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Post-Graduation Plans of International Science and Engineering Doctoral Students Attending U.S. Universities

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ABSTRACT

This study examines the post-graduation plans of international science and engineering doctoral students at a public research-intensive university, and the extent to which graduate school experiences influence post-graduation plans. The study is grounded in Tinto's Integration Model as well as Berry's Acculturation Model. Study findings highlight the variety of challenges international doctoral students go through such as adapting to a new culture, experiencing English language difficulties, and cultural, social, and academic adjustment barriers. Using survey data collected in 2013-2014, this study reveals the complexity of factors that affect post-graduation plans and need for institutional initiatives to provide socio-cultural and academic support, and recommends changes in immigration policies to sustain the retention of talented international scientists and engineers upon degree completion.

Keywords: doctoral students; science and engineering; graduate school experiences; post-graduation plans

The Institute of International Education (IIE) reported that the number of international students in the United States increased by 8% in 2013/2014 compared to the previous year to a record high of 886,052 (IIE, 2014). According to several studies, in 2025 this number will rise to 8 million (Altbach & Bassett, 2004; Eustace, 2007; Fischer, 2009). Meanwhile, the

number of international graduate students attending U.S. universities in 2014 reached 329,854 representing 37% of all international students in the country (IIE, 2014), and continued to increase through fall 2010, with all of the increase occurring in Science and Engineering (S&E) fields. For instance, about 60% of all international graduate students in the United States in 2010 were enrolled in S&E fields, while only 32% of all international students enrolled in undergraduate programs were in S&E fields (National Science Board, 2012). There is a clear trend to attract large numbers of international students for the graduate S&E programs in the United States.

As more international doctoral students flow into American universities, a marked shift in the demographic composition of the doctoral student population in S&E has also been witnessed. Foreign students on temporary visas earned high proportions of S&E doctorates and dominated in fields like engineering, physics, computer science, and economics. In 2009, they received 57% of doctorates in engineering, 54% in computer science, and 51% in physics (National Science Board, 2012). These statistics have been extremely stable; in 2011, foreign students earned 56% of doctorates in engineering, 51% in computer science, and 44% in physics (National Science Board, 2014).

As described in Allum's (2014) report based on the annual Survey of Graduate Enrollment and Degrees, in the fall of 2013, 56.2% of all foreign graduate students were in engineering, mathematics and computer science, physical and earth sciences, or biological and agricultural sciences. Meanwhile, only 17.6% of U.S. citizen and permanent resident graduate students were enrolled in these fields. This trend has continued unabated showing that the United States receives a considerable number of international graduate students, who are preferentially enrolled in S&E programs.

The flow of scientists and engineers to the developed countries is not surprising. The United States' economic growth and its leading position in the global markets depend heavily on advancements in science, technology, engineering, and mathematics (STEM) fields (Machi, McNeill, Lips, Marshall & Carafano, 2009; National Academy of Sciences, 2006). The growing demand for scientists and engineers is a worldwide phenomenon and many developed countries that cannot meet this increased demand locally, recruit international students and foreign-born highly educated workers who are likely to bring a significant contribution to the higher education system and workplaces. Despite the magnitude of the international S&E doctoral students population, the investment that U.S. higher education institutions make in preparing them, and the potential contributions that these individuals can make to the United States, S&E doctoral students' graduate school experiences and the impact on their post-

graduation plans have been understudied (Ren & Hagedorn, 2012; Mori, 2000). By gaining an understanding of these issues, American higher education institutions could proactively formulate appropriate policies and programs that would benefit international students and in long term would contribute to recruit, train, and retain talented specialists in science and engineering fields.

