Predictors of Women Entry in STEM Degree Programs in the Philippines

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Women are generally underrepresented in professional careers, especially in the STEM fields. Although observed in most parts of the world, such gender disparity is not true in the Philippines where there are more licensed professional women than men. We explore predictors for career choice among 34 women in engineering and architectural degree programs who were among top academic performers from the Technological Institute of the Philippines, Quezon City. Data have been gathered on intrinsic (self-awareness, educational and technical background) and extrinsic (socio-economic status, perceived career opportunities, and obstacles to domestic roles) variables. Type of secondary school (p<0.001), attitude (p=0.005) and interest ($p=0.024$) emerge as significant predictors accounting for 78% of the variation in the outcome. While the female students perceive that the profession will provide them opportunities for career advancement yet present potential conflict in their domestic roles, these extrinsic factors do not exert significant contribution to their career choice.

Keywords: Career pathing, engineering education, gender issues, academic preparation, college, women in science, STEM, non-tradition fields

1. INTRODUCTION

The barrier-free mobility of engineers across nations, particularly in the ASEAN with the integration of an economic community (or AEC) in December 2014, would mean the rise in demand for more highly-trained licensed professionals and associates in the technical field to meet international competition for trans-boundary projects. More especially, there is also an opportunity for a greater participation of women and cultural minorities in engineering and other technical areas. As a high-status and fast-growing occupation that plays an important role in the global economy (Grossman, 1993), STEM career pathing presents a compelling context in which to conduct this gender and career choice investigation.

There are major advancements for women's role in the traditionally male-dominated job sectors in the Philippines. Based on the 2010 Census on Population and Housing, the latest gender disaggregated data show that women constitute 45.6 million (49.4%) of the 92.3 million Filipinos as of 2010. Around 21.5 million are between ages 15 - 40 years reflecting a young and dynamic female population. With women comprising nearly half of the Philippine social capital, it is interesting to note that, there are already more women who are registered professionals (1.27 million) than men (609 thousand) in 2013. There has been an increasing trend for women to engage in technical jobs (in 2009, 484 million; in 2013, 496 million) whose numbers approach that of men (in 2013, 500 million). Forty-seven % of Filipino government officials and corporate executives are women -- which is one of the highest in the world. These employment and gender statistics (Philippine Statistics Office, 2014) place the Philippines as the 5th among 135 countries in terms narrowing the "gender gap index" – and 1st, tied with Iceland, in terms of having its women realize their education target (Forum, 2014). As technical professions' carry distinct profiles of earnings, status and work demands, the field of engineering, as well as other technical fields, are becoming attractive career

options for women in the Philippines. "Feminization" of non-traditional jobs in Philippine society is expected to have a notable impact on the country's future economic competitiveness.

The main purpose of the study is to evaluate predictors of career choice by women in non-traditional, male-dominated STEM fields. We analyze 36 female 5th-year, graduating students of TIP-QC who were enrolled in the civil, mechanical and electrical engineering; architecture and maritime education programs during the academic year of 2011-2012. This research is limited to understanding the factors that contribute to the career choices of the top academic performers.

2. METHODS

2.1 Research Design and Respondents

This study employed a descriptive survey research design. We surveyed 150 5th year, graduating, single, female students, aged 20-21, and, at the time of the survey, were enrolled in the civil, electrical, mechanical, marine engineering and architectural programs of the Technological Institute of the Philippines in Quezon City during the 2nd semester of SY 2011-2012. From this, we narrowed-down the respondents to 34 students who were among the top 10% of the student body and were eligible to graduate by the end of the term. Majority of the female engineering students came from private high schools (60**%**) and had excellent GPA of $\geq$ 85%. All the students are from lower-middle class families based on their combined family monthly income of USD 445 – 556 (1 USD=45 Philippine pesos). Majority of the students (80%) have parents who have college degrees and are working as professionals, such as engineers, administrative staff, consultant, teachers, and managers.

The study protocol and structured questionnaires were reviewed and approved by the Research & Development Management Office (RDMO) of TIP.

2.2 Survey Instrument and Data Analysis

Using a structured questionnaire, respondents were asked about their entry decisions to the school's engineering program; academic orientation (high school grade point average, type of high school graduated, etc.); family background (family monthly income, parents' educational attainment, parents' occupation, etc.); self-awareness values and motivating factors for their career choice (personal values, perceived career opportunities, and skills); and the values on work-family balance. The data gathered were analyzed with multiple regression (SPSS software version 20.0) and p-values < 0.05 were considered significant.

3. RESULTS AND DISCUSSION

"To have a path of knowledge, a path with a heart made for a joyful journey."
Carlos Castaneda (The Teachings of Don Juan, 1968)

There is no single psycho-sociologic framework explaining why women enter or avoid STEM careers. The intrinsic and extrinsic factors behind career decisions have been widely studied because knowledge on such could provide insights into how educational practices can be modified to help bring-in more women to this largely male-dominated career path (Brown, 2002). In our paper, we initially present a model showing the intrinsic and extrinsic factors affecting career choices as defined in a previous study (Ryan & Deci, 2000) (**Figure 1**). Here, we operationally define intrinsic factor as motivating conditions that may lead to the highest degree of autonomy during informed decisions and wherein the individual derives satisfaction upon the engagement of an activity or decision. The following variables are categorized as intrinsic: attitude, GWA, technical skills, work values and interest. On the other hand, extrinsic factors may cover anything outside of the 'self' that needs to be acquired or controlled to arrive at a decision. We refer here to

career opportunities (salary and advancement in career), socio-economic conditions and family-work demands.

