AC 2011-1413: ATTITUDES TOWARD PURSUING DOCTORAL STUDIES IN ENGINEERING

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Attitudes toward Pursuing Doctoral Studies in Engineering

Abstract

Pursuing a doctoral degree in engineering is often seen as a risky decision. This study investigates the factors for considering enrollment in engineering doctoral programs. Two groups were involved; the first consists of 274 graduate students enrolled in various engineering programs in Lebanon and the second consists of 187 working engineers scattered in several countries around the world working in different social and multicultural settings. Both groups of participants completed a survey investigating the parameters that may impact their decision to pursue a PhD. Based on the Theory of Reasoned Action, the Likert-scaled items aimed to identify the attitudinal and normative factors leading to the intention of enrolling in PhD program. An Independent t-test revealed no significance between students and engineers' intention. An exploratory Factor Analysis provided four factors. Repeated measures ANOVA showed the Professional attitude factor as the most important motivator for participants followed by the Financial attitude, the Subjective norm, and the Social attitude. The findings are discussed and recommendations for future studies are offered.

Introduction

In December 2010, The Economist issued an article titled "The disposable Academic: Why doing a PhD is a waste of time", arguing about an oversupply of PhDs. Between 1998 and 2006, PhD production increased especially in Mexico, Portugal, Italy and Slovakia and the number of granted doctorates in all OECD countries grew by 40%, compared with 22% for America. For instance in Japan, the number of PhDs increased by 46%[1].

Meanwhile, a scarcity of research can be found investigating the intention to pursue a doctoral degree. Churchill and Sanders[2] identified five motivational categories for enrolling in a PhD program: career development, lack of current job satisfaction, personal agenda, research as politics, and drifting in. Recently, Gill and Hoppe[3] suggested five 'motivational profiles' that can lead business professionals to doctoral studies: traditional (entry to academia), advanced entry (professional development), continuing development (professional advancement), transition (entry to a new career), and personal fulfillment (self-enhancement). Gill and Hoppe believe that the first two profiles may occur in early career stages, the second two profiles may occur in mid-to-late career stages, while the personal fulfillment may apply to individuals at any stage of their life.

In the engineering field, Carpinelli, et al.[4] measured undergraduate engineering students' attitudes toward graduate studies and showed that 28% of students don't have the endurance to attend school for at least five years to complete a PhD program, 50% agreed that they would like to complete a Masters degree but not a PhD while only 20% consider pursuing doctoral degree in engineering. The same study showed that 70% of students are considering a graduate degree in a field different from the undergraduate major and 50 % agreed that people should work for a couple of years in their field before considering the graduate studies.

According to the National Center of Educational Statistics in the U.S., the number of obtained engineering doctoral degrees between 1997-98 and 2007-08 rose 35% from 5,996 to 8112 degrees as the third most granted doctoral degree. At the same time, the Council of Graduate Schools[5] in the United States reported a consecutive four years of growth of international students at U.S. graduate schools. China, one of the first countries that send the most graduate students to the U.S., increased by 16% and there was 22% growth from the Middle East region.

Given the observed enrollment increase, this research attempts to predict the factors for considering enrollment in engineering doctoral programs. For the purpose of this research, Lebanon was considered as a case study in the Middle East. Lebanon has one of the best educational systems in the Middle East where higher education institutions constitute a prosperous source of fresh engineers for the Gulf region and it is regarded as an engineering educational center in the Middle East[6].

Theoretical framework

The Theory of Reasoned Action (TRA) helps characterizing human behavior as intentional and rational. This model provides a social psychological framework proved to be useful in explaining several types of behavior[7,8]. It suggests that someone's Behavioral Intention (BI) depends on Attitude (A) and Subjective Norm (SN). This framework will help predicting the intention for holding a doctoral degree in engineering. The Behavioral Intention (BI) defines the objective to enroll a PhD program in the future. Attitude (A) refers to the degree of evaluative affect that an individual associates with enrolling a PhD program. Subjective norm (SN) is participants' perception that people who are significant for them think that s/he should or should not pursue a doctoral degree. Because choosing to become a doctoral student represents a major life decision, the focus of this study is to identify and discuss these factors in terms of attitudes and the subjective norm by using a Likert-scaled survey and to better understand what and how "important" these factors are to students as well as to engineers as part of their career decision-making process.

Method

Participants

For a better understanding of the motives to pursue a PhD in engineering, two populations were targeted: M.S. students and practicing engineers. The first population includes engineering graduate students who are currently enrolled in various engineering programs. Three top ranked universities in Lebanon are targeted: The American University of Beirut (AUB), The Lebanese University (LU), and Balamand University (BU). The American university of Beirut, established in 1849 by American Protestants missionaries, implemented the school of engineering in 1951. The Lebanese university, established in 1951 is the only state operated university, implemented the college of engineering in 1980. The Balamand University, founded by the Greek Orthodox Church in 1988, established the faculty of engineering in 1993[6]. As of the Spring semester 2009, the number of graduate students enrolled in engineering programs in the three selected university was 517. Professors from different disciplines in the targeted universities were contacted and asked to distribute the survey to their students. The survey invites students to voluntary

participate while ensuring them of complete anonymity. The survey was randomly distributed to the targeted population and data collection ended when reaching 274 observations representing over 50% of response rate.

