IT majors has become the source of initiation and constructive competition in IT education system and career path that we are experiencing in Thailand.

The changing nature of IT discipline to soft sciences is seemingly evident in Australian universities (Koppi et al., 2010), but the number of female students enrolling in IT majors has not increased drastically, especially in the United States. We are motivated by the need to recruit and retain more female students in IT majors (Eppes, 2010). Our initial pilot study, seeking to empirically examine this gap from a cross-cultural perspective, contributes to the existing knowledge by examining the way in which IT students from two different countries make decisions based on the influence of their personality, social, and cultural upbringing. This preliminary study will yield benefits to college recruiters as they formulate a strategic plan to recruit more female students into IT majors.

This paper is organized in the following manner: in the next section, we present the framework to identify key factors affecting the decision to select IT majors and develop hypotheses comparing these factors from a gender as well as a cross-cultural perspective. Section 3 explains the methodology, data collection, and analyses and shows the obtained results. The insightful discussion is given in Section 4. Finally, the conclusion and future direction of research is provided in the last section.

## 2 PROPOSED FRAMEWORK

This paper proposes the framework that explores the underlying factors impacting student's decision to enroll in IT majors (i.e., computer science, information systems, and networking and telecommunication management). Trauth et al., (2004) propose *individual difference theory*, which includes personality traits, interests, abilities, identity as well as external factors, such as role models, mentors and life experiences. As illustrated in Figure 1, the hypothetical composite factors are of three dimensions: personality traits, attitude toward the IT education, and the socio-economical forces. Figure 1 and Table 1 illustrate the framework and its underlying research variables. The following subsections describe each contributing factor along with its primary attributes:

**2.1 Personality Traits** are a set of factors related to individual personality. The personality traits reflect the internal asset of an individual based on beliefs and values: intrinsic differences that usually remain stable throughout most of one's life. Personality traits have been reported as possible determinants of major selection by educators. We observe six relevant sub-factors deemed most important to the success of IT majors: affinity to computers and information technology, personal innovativeness, locus of control, self-confidence, and self-efficacy. While other factors do not require elaborate interpretations, locus of control, personal innovativeness, and self-efficacy need clarification. *Locus of control* is the degree to which a person expects that an outcome of their

behavior contributes to his/her action (internal locus of control) versus the degree to which a person expects that the outcome is a matter of fate or luck (external locus of control). We argue that the external locus of control of Thai students is stronger than that of students from the United States, an individualistic society where performance or achievement is believed to be a result of one's own doing. *Personal innovativeness* is the willingness of an individual to try out new technologies. Innovative students are likely to enroll in IT majors than those less innovative. *Self-efficacy* is the belief in a person's ability to accomplish a specific outcome. Beyer (2008) finds that women have lower computer self-efficacy than men. Students who believe that they are adept with computers might choose IT majors, while ones with lower self-efficacy and self-confidence may choose a different major.

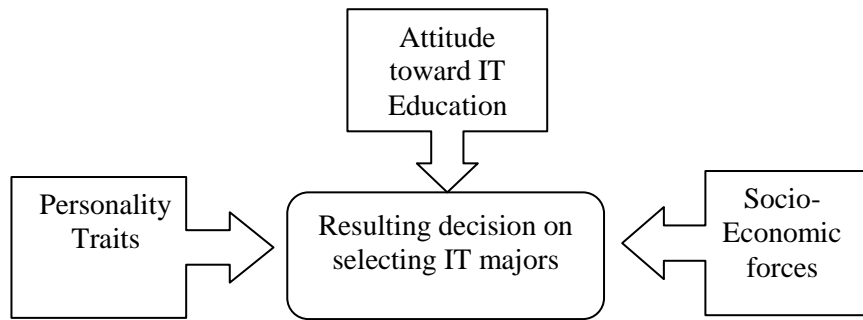


Figure 1 Proposed Framework of Underlying Factors

**2.2 Attitude Toward IT Education** is a set of overall attitudes relevant to IT instructors, IT profession and IT subject matter. For example, the attitude toward the mathematics, science, and computer may drive the students to choose IT major. Zhang (2007) applies the theory of reasoned action, using attitude and subjective norm (a factor relevant to section 2.3) to predict student's intention to choose an information systems major. Having an appropriate attitude leads to the behavioral attention and actual action (Ajzen and Madden, 1986). In our study, attitude has three sub-components. It seems appropriate to assume that students with a positive *attitude toward IT instructors* will increase their willingness to learn the subject matter. *Attitude toward IT profession* also fosters one's belief that having a career in IT is a wise decision. In addition, continuously updating the IT curricula by providing relevant subject matter considered important to employers and job markets will change *attitudes toward IT subject matter*, further fueling the willingness to be active learners. In general, female students have more positive attitudes towards their instructors and subject matters (Beyer, 2006). Therefore, when it comes to choosing a major, a holistic attitudinal view of IT education does play an important role.