Self-awareness, an intrinsic factor, is viewed as the first stage in developing a career choice - in fact, this is the most significant single determinant from highly technical fields to vocational line of work (Adya & Kaiser, 2005; Gati, Landman, Davidovitch, Asulin-Peretz, & Gadassi, 2010; Mustapha, Zaharim, Long, & Mohd, 2009; Shadbolt & Bunker, 2009; White, 2007). Self-awareness refers to the consciousness of one's personal qualities, the extent of which, are internally integrated and congruent with the way others perceive the individual (Hall, 2004). For example, if a student believes that her academic strength lies in engineering, in corollary, her teachers and parents also expect her to possess engineering-related skills, such acumen in mathematics.

As seen in **Table I**, type of secondary school ($p<0.001$), attitude ($p=0.005$) and interest ($p=0.024$) emerged as the significant predictors out of the 13 variables tested. These variables account for 78% of the variation in the outcome which means that the regression analysis model is accurate. In contrast, extrinsic factors surveyed, such as family-work conflict, career opportunities and socio-economic conditions, all failed to reach statistical significance despite the students acknowledging, based on our personal interviews, that their profession comes with both the opportunities for career advancement and conflict in a woman's domestic roles.

Emerging as a strong predictor is attitude defined as the collective and enduring beliefs, feelings and behavior towards socially-significant objects, groups, and events (Besterfield-Sacre, Atman, & Shuman, 1998). Women who are pragmatic in making decisions and are exploratory may likely pursue careers in STEM. Based on John Holland's theory of vocational choice', women who possess investigative and conventional personality-types are more likely to work in STEM fields (Holland, 1997).

Interest is also a predictor for Filipino women's choice of STEM careers. This psychological state defines the viewpoint of a person having a cognitive and affective component (Boekaerts & Boscolo, 2002; Hidi & Renninger, 2006; Prendergast, 2011). As a motivational variable, interest arises from interactions between the person and his/her objects of interest, and is characterised by increased attention, concentration and affect (Hidi, 2006) in a goal-directed way (Alexander, 2005). The female students in our study show particular curiosity in mathematics and engineering course. Students who have strong interest on a topic tend to pay closer attention to, persist for longer periods of time, and learn more from activities than those with lesser degree of interest (Del Favero, Boscolo, Vidotto, & Vicentini, 2007; Hidi & Harackiewicz, 2000; Renninger, 2009). The interaction of both positive attitudes and interest towards STEM are also associated with retention of women in the field through-out college (Besterfield-Sacre, Atman, & Shuman, 1997).

We found as the strongest predictor is the type of secondary school. This observation is well-supported by studies underscoring the importance of quality of secondary education in STEM. Truly, schools that are proficient in developing students in science and math are more likely to have their students take careers in STEM in college (Evetts, 1993; Santos, 1999). In the Philippines, private secondary schools have generally more mathematics subjects in their curricula than do public schools have. For example, the curriculum in one private high school offers basic and advance subjects in algebra, geometry, statistics, and business math in lower year levels, while higher mathematics subjects, such as trigonometry, analytical geometry and basic calculus, in the senior years. Additionally, teachers in private secondary schools are more active in providing opportunities for students to participate in academic contests, like quiz bees, compared to resource-poor public schools that tend to show little support for such extracurricular endeavors. Of note, a comparative study between public and private secondary education in developing countries, which

included data from the Philippines, found that students in private schools generally outperform their counterparts from public schools on standardized mathematics or language tests (Jimenez & Lockheed, 1995).

The extrinsic factors we analyzed fail to show significance as a career choice predictor. This is in contrast to the findings by some investigators. Ecological model theory suggests that women consider managing multiple roles, obtaining quality childcare, healthy working environments, access to role models and mentors, and competitive salaries in career decision process (Cook, Heppner, & O'Brien, 2002). Changes in economic conditions may have brought women to enter in STEM careers with the expectation that it could provide them with better employment opportunities and salaries (Edwards & Quinter, 2011; Munyingi, 2012; Stebleton, 2007; Valcour & Ladge, 2008; Wataka, 2013). This may not be evident from our respondents who believed that they can compete with men in STEM fields on an equal playing field.

Lastly, family interaction patterns may also play a significant role in the formulation of clear and stable career goals (Hargrove, Creagh, & Burgess, 2002; Taylor, Harris, & Taylor, 2004). Parents have a strong impact on adolescent occupational development (Roach, 2010; Whiston & Keller, 2004). The students agree that work-and-family balance are key issues for women engineers, however this issue did not impede them in making the career decision. Women responsibilities towards their families are not generally perceived as hindrance to career progress in developed countries (Tlaiss & Kauser, 2011).