This paper examines the relationship between post-graduation plans and the graduate school experiences of S&E doctoral students when controlling for demographic factors (age, sex), culture-specific characteristics (race/ethnicity as a proxy for region of origin), field of study, and English language proficiency. Tinto's Integration Model (1993) and Berry's Acculturation Model (1997) offer an appropriate theoretical framework to interpret the challenges faced by international doctoral students in S&E such as adapting to a new culture, experiencing English language difficulties, and adjusting to cultural, social, and academic barriers. The study addresses several research questions:

1. What are the graduate school experiences (i.e., academic, social, cultural) of doctoral students enrolled in S&E programs? Do these experiences vary by demographic factors, culture-specific factors, field of study and English language proficiency?
2. What are students' post-graduation plans and how do they differ by demographic factors, culture-specific factors, and field of study?
3. What is the relationship between post-graduation plans and the graduate school experiences of S&E doctoral students when controlling for demographic factors, culture-specific factors, field of study and English language proficiency?

LITERATURE REVIEW

Social and Culture Adjustment

Research indicates that multiple factors are associated with students' graduate school experience. For international doctoral students, these factors include, but are not limited to age, sex, race/ethnicity, field of study, and English language skills (Duru, 2008; Lee, Park, & Kim, 2009; McClure, 2007; Poyrazli & Lopez, 2007; Poyrazli, Kavanaugh, Baker, & Al-Timimi, 2004). Olaniran (1996) reported that older international students who were less proficient in English appear to have more problems acquiring social skills. Yet another study indicated that younger international doctoral students were much more social and independent (Moffett, 2006). Poyrazli and Lopez (2007) discovered that while older foreign students reported a higher level of perceived discrimination, younger students reported a greater amount of homesickness.

The literature also suggests significant gender differences in international students' sojourn experiences (Fong & Peskin, 1969; Lee, et al., 2009). An early study found that female foreign students reported a greater number of adjustment problems compared with male foreign students (Fong & Peskin, 1969). Contrary to earlier gender research on international students, Ying and Han (2006) more recently found that females were more adaptable than males.

Empirical studies have consistently demonstrated that international students from particular areas of the world have uniquely differing experiences in their adjustment to the United States. For example, students from regions such as Asia, Africa, and Latin America are more likely to face adjustment difficulties in the U.S. due to cultural dissimilarity, and more likely to report racism and discrimination (Yeh & Inose 2003). Trice (2004) also found that international students from African and Middle Eastern countries tended to interact less often with their American peers than those from other world regions.

Many studies point out that language proficiency affects the academic performance of international students (Andrade, 2006; McClure, 2007; Mori, 2000; Yeh & Inose, 2003). Ying (2003) reported that students who had stronger English writing skills had higher academic achievement. Yet another study (Poyrazli, Arbona, Bullington & Pisecco, 2001) reported that graduate students with higher English proficiency experienced fewer academic adjustment problems.

A review of previous literature indicates that international students frequently face challenges in adjusting socially to the university environment in the United States (Duru, 2008; Olivas & Li, 2006). Al-Sharideh and Goe (1998) added that social support is therefore important in ensuring that international students succeed in their new environment. Like other authors, McClure (2007) explained that foreign students often feel lonely in their new environment because they lack family, friends and social network. Further research emphasized that developing social networks that include American students helps international students make successful social adjustment (Lee, 2010).

Other studies suggest that language deficiency affects the social adjustment of international students (Andrade, 2006; Kwon, 2009; Mori, 2000; Poyrazli & Kavanaugh, 2006; Yeh & Inose, 2003). Trice (2007) discovered that international students who reported English language difficulties also experienced poor social adjustment. She also found that students who had difficulties forming relationships with American students were more likely to feel isolated. Although her study used teachers' rather than students' perspectives, her findings were similar to other studies which showed that language proficiency was crucial to the social experience of international students. In addition, Sherry, Thomas, and Wing Hong (2009)

revealed that students who socialized only with other foreign students tended to experience poorer social adjustment.

In addition to demographic and culture-specific adjustment issues, international students go through a significant culture shock (Oberg, 1960). Since then the role of culture has long been studied in relation to acculturation problems. According to Cohen (1968), culture is one of the most important factors influencing the adaptation of individuals. Likewise, international students who come to the U.S. for higher education find themselves in a new cultural environment and experience the overwhelming task of organizing their life to meet the needs and requirements imposed upon them by the new society.