The second population includes practicing engineers working in various engineering fields. Flyers were posted at engineering syndicates' offices inviting engineers, who have been practicing for no more than 5 years, to participate in this study. The flyer explains the objective of the research asking engineers who are willing to participate to contact the authors. Within three months, 214 engineers expressed their interest in the study. An anonymous online survey was sent to the 214 engineers using their email addresses and 187 engineers completed the survey.

Instrumentation

The same instrument was used for both populations. The instrument was based on questionnaires employed in previous studies related to attitudes toward undergraduate and graduate Engineering studies[4,9-11] and enrollment in doctoral programs[12]. Questions included general characteristics such as gender and area of specialization. Participants were asked to indicate if any family member holds a doctoral degree in any field to explore if such factor has any influence on their behavioral intention. Also, participants were asked to rate 18 likert-scaled items on a scale of 5 (1=strongly disagree, 5=strongly agree). The 18 items include: six that were designed to reveal the participants' interests in pursuing a PhD degree, three that were used to reflect the subjective norm, and nine that were used to reflect the participants' attitudes toward enrolling in PhD programs. The 18 Likert-scaled items related to the interests, subjective norm, and attitudes revealed a reliability of 0.91. Descriptive statistics were calculated to obtain the measures of central tendency as well as the measures of variability of each of the identified items.

Statistical analysis and findings

Students participants (*n*=274) were mostly male (74%) with only (26%) female. The sample was distributed among Civil (25%), Mechanical (29%), Electrical (30%), Computer (5%), Management (7%), and others (4%). The other sample including (*n*=187) engineers were mostly male (82%) with only (18%) female. The sample was distributed among Civil (31%), Electrical (28%), Mechanical (24%), Management (8%), Computer (7%), and others (2%).

Interest in pursuing a PhD

Using a 5-point scale, participants were asked to reflect on their personal interest toward pursuing a PhD degree. Table 1 shows both samples' opinions about enrolling in a doctoral program. The first item, that reflects the intention to pursue a PhD, indicates that a high percentage of participants – (42% of students and 37% of engineers) – is interested in pursuing a PhD program.

Looking at the other items, the requirements for a PhD do not represent a barrier for participants. Also, the grades and GRE scores seem to not influence participants' decision with only 15% of students and 8% of engineers believe that their grades may represent a difficulty for the

procedure. Moreover, 69% of participants (same percentage for both students and engineers) strongly favored the idea of working for few years in the field before pursuing a PhD degree. Apparently, PhD programs emphasizes on theoretical aspects rather than practical applications and therefore participants may prefer to acquire some experience before getting committed to post graduate studies.

Interestingly, engineers (62%) find that completing a MBA degree is more beneficial than a doctoral degree. Indeed, these engineers have been working in the field and have had the chance to explore the best for their career prospects. Hence, preferring MBA reflects that engineers are in need of some management-related skills. At the same time, both students (53%) and engineers (44%) believe that they cannot endure 5 years of studies. Such observation is seen as discouraging and may impede the process of enrolling in PhD programs.

Table1: Interest in pursuing PhD

	MS Engineering Students (n=274)			Practicing Engineers (n=187)		
	S. Disagree /Disagree	Neutral	Agree/ S. agree	S Disagree /Disagree	Neutral	Agree/ S. agree
I have the intention to pursue a PhD	28%	30%	42%	37%	26%	37%
The research requirements necessary for a PhD are undesirable	38%	35%	27%	35%	44%	21%
My grades and/or GRE scores might be too low	70%	15%	15%	66%	26%	8%
Engineers should work for a couple of years in their field before pursuing a PhD	15%	16%	69%	14%	17%	69%
I would like to complete a MBA degree but not a PhD in my major	33%	21%	46%	13%	25%	62%
I cannot endure 5 years to complete a PhD	29%	18%	53%	29%	27%	44%

Attitudes and subjective norm to pursue a PhD

In an attempt to predict the attitudes and subjective norm that may contribute to pursuing a PhD, participants were asked to indicate their opinion regarding twelve items on a scale of 5 (Strongly disagree to Strongly agree). Table2 shows the items along with the frequencies for both groups of students and engineers. By examining the frequencies, we can notice that both students and engineers almost agree on all the items that may contribute to their decision for enrolling in a PhD program and there is a consistency in the responses. The majority of participants converged

on four items with 58% of students and 53% of engineers prefer practicing engineering to make money instead of pursuing a PhD, 60% of students and 57% of engineers would like to pursue a PhD to learn more about the field, 55% of students and 52% of engineers would like to pursue a PhD to invent new products, and 54% of students and 51% of engineers would like to pursue a PhD to help others learn.