Underlying Factors	Sub-Categories of Research Variables
<b>Personality Traits</b>	Affinity to IT
	Innovativeness
	Locus of Control
	Self-confidence
	Self-efficacy
<b>Attitude Toward IT Education</b>	Attitude toward instructor
	Attitude toward IT professionals
	Attitude toward IT subject
<b>Socio-economical Forces</b>	Career Opportunities
	Parental Influence
	Public Image
	Self-image

Table 1 Sub-categories of Research Variables

**2.3 Socio-economic Forces** are external forces that influence career decision. Other than *career opportunities*; *parental influence*, *public image* and *self-image* are typically influenced by cultural and family background (Zhang, 2007; Leppel et al., 2001). In a collective society, the impulse to comply with the public and other influential figures becomes a psychological struggle, pushing one to accept the demand of others and losing one's ego in the process. When choosing a major, Thai students generally make their career decision based on information formed by a reference or respected group, e.g., parents, friends, or social norms. Not complying with the collective whole may increase the possibility of social alienation and apathy. Leppel et al. (2001) finds that female students are more influenced by their fathers' occupation. Furthermore, the behavior of a person can be explained by self-concept (Sirgy, et al., 1997); the need for self-consistency is one of the most important behavioral motives. Kuechler et al. (2009) suggest that the selection of a college major depends on the consistency between self-image and career stereotype. We ration that these external forces are less influential in an individualistic society.

In sum, this study compares the statistical differences among the three interrelated attributes (i.e., personality traits, attitude toward IT education, and socio-economical forces) from a cross-cultural, gender perspective. Therefore, the study proposes the following hypotheses:

H1a: *Personality traits of the United States male students differ from those of female students.*

H1b: *Personality traits of the United States male students differ from those of Thai male students.*

H1c: *Personality traits of the United States male students differ from those of Thai female students.*

H2a: *Attitude toward IT education of the United States male students differs from those of female students.*

H2b: *Attitude toward IT education of the United States male students differs from those of Thai male students.*

H2c: *Attitude toward IT education of the United States male students differs from those of Thai female students.*

H3a: *Socio-economical forces of the United States male students differ from those of female students.*

H3b: *Socio-economical forces of the United States male students differ from those of Thai male students.*

H3c: *Socio-economical forces of the United States male students differ from those of Thai female students.*

To the hypotheses above, the study applied simple planned contrast analysis of variance (ANOVA) by comparing each group to the first group of U.S. male students. The following sections describe the processes of our data collection and statistical analyses along with the results, discussion, and implications.

## **3 METHOD**

### **3.1 Measurements**

To statistically compare our proposed factors, we surveyed literature from psychology, education, and information systems disciplines with the objectives of modifying existing measurements to fit our context. The instruments were classified into three categories: (1) *Personality Traits* (affinity, individual values and personality); (2) *Attitude Toward IT Education* (curricula, subject matters and instructors), (3) *Socio-economical Forces* (career opportunities, family, peers or role models). In order to verify the accuracy and validity of the translated instruments, the survey distributed to Thai respondents had been translated from English to Thai and then from Thai back to English by two independent professional translators. Table 2 shows the three categories of factors along with their contributing attributes and the sources of the original measurements.