When foreign students move to a new culture for a period of intensive education abroad, they are exposed to a new environment in which they must adapt in order to function effectively (Hechanova-Alampay, Beehr, Christiansen, & Van Horn, 2002). English language proficiency is certainly a first impediment as they may struggle understanding class lectures, completing class assignments, speaking in class or expressing their feelings, and making friends with their American classmates. Zhai (2002) adds that helping international students to successfully adjust to the U.S. culture and higher education system should not be overlooked. Many recognize that the culture shock symptoms add to the challenges experienced by international students coming to study in the United States (Baier, 2005; Poyrazli, Kavanaugh, Baker, & Al-Timimi, 2004; Yeh & Inose (2003).

Post-Graduation Plans

As stated previously, international students encounter some adjustment difficulties during their educational journeys in American universities. It may not be surprising to find that these students could also face difficulties when deciding on their future careers and place of residence (e.g., whether or not they should stay in the United States or go back to their countries after graduation). Despite the significant implications of the stay or leave decision for international graduate students, only a few studies have investigated post-graduation issues and the factors that may influence students' decisions (Finn, 2005; Kim, Bankart, & Isdell, 2010; Shen & Herr, 2004). There have been however, discussions in the literature about the stay rate of international students after graduation from American universities. Many researchers found that the stay rate of foreign-born doctorates varied by country of origin (Finn, 2003) and by field of study (Finn, 2005). For instance, according to Finn (2003), students from Egypt, South Africa, and other African countries have higher stay rates than those from other countries.

Although limited, other studies investigated the career plans of graduate international students. Shen and Herr (2004) investigated the career placement concerns and the needs of international graduate students leaving the U.S. or staying in the country after graduating. They found that although many international students wanted to stay in the U.S. after graduation for greater chances of career advancement, others expressed the intention to return to their country of origin because they recognized the needs for qualified people in the home country. On the other hand, Shen and Herr (2004), and Saravia and Miranda (2004) reported that about half of internationally-born graduate students studying in the U.S. stayed behind even upon completion of their doctoral degree programs.

Contrary to Shen and Herr (2004), and Saravia and Miranda (2004), Finn's (2014) study specifically focused on international doctorate students and not graduate students in general. Finn's (2014) study looked at doctorate recipients since 1991 and revealed high stay rates of doctorate recipients. For instance, the 2011 stay rate for foreign doctorate recipients, including both permanent and temporary visas at graduation, was 68% for those graduating in 2006, and 65% for those graduating in 2001. When only temporary resident visas were included, the stay rates dropped to 66% for those graduating in 2006, and 62% for those graduating in 2001, but were still high. Stay rates depend on discipline and country of citizenship. Finn (2014) concluded that doctorate recipients from disciplines such as economics, agricultural sciences, and social sciences have significantly lower stay rates than those in S&E fields.

THEORETICAL FRAMEWORK

Tinto's (1993) Student Integration Model (SIM) and Berry's (1997) acculturation model serve as the theoretical framework for this study. Given the absence of a comprehensive theory to describe the international doctoral students' experiences and post-graduation plans, using existing undergraduate models of student integration and acculturation as a starting point to frame this study proved to be useful. This study expands the work of Tinto's SIM and contributes to the literature concerning the effects of higher education experiences on post-graduation plans by examining an understudied population: international doctoral students enrolled in S&E fields at a public university.

In his theory, Tinto (1993) posits that the social and academic integration into a higher education institution is the foundation for students' academic success. One of the criticisms of Tinto's theory is that it does not apply to non-traditional students or those underrepresented in higher education (e.g., African-American), so one can question whether it should apply to international students who also experience challenges on campus.