4. Concluding Remarks

The results indicated that female Filipino students career choice is largely "values-driven'' and the papers describes the extent to which a one's career decisions is driven by personal values (love for family, etc.) shaped by one's life history as opposed to extrinsic factors, such as money, promotion opportunities, etc.

The limitation of the study was that personality, self-efficacy, social support like friends, colleague and teachers were not measured which could give more meaningful prediction of career choices of these women. Our respondents were also limited to the top academic performers and cannot represent a cross-section of Filipino women in the engineering and architectural fields.

From this, we recommend guidance counselors should provide students with information that will help them expand their exploration process (Super, 1980) and a wide range of career information so that they can arrived at sound career decision. Given the importance of high school education to a woman's choice of taking up a STEM career, schools should prepare students early on in their exploration process through career pathing program.

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Table I. Predictors of technical career choice of female college students

Variable	Unstandardize Coefficient β	Standardized Coefficient β	*p*-value
Intrinsic factors			
Type of high school	-1.453	-0.584	<0.001
Attitude	2.576	0.738	0.005
Interest	-2.521	-0.834	0.024
Work values	0.208	0.072	0.100
Technical skills	0.777	0.227	0.465
Extrinsic factors			
Father occupation	-0.814	-0.385	0.286
Mother occupation	0.246	0.144	0.443
Mother educational attainment	0.118	0.214	0.343
Father educational attainment	0.005	0.008	0.954
Family-work conflict	-0.693	-0.241	0.197
Career opportunities	-1.986	-0.663	0.100

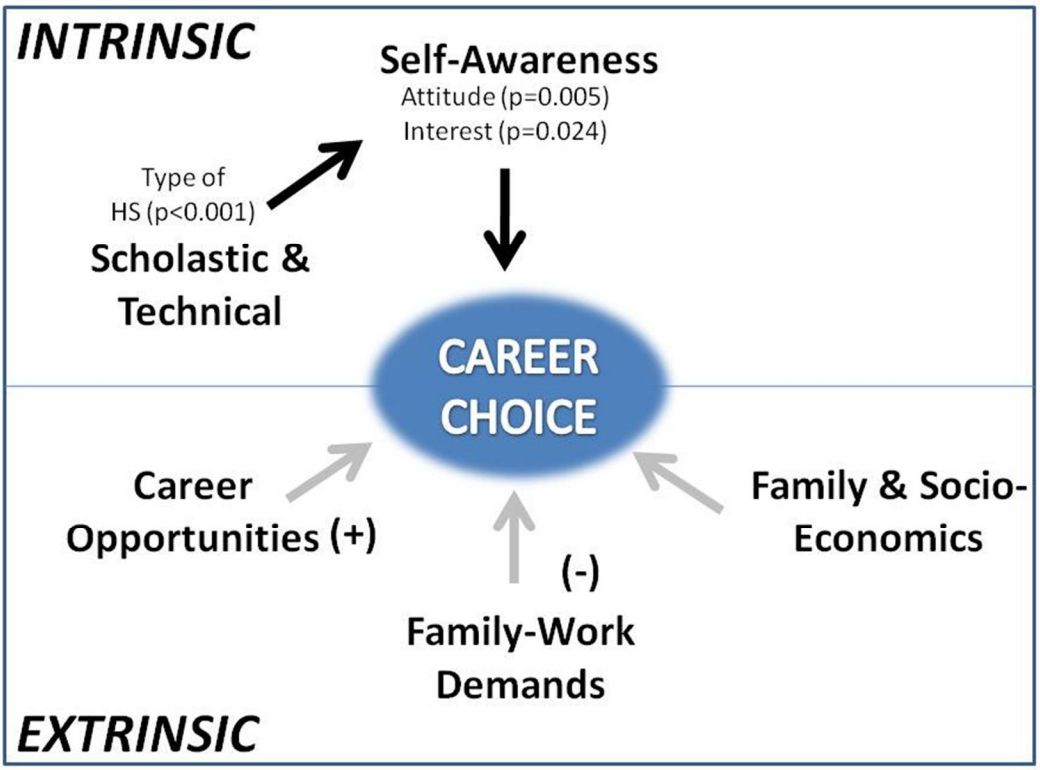

Figure 1. A model for the predictors of career choice among the Filipino female college students in STEM fields. The predictors were either intrinsic or extrinsic, and associations among the variables (black arrows: strong; grey arrows, weak) are indicated. Self-awareness (an intrinsic factor) was affected by the educational/technical background of the student, specifically, the quality of secondary education. Other strong predictors were attitude and interest. These variables describe the student's curiosity to learn new things, their pragmatic approach in decision-making and their aggressiveness in seeking challenging experiences (Holland, 1997). Socio-economic factors and the perceived opportunities for career advancement (high salary and good reputation), which are viewed as positive motivations, and family-work demands (the future challenges faced in balancing family and career), which are viewed as negative motivations, failed to reach statistical significance as career choice predictors among the respondents.