Categories	Measurement Construct	Original Source of Instrument
Personality Traits	Affinity to IT	Zaichkowsky (1985)
	Innovativeness	Agarwal and Prasad (1998)
	Locus of Control	Rotter (1966)
	Self-confidence	Wells and Tigert (1971)
	Self-efficacy	Jones (1986)
Attitude Toward IT Education	Attitude toward instructor	Boulding, et al. (1993)
	Attitude toward IT professionals	Rich (1997)
	Attitude toward IT subject	Derbaix (1995)
Socio-economical Forces	Career Opportunities	Kraimer et al. (2010)
	Parental Influence	Hui (1998)
	Public Image	Park and Lessig (1977)
	Self-image	Sirgy, et al. (1997)

Table 2 Category of Research Variables, Measurements and Original Instruments

### 3.2 Data Collection

A paper-based survey was distributed to *local* (native) undergraduate IT students in both countries, using the modified instruments from Table 1. The process of retrofitting the existing instruments was essential to the context of this study. Among the respondents, thirty-three were from the United States (79% male) and seventy-four were from Thailand (62% male). Two respondents did not indicate their gender. Initial count showed that thirty-three (33%) of Thai respondents were freshmen. However, chi-square test showed significant difference in the educational status ( $\chi^2$  (5, n=107)=26.7,  $p < .001$ ), i.e., sophomore, junior, and senior. To achieve a homogeneous comparison, the study eliminated thirty-three freshmen and two respondents of unknown gender from the study. The characteristics of our respondents are shown in Table 3, demonstrate no significant difference in gender, age and educational levels between the two groups of respondents.

	n=70	Age: Mean (s.d.)	Gender: M/F/NA	Status: So/Jr/Sr/NA
United States	31	19.6 (7.8)	24/7	0/8/18/5
Thailand	39	19.7 (7.1)	27/12	7/8/19/5
Test of Homogeneity	n/a	t=.030, p=.976	$\chi^2$ =.59, df=1, p=.444	$\chi^2$ =6.91, df=3, p=.103

Table 3 Respondent Characteristics

### 3.3 Data Analyses

Principle component analyses (PCA) were separately performed on each group to eliminate any redundant or irrelevant measures. We dropped questions that were cross-loaded onto other factors or exposed insignificant factor loadings. The procedure during this stage was iterative in nature, yielding a number of original questions being eliminated for the following variables: affinity to computer/information technology, innovativeness, attitude toward IT instructors, and attitude toward IT professionals. We also modified several questions for the purpose of future data collection. Table 4 depicts the final research variables along with their composite reliability. All research variables fall within acceptable alpha value, except for parental influence ( $\alpha$ =.544).

Categories	Research Variables	Combined Samples $\alpha$	United States		Thailand	
			Male: Mean(sd)	Female: Mean(sd)	Male: Mean(sd)	Female: Mean(sd)
Personality Traits	Affinity to IT	.972	6.48(0.84)	6.55(0.43)	6.03(1.53)	4.40(2.70)
	Innovativeness	.879	5.53(1.18)	5.81(0.81)	5.46(1.14)	5.00(1.30)
	Locus of Control	.673	5.86(0.76)	5.57(0.85)	5.75(0.78)	5.22(1.03)
	Self-confidence	.883	5.21(0.79)	4.36(1.71)	5.12(0.85)	3.96(1.15)
	Self-efficacy	.745	4.74(1.14)	3.67(1.07)	4.73(1.09)	3.47(1.02)
Attitude Toward IT Education	Attitude toward instructor	.889	5.17(1.27)	4.71(1.81)	5.13(1.21)	5.27(1.59)
	Attitude toward IT professionals	.892	5.83(0.90)	6.03(0.87)	5.75(0.89)	5.90(0.77)
	Attitude toward IT subject	.820	3.74(0.54)	3.94(0.94)	3.53(0.78)	3.25(1.27)
Socio-economical Forces	Career Opportunities	.855	4.56(0.63)	4.52(0.50)	4.37(0.80)	3.97(0.83)
	Parental Influence	.544	4.36(1.35)	5.33(1.37)	4.48(1.35)	5.36(1.24)
	Public Image	.744	3.12(0.63)	3.40(0.52)	3.09(0.60)	3.27(0.57)
	Self-image	.766	3.29(0.92)	3.43(0.46)	3.23(0.89)	3.32(0.40)

Table 4 Composite Reliability and Group Means

### 3.4 Results

The study conducted simple planned contrast analysis of variance (ANOVA). Planned contrasts compared different groups of respondents to a de facto IT student group—using the male respondents from the United States as a control group. Levene’s test was used to determine homogeneity of variances across groups, providing an accurate report of t-values. Significant F-ratio, a method to identify mean differences among groups, suggested a divergence in characteristics from the typical male dominated majors. Table 5 provides a direct comparison between the four groups of our respondents.