However, Tinto recognized that a student comes to school with an individual background, motivation, academic preparation, study skills, goals and intentions that influence his or her ability to integrate academically and socially into the campus environment. Academic integration concerns the degree to which students interact with faculty, in and outside of the classroom, and the degree to which they become part of the campus' culture. Social integration represents student's interaction with peers (Pascarella & Terenzini, 1991). As Tinto himself suggested, students who do not sufficiently integrate, socially and academically, into the college environment run the risk of being isolated within the campus environment. We argue that tenets of Tinto's theory can be extended to the academic and social experiences of international graduate students.

Likewise, Berry's acculturation model (1997) provides a useful framework to examine the cultural adjustment of international students in the United States. Berry defined acculturation as the social and psychological exchanges that take place when there is continuous interaction between individuals from different cultures. According to Berry (1994), international students who are not fully integrated into the new culture might experience culture shock. Berry explored what happened to individuals when they attempted to adapt to a new culture. He explained that individuals either continued to act in the new culture as they did in the previous one, or tried to change their behavior, values, and beliefs. Berry (2003) noted in his later work that a person exposed to a new culture would undergo a process of change and could adopt various coping strategies. Berry's notion of cultural integration is similar to Tinto's notions of academic and social integration. A person using the integration coping strategy shows an interest in learning and participating in the host culture even if maintaining ties with the native culture. We argue that Tinto's Student Integration Model (1993) and Berry's Acculturation Model (1997) provide a useful framework to study how international doctoral students present on American campuses experience and respond to various academic, social and cultural challenges.

RESEARCH METHOD

Data Collection

This is an empirical study that employs quantitative methods to analyze survey data collected by researchers in 2013-2014. The data were gathered at a large public research university located in the Dallas-Fort Worth Metroplex. The university serves about 35,000 students who attend more than 180 degree programs in 12 different schools and colleges. This university offers 71 masters and 30 doctoral degrees in nine different academic areas that include science and engineering.

In Fall 2013, the university enrolled about 7,500 graduate students (both international and domestic) with almost 2,000 students in the S&E fields. Of these 2,000 S&E graduate students, 74% were in engineering while 26% in science. In engineering, international graduate students ranked first place with over 1,000 students comprising 69% of the total graduate engineering student population. Although the number of international graduate students in science (about 150) is not as high as in engineering, they comprised 27% of the graduate science students, ranking the second largest. Overall, the international graduate students combined to make up more than half (58%) of the entire graduate student population in science and engineering at this university. About 500 of the 1,150 international graduate students in S&E were enrolled in a doctoral program, and they represented the target population for this study.

After examining numerous empirical and theoretical studies on international students and graduate school experience, the authors developed a survey instrument for online administration (Ugwu, 2014). In order to ensure content validity of the questionnaire, the researchers asked a colleague to review and comment on the survey construction, wording format, clarity and question flow as to capture international graduate students' experiences and post-graduation plans. A face-to-face pilot study was then conducted with a few international doctoral students to ensure that the participants were able to understand the questions and complete the survey.

The survey was conducted online. Three sets of emails were sent to the international doctoral students through the Office of International Education and the S&E departments. Emails included an introduction to the study, information about the survey, confidentiality policy, estimated survey completion time, and the online survey's web link. The survey instrument included an informed consent on the first page. Only those who agreed to participate were able to access the survey. IRB approval was received from the university prior to conducting the data collection, research, and reporting.

Participants

An invitation was sent to about 500 international doctoral students at the university in October 2013 and 129 responded by December 2013(a response rate of about 26%). Of the 129 respondents, about 91 students answered the survey and provided relevant information. Of the 129 respondents, 75 students completed answers on the main variables and had valid data for inclusion in the study. Therefore, the study's sample size was *N*=75. The final response rate of 15% was consistent with recent research showing that response rates tend to be lower in online than paper surveys (in their study, Sax, Gilmartin, and Bryant (2003) found online response rates

ranging from 17.1% to 19.8% while paper response rates ranged from 22% to 24%). The research sample consisted of 53.3% Asian, non-Hispanic, 32% White, non-Hispanic, and 14.7% other races. Males accounted for 68% and females 32% of the sample. It included 50.7% and 49.3% of the S&E programs' international students, respectively.

Variables and data analysis

Table 1 presents the study's variables. The main outcomes were students' post-graduation plans and graduate school experiences. We conducted an exploratory factor analysis that served to uncover the relationships between survey items and identify the three hypothesized dimensions of graduate school experience: academic experiences, social involvement, and cultural global values. For each of them, we checked the scale's reliability and obtained high Cronbach's alpha (Table 1) as a measure of internal consistency.

Table 1: Data Variables

Variable	Categories/Variables
Age	3-category variable: 20-25; 26-30; Over 30
Sex	2-category variable: male; female
Race/Ethnicity	3-category variable: White, non-Hispanic; Asian, non-Hispanic; Other -- under-represented minorities (URM)
English language skills	2-category variable: Some difficulties; No difficulties (Overall English skills are computed as an average of speaking, writing, reading scores ranging from 1 to 4. No difficulties category include only those whose overall score equals 4, meaning very good skills)
Field of study	2-category variable: science; engineering
Outcomes	
Graduate School experiences Academic experiences Social involvement Cultural global values	Composite scores (range 1-5) corresponding to the 3 dimensions: Academic (10 items, Cronbach's alpha=.859) Social (13 items, Cronbach's alpha=.941) Cultural (17 items, Cronbach's alpha=.934)
Post-graduation plans	3-category variable: Stay in U.S. to find a job or continue education; Go back to own country- immediately/after working in U.S.; Not sure/ work anywhere in the world

The composite scores of academic, social, and cultural experiences represented new variables employed in the analysis. We also included demographic factors (i.e., age, sex), culture-specific factors (race/ethnicity), English language proficiency, and field of study as independent variables.

The study employed descriptive statistics, bivariate, and multivariate data analyses. Chi-square tests were used to determine the

association among categorical variables and ANOVA tests were used to determine whether cultural, social, and academic experiences differed by the predictive factors. Finally, a Multinomial Logistic Regression (MLR) was conducted to examine the relationship between the main dependent variable (post-graduation plans) and a set of eight predictors (i.e., age, sex, race /ethnicity, field of study, English language skills, and cultural, social, and academic graduate school experiences). The sample size of 75 closely satisfied the MLR's sample size requirement (Schwab, 2002).

RESULTS

Graduate School Experiences

We identified three dimensions of graduate school experiences by following the proposed conceptual framework combining Tinto's Student Integration Model (1993) and Berry's Acculturation Model (1997). As shown in Table 2, descriptive statistics and ANOVA F-tests were used to compare the three scale scores by various individual factors.

Table 2: Graduate school experiences -- Comparative analysis (ANOVA)

Factors	*N*	Academic experiences		Social involvement		Cultural global values	
		M	*p*-value	*M*	*p*-value	*M*	*p*-value
Age							
20-25	20	4.3	.548	2.4	.138	4.5	.022*
26-30	36	4.1		2.0		4.2	
Over 30	19	4.2		2.3		4.1	
Sex							
Male	51	4.2	.480	2.2	.975	4.2	.813
Female	24	4.1		2.2		4.3	
Race/Ethnicity							
Asian, non-Hispanic	40	4.2	.238	2.3	.157	4.2	.433
White, non-Hispanic	24	4.1		2.1		4.3	
Other	11	3.9		1.8		4.4	
Field of Study							
Science	38	4.1	.578	2.1	.588	4.4	.094 [+]
Engineering	37	4.2		2.4		4.2	
English language skills							
No difficulties	32	4.3	.131	2.1	.230	4.4	.014*
Some difficulties	43	4.1		2.3		4.1	
ALL	**75**	**4.2**		**2.2**		**4.3**	

*p < 0.05 [+]p<0.1

First, the overall score for the social involvement dimension (mean=2.2) was low compared to academic experiences (mean=4.2) and cultural values (mean=4.3) dimensions; this showed that international

doctoral students were not interested in campus activities other than ones related to their academic programs. They scored high in terms of cultural global values, broad cultural understanding skills useful to integration in the host country.