Categories	Research Variables	Result: Simple Contrast			
		Proposed Hypotheses	F, sig. level	t, sig. level	Hypothesis Testing
Personality Traits	Affinity to IT	H1a	5.301, .002	.291, .774	reject
		H1b		-1.317, .195	reject
		H1c		-2.604, .023	accept
	Innovativeness	H1a	.861, .466	.566, .573	reject
		H1b		-.218, .828	reject
		H1c		-1.288, .202	reject
	Locus of Control	H1a	1.716, .172	-.815, .418	reject
		H1b		-.465, .643	reject
		H1c		-2.183, .003	accept
	Self-confidence	H1a	6.389, .001	-2.152, .035	accept
		H1b		-.340, .735	reject
		H1c		-3.839, .000	accept
	Self-efficacy	H1a	5.474, .002	-2.272, .026	accept
		H1b		-.025, .980	reject
		H1c		-3.263, .002	accept
Attitude Toward IT Education	Attitude toward IT instructors	H2a	.265, .850	-.733, .442	reject
		H2b		-.097, .923	reject
		H2c		.216, .830	reject
	Attitude toward IT professionals	H2a	.226, .878	.543, .589	reject
		H2b		-.314, .755	reject
		H2c		.243, .809	reject

	Attitude toward IT subject matter	H2a H2b H2c	1.393, .253	.543, .603 -1.118, .270 -1.282, .222	reject reject reject
<b>Socio-economical Forces</b>	Career Opportunities	H3a	1.814, .153	-1.102, .919	reject
		H3b		-.907, .368	reject
		H3c		-2.267, .027	<b>accept</b>
	Parental Influence	H3a	2.258, .090	1.696, .095	reject
		H3b		.322, .749	reject
		H3c		2.120, .038	<b>accept</b>
	Public Image	H3a	.644, .577	1.096, .277	reject
		H3b		-.165, .870	reject
		H3c		.705, .483	reject
	Self-image	H3a	.125, .945	.534, .599	reject
		H3b		-.248, .805	reject
		H3c		.125, .901	reject

Table 5 Hypothesis Testing

The results showed partially accepted hypotheses; there was no significant difference among the groups in terms of attitude toward IT education (i.e., attitude toward IT instructors, attitude toward IT professionals, and attitude toward IT subject matter). In addition, male students from both countries showed no significant difference in all of the three categories, suggesting that—in a male-dominated IT discipline—personality traits, attitude toward IT education, and socio-economical forces do not vary across the two distinct cultures. The study found that most of the accepted hypotheses occurred when comparing U.S. male students to Thai female students; both groups significantly differed by affinity to IT, locus of control, self-confidence, self-efficacy, parental influence and career opportunities. *Appendix A* provides additional planned contrasts using Thai-female as a control group—each category is compared to the last category. The statistics based on *female* students from both cultures were not statistically significant, except for affinity to IT ( $t=-2.696, p=.020$ ). The appendix also revealed that male and female students from Thailand differed by self-confidence ( $t= -3.146, p=.006$ ) and self-efficacy ( $t= -3.305, p=.002$ ).

## 4 DISCUSSION AND IMPLICATION

Among these significant factors (see Table 4 and 5), Thai female students scored the lowest in locus of control, self-confidence, and career opportunities. The results do not explain why there are more female IT students in Thailand than in the United States; at least from our samples, there are 15% more female students in Thailand than in the United States. However, by closely observing this phenomenon, low (internal) locus of control also signifies high external locus of control—a belief that one's outcome is influenced by external forces, e.g., fate, luck, faith, society, teachers, parents, etc. Being a submissive, collective society, Thai female students relegate their career decisions to parental guidance—attributing their successes by the assistance of possible external factors—despite of their low perceptions in career opportunities, self-confidence, and self-efficacy in IT majors.

Table 4 and 5 also show that the overall personality traits differentiate the U.S. male from the female in both countries. Not surprisingly, male students from both countries are similar in all categories—a strong evidence showing that male students are attracted to IT majors. The only variable that is consistent among all of the groups is innovativeness, suggesting that IT students are similar in this aspect of personality. Providing various innovative courses supported by emerging technological infrastructures can be an effective recruitment strategy. Additionally, to recruit female students in the United States, educators need to revise a long-term strategy by marketing IT majors in the earlier years of their schooling, as evidenced by their significantly lower self-confidence and self-efficacy when compared to the group of U.S. male students.