Second, there was little variability in the experience scores by the selected factors. Academic experience scores varied from a minimum of 3.9 (Other race) to a maximum of 4.3 (age 20-25; those with very good English skills). Greater variability occurred among the social involvement scores that varied from 1.8 (Other race) to 2.4 (age 20-25; engineering students). Finally, the cultural global values scores varied from 4.1 (age over 30; those experiencing some language difficulties) to 4.5 (age 20-25). ANOVA tests indicated statistically significant differences only for the cultural global value scores by age and English language skills, and to some extent by field of study. The research sample was quite homogeneous in terms of student perceptions of graduate school experiences.

Post-graduation Plans

An association between post-graduation plans and the factors considered in this study is shown in this section through a series of chi-square tests. Table 3 presents the percentages of students with various characteristics within each 'post-graduation plan' category which are compared to the marginal percentages (first column) to identify whether some groups are more or less represented within the respective 'post-graduation plan' category. For instance, although age does not appear to be significantly associated with post-graduation plans, 68% compared to 48% in the sample of the age group 26-30 were among those who either had uncertain plans or intended to go after graduation anywhere in the world. Meanwhile, the older students were more likely to intend to return to their home country after graduation.

Table 3 also shows that men were more likely to plan to return to their country as compared to women who were uncertain or wanted to work anywhere in the world. Similarly, engineering students were likely to plan to return to their country as compared to science students who were uncertain or wanted to go anywhere in the world. The only statistically significant associations with post-graduation plans were obtained for race/ethnicity and English proficiency. Asian students planned to return to their home countries while White students planned to stay in the U.S. and find jobs or continue education. Other race groups had uncertain plans or wanted to go anywhere in the world. Finally, the data show the importance of English proficiency in making post-graduation plans. Planning to stay in the U.S. is clearly determined by having higher levels of English proficiency. Two thirds of those who had no difficulty with English intended to stay after graduation although they represented only 43% of the sample. Meanwhile,

79% and 68% of those who experienced language difficulties planned to either return to their countries or go elsewhere.

Table 3: Post-graduation plans (column %)

	ALL	Stay in U.S. and find a job or continue education	Go back to own country immediately/after working in U.S.	Not sure/work anywhere in the world	Sig. test [a] *p*-value
Age					
20-25	27	28	25	26	.142
26-30	48	44	38	68	
Over 30	25	28	38	5	
Sex					
Male	68	69	75	58	.487
Female	32	31	25	42	
Race/Ethnicity					
Asian, non-Hispanic	53	41	79	42	.006**
White, Non-Hispanic	32	50	8	32	
Other	15	9	13	26	
Field of Study					
Science	51	56	33	63	.107
Engineering	49	44	67	37	
English language skills					.002**
No difficulties	43	66	21	32	
Some difficulties	57	34	79	68	
N	**75**	**32**	**24**	**19**	

**p < 0.01 *p < 0.05 [+]*p*<0.1 [a] Chi-square tests

Modeling post-graduation plans

Table 4 contains the results of a multinomial regression model for post-graduation plans when all variables are included. This table includes odds ratios indicating the likelihood of 'going back to the home country' or 'being not sure/going anywhere in the world' as compared to 'stay in the U.S.' (reference category). As indicated by Nagelkerke's R^2 coefficient, the set of variables used in the model explains 46% of the outcome's variability.

The strongest predictor of the model is English proficiency. As compared to students who had no language problems, those who did have language difficulties were almost 5 times and 7 times more likely to plan to go back to their country or anywhere in the world rather than staying in the U.S. As compared to Asian students, White non-Hispanic students were very unlikely to plan to return to their country rather than stay in the U.S.

Table 4. Multinomial Logistic Regression ('Stay in U.S.'=reference group)

Variables (Reference categories)	Levels	Odds Ratios	
		Go back to home country	Not sure / work anywhere in the world
Age (20-25=ref)	Age 26-30	1.1	2.0
	Age over 30	1.6	.2
Sex (Male=ref)	Female	1.5	2.9
Race (Asian, non-Hispanics=ref)	White, non-Hispanics	.1*	1.0
	Other race	1.1	2.8
Field of study (Engineering=ref)	Science	.6	.8
English Skills (No difficulties = ref)	Some difficulties	4.5*	7.3*
Graduate school experience	Ordinal variable	1.1	1.1
Academic experiences	Ordinal variable	1.2	.6
Social involvement	Ordinal variable	.8	4.0
Cultural global values			
	Likelihood ratio tests Chi-Square		39.463*
	Nagelkerke R^2		.46

*$p < 0.05$ **$p < 0.001$

This study is exploratory, so the following brief discussion of the direction of some relationships does not have statistical evidence for their strengths. Female as compared to male students were more likely to plan either to return to their country of origin or go anywhere in the world rather than stay in the U.S. Science doctoral students were more likely to plan to stay in the U.S. compared to engineering students. Higher levels of cultural values increased by a factor of 4.0 for the likelihood of students planning to go anywhere in the world after graduation rather than staying in the U.S. These observations suggest that academic and social graduate school experiences are not crucial to post-graduation plans.

DISCUSSION AND CONCLUSIONS

Similar to what the literature suggests, the present study also has shown that language is a major problem in the adjustment of international students at this public university. The present study's results indicated that more than half (57%) of the respondents reported some English language problems. Those who were not native English speakers may experience some difficulties in the classrooms or establishing relationships with their American classmates (Galloway & Jenkins, 2005; Lee, 2010; Mori, 2000;

Poyrazli & Grahame 2008; Sherry et al., 2009; Yeh & Inose, 2003). Invariably, these scholars assert that language inadequacies and the lack of close friendships make it difficult, if not impossible, for international students to adapt culturally, academically, and socially.

Researchers have drawn attention to the need to create positive campus climates that support international student adjustment to the academic and social demands of college life (Schweitzer, Morson, & Mather, 2011). International students face a plethora of challenges, including navigating different social and cultural norms, and building friendships, especially when their home cultures and host culture are very distant (Mori, 2000). The present findings have also demonstrated that the international doctoral students shared most of the similar challenges highlighted in the literature, including social and cultural challenges, and language-related difficulties. The presence of challenges is somehow surprising since the doctoral students in this study have acquired academic knowledge and have already spent several years of their lives in school in or out of the United States.

Challenges are not the same for all students. Moffett (2006) found that older international students are less social than younger ones. Poyrazli et al. (2001) suggested that younger international students face less social difficulty and adjust more quickly than older students. This age group may be socially more mobile and interactive than their older peers, thus increasing their potential to integrate and assimilate. The present findings are in agreement with earlier ones showing that age may play a role in cultural experiences. For example, our data revealed that younger international students reported higher cultural values than the older students. Since these students are younger, and still in the exploratory stage of their careers, they are more open to meet with people from different cultures. Although students in this study were not asked to rate their social interactions with American students, one can infer that younger foreign students had more extensive social interactions with the American students. As a result, they are likely to acquire tenets of the new culture. This interaction may help them overcome cultural difficulties or literally break cultural boundaries than these other students, who may be held down by age-acquired change resistance (Huntley, 1993).

The present study's sample was composed of twice as many males as females. Previous research showed that females are underrepresented in the S&E fields (Smart Richman, VanDellen, & Wood, 2011). Women in the U.S. and other developed countries are increasingly entering the traditionally male-dominated fields of study like S&E. For example, the National Science Foundation (2008) reported that the percentage of women in the U.S. who earned doctorates in engineering increased from less than 1% in 1958 to 20% in 2006. The same report also claimed that women are

finally assuming faculty positions in engineering in many universities. Although women still face challenges in S&E, they are coping effectively with their minority status in these fields (Smart Richman, et al., 2011).