The overall attitude toward IT education is consistently similar across the groups. Although these results are not significantly different, Table 4 shows that Thai female students have the lowest attitude toward IT subject matters while the U.S. female students have the lowest attitude toward IT



instructors, contradicting the previous findings (Beyer, 2006). From a recruitment standpoint, U.S. universities need to increase the presence of female IT faculty, who can serve as role models and mentors to female students, thereby changing their attitude toward the instructors—who are typically male. Low attitude toward IT subject matters among Thai female students also suggests that IT courses, especially advanced technical courses, can be applied or made relevant to female audience.

Career opportunities and parental influence are the main socio-economical forces that impact female students in Thailand. Despite the popularity of IT majors among female students in Thailand, they are less aware of their future IT careers when compared to the other groups. Again, parental influence is the main contributing factor of career decisions among female students. As expected, self-image and public image are not based on gender or cultural differences; IT students in general are less susceptible to societal norms and perhaps are less likely to mold themselves to the images of others.

Overall, the obtained results show that the decision made by the students from the United States is more rational and well-informed than that of Thai female; U.S. students have higher IT affinity, locus of control, self-confidence and career path and are less influenced by socio-economical forces. This initial finding may lead to the question about the attrition or success rate of female IT students in Thailand, given high parental influence but low personality trait scores.

## **5 LIMITATIONS**

Researchers must be mindful as they apply our findings to fit their settings. As a pilot study, it suffers from a small sample size, especially when comparing the small groups of female students. In addition, the composite reliability of parental influence is quite low; and therefore, the support of hypothesis H3c remains questionable. A full scale survey may provide better understanding of parental influence on the decision of female IT students. With our constraint, the study also acknowledges that there are various factors contributing to the gap difference. Nevertheless, the study sets a direction for future studies; future research can validate the perception of female students to the actual IT curricula and career opportunity in the United States, as well as comparing the attrition rate of Thai female students pursuing IT education when asserted by external influences.

## **6 CONCLUSION**

Through a proposed framework, the paper seeks to empirically compare male and female students from Thailand and the United States. A planned contrast analysis of variance was used to validate the proposed framework. Using male students from the United States as a control group, the results show the evidence of cultural differences between the control group and Thai female students in the measures related to locus of control, self-confidence, self-efficacy, and parental influence. Male and female students in the United States also differ in self-confidence and self-efficacy. In addition, female students in Thailand have lower IT affinity when compared to the females from the United States. There is no statistical difference between male students from either country. The findings from this pilot study will lead to a full study, possibly gaining insight into the factors affecting career decisions across the two different cultures.

**Acknowledgement:** We would like to thank Miss Chompoonut Watcharinkorn for her with programming and online data collection.

## Appendix A Using Thai-Female as a Control Group

Categories	Research Variables	Simple (Last) Contrasts	t, significant level
Personality Traits	Affinity to IT	U.S. (M) U.S. (F) Thai (M)	-2.604, .023* -2.696, .020* -1.955, .070
	Innovativeness	U.S. (M) U.S. (F) Thai (M)	-1.288, .202 -1.469, .147 -1.136, .260
	Locus of Control	U.S. (M) U.S. (F) Thai (M)	-2.183, .033* -.796, .439 -1.595, .129
	Self-confidence	U.S. (M) U.S. (F) Thai (M)	-3.839, .000* -.721, .484 -3.146, .006*
	Self-efficacy	U.S. (M) U.S. (F) Thai (M)	-3.263, .002* -.373, .710 -3.305, .002*
Attitude Toward IT Education	Attitude toward IT instructors	U.S. (M) U.S. (F) Thai (M)	.216, .830 .859, .394 .229, .766
	Attitude toward IT professionals	U.S. (M) U.S. (F) Thai (M)	.243, .809 -.310, .758 .501, .618
	Attitude toward IT subject matter	U.S. (M) U.S. (F) Thai (M)	-1.282, .222 -1.358, .194 -.713, .487
Socio-economical Forces	Career Opportunities	U.S. (M) U.S. (F) Thai (M)	-2.267, .027* -1.594, .116 -1.577, .120
	Parental Influence	U.S. (M) U.S. (F) Thai (M)	2.120, .038* .044, .965 1.900, .062
	Public Image	U.S. (M) U.S. (F) Thai (M)	.705, .483 -.466, .643 .852, .397
	Self-image	U.S. (M) U.S. (F) Thai (M)	.125, .901 -.521, .612 .439, .664

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