The present findings seem to support the statement in the literature (Finn, 2014) that more international students, especially those in S&E, report that they would stay in the U.S. upon graduation instead of returning to their home countries. Finn (2014) concluded that doctorate recipients from other disciplines (such as economics, agricultural sciences, and other social sciences) have significantly lower stay rates than do students in S&E. Not only does this study support prior research showing that 43% of S&E doctorate recipients intend to stay in the U.S., but it also uncovered that race/ethnicity and language skills affect their intent.

Results from multivariate statistical analysis in the present study revealed that White, non-Hispanics students were the least likely to plan returning to their home countries upon degree completion than the other racial groups. A study by Klomegah (2006) strengthens the above assertion. He found that students from the European countries and geographic areas similar to that of the U.S. in terms of language and culture reported less adjustment difficulties than students from other regions. With less adjustment issues as reported by Klomegah (2006), it becomes easier for White, non-Hispanic students to plan to stay in the U.S. after graduation. Lee (2010) similarly believes that individuals from non-Western countries face greater challenges due to the need to negotiate cultural and linguistic differences, so they may prefer to return to their home countries upon graduation.

Other researchers (Trice, 2004; Yeh & Inose, 2003) reported that students from African and Asian countries evidently were more likely to be unsatisfied with their educational experiences, mainly due to issues related to language proficiency and adaptability. The above report is congruent with the findings in this study inferring that Asian, non-Hispanic students were more likely to plan to return to their countries than stay in the U.S. One can also speculate that students who want to stay in the U.S. after graduation may do so because they want to gain employment and improve their economic status and that of their families. Some may want to stay for better job opportunities here in the U.S. especially if an employer is willing to sponsor them to get their permanent resident card.

On the other hand, some international students intentionally expressed their desires to return to their countries after completing their studies. Amongst these students were ones who indicated that they had some language challenges, and thus communication difficulties might have interfered with their studies or their social, academic or cultural adjustment. In line with the preceding argument, Andrade (2006) also identified English language proficiency, culture, support services, and educational background

as influential toward the academic achievement of international students. Additionally, many researchers have investigated how students' English proficiency affects their adjustment (Poyrazli, Arbona, Nora, McPherson, & Pisecco, 2002). Our findings suggest the importance of either recruiting students who already have good English skills or offering them professional support to improve their language proficiency.

With respect to gender, it is likely that more males than females said they would return because of the societal role expected of men as the head of family in their native countries. They might want to find employment to support their families or return to a previous position in their country to fulfill professional obligations after graduation. Some students may have been sponsored financially to travel abroad and study, and they may be obligated to return for contractual obligations. Others may be doing so because of their strong family ties and attachment to their countries (Singaravelu, White, & Bringaze, 2005).

IMPLICATIONS

First, this research study is relevant to higher education policy and practice because it adds to a growing body of research on the graduate school experiences and post-graduation plans for international doctoral students who are enrolled in science and engineering fields of study. Though the generalizability of this study is limited by the small sample size, the findings reinforce the multidimensional aspect of graduate students' experiences. More studies are needed to focus on this population and to understand their challenges, in part so that post-secondary educators can effectively and carefully consider where to invest resources to provide meaningful social, cultural, and academic experiences for international students on their campuses. The present findings complement and extend prior research on social and cultural adjustment (Yeh & Inose, 2003), social integration (Tinto, 1997), and language proficiency (Andrade, 2006; Trice, 2007).

Second, this study is informative for immigration policy makers by showing that about 43% of the international doctoral students in science and engineering would like to stay in the United States after graduation. This draws attention to changes in immigration policies to ensure not just the recruitment but also retention of highly qualified international individuals. For instance, a desirable change in U.S. academic visa issuance policy would be to make our country more accessible and H-1B visas easier to obtain for scientists and engineers who want to work in the U.S. (Douglas & Edelstein, 2009).

Third, this study is relevant to policies and practices that deal with the recruitment, training, and retention of the S&E workforce. American higher education institutions make a laudable effort to recruit international

students in S&E. However, there should be a coordinated effort by government, higher education institutions, and business/industry to retain highly qualified graduates so they can contribute to the American economy (National Association of Foreign Student Advisors, 2010-2011).

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