Table2: Subjective norm and attitudes to pursue a PhD

	MS Engineering Students (n=274)			Practicing Engineers (n=187)		
	S. Disagree /Disagree	Neutral	Agree/ S. agree	S Disagree /Disagree	Neutral	Agree/ S. agree
My professors motivate me to pursue a PhD	24%	46%	28%	31%	38%	31%
My parents motivate me to pursue a PhD	21%	38%	41%	18%	37%	45%
My friends who are seeking a PhD motivate me to pursue a PhD	21%	53%	26%	22%	47%	31%
I prefer practicing engineering to make money instead of pursuing a PhD	23%	19%	**58%**	23%	24%	**53%**
I would like to pursue a PhD because I like teaching in a university	49%	24%	27%	43%	26%	31%
Working as an engineer generates more money than teaching in a University	17%	36%	47%	17%	42%	41%
I would like to pursue a PhD because a professor title is more prestigious	43%	33%	24%	43%	34%	23%
I would like to pursue a PhD to get leadership position in my profession	28%	24%	48%	34%	24%	44%
I would like to pursue a PhD because I like research	34%	28%	38%	27%	27%	46%
I would like to pursue a PhD to learn more about the field	18%	22%	**60%**	16%	27%	**57%**
I would like to pursue a PhD to invent new products	15%	30%	**55%**	15%	33%	**52%**
I would like to pursue a PhD to help others learn	15%	31%	**54%**	15%	34%	**51%**

Do students have different perceptions than engineers?

Before testing the hypotheses that predict the relation between the attitudes, subjective norm, and behavioral intention, the perceptions for both groups (students and engineers) were compared for any difference. An Independent-Samples t-Test was applied and revealed no significance between the two groups for all the factors (p>.05). Although it is surprising to find the strong agreement between both groups regarding PhD enrollment, such finding reveals that engineers had pre-established their perceptions about post graduate studies before they started their professional life, and the career doesn't seem to influence such intention. Another possible explanation is that some engineers may be not satisfied with their current job and they may find in pursuing PhD an alternative for better prospects.

Attitudes and Subjective norm factors

Given the non-significance findings between both samples (274 students and 187 engineers), all the available 461 observations were combined in one set of data in order to investigate the predictors of the Behavioral Intention through the attitudes and the subjective norm. An exploratory Factor Analysis (FA) was employed to the data in order to determine which of the 12 items formed related subsets using principal components extraction, eigenvalues greater than 1.00, and absolute value more than .40. Results of Kaiser-Meyer-Olkin (KMO) measure of sampling for students and engineers samples equal to .843, and Bartlett's test (p<.0001) showed that using FA is appropriate for this study. The FA with the principal components extraction yielded four factors accounting for 64.03% of the total variance. Table 3 shows the rotated factor loadings, which are the correlations between the variable and the factor. For items that were loaded under two factors, only the highest loading was retained. Factor1 reported a variance (σ^2 =35.09%), factor2 (σ^2 =10.35%), factor3 (σ^2 =9.58%), and factor4 (σ^2 =8.99%).

After evaluation of the items loaded under each factor, descriptive names were generated. Factor1 was labeled Professional Attitude (PA), factor2 was labeled Subjective Norm (SN), factor3 was labeled Social Attitude (SA), and factor4 was labeled Financial Attitude (FA). Four new variables were computed based on the mean of the items falling under each factor. In order to obtain the most important factor, one-way repeated measures ANOVA was applied on the four variables for each sample. Repeated measures ANOVA indicated significant differences among the four factor scores, ($F(3, 1380) = 25.66$, $p < .001$). The Professional attitude was shown as the most important for participants with a mean of (μ=3.39) followed by the Financial attitude (μ= 3.43), the Subjective norm (μ= 3.13), and the Social attitude (μ=3.04). The Post Hoc tests using Bonferroni technique indicated significance (p<.0001) except between the Professional and Financial attitudes and between the Social attitude and the Subjective norm which have close values.

Table3: Rotated factor matrix with extraction method: principal component. Rotation method: Varimax with Kaiser Normalization.

Items for Subjective norms and Intentional behavior	Component			
	Professional attitude	Subjective norm	Social attitude	Financial attitude
I would like to pursue a PhD to invent new products	.846			
I would like to pursue a PhD to learn more about the field	.809			
I would like to pursue a PhD because I like research	.649			
My friends who are seeking a PhD motivate me to pursue a PhD		.824		
My professors motivate me to pursue a PhD		.698		
My parents motivate me to pursue a PhD		.695		
I would like to pursue a PhD because a professor title is more prestigious			.851	
I would like to pursue a PhD to get leadership position in my profession			.660	
I would like to pursue a PhD because I like teaching in a university			.589	
I would like to pursue a PhD to help others learn			.579	
Working as an engineer generates more money than teaching in a University				.839
I prefer practicing engineering to make money instead of pursuing a PhD				.704

Conclusion

The statistical analysis showed similar driven attitudes for students and engineers regarding PhD enrollment. Following the Theory of Reasoned Action, the responses' analysis of the survey predicted three attitudes and a subjective norm. The Professional attitude appeared to be the most important contributor to enroll in a PhD program.

Although a good number of participants have a strong intention to pursue post graduate studies, the implications of these findings necessitate further investigations. This research is a case study that included students from one country in the Middle East region. The scarcity of available information about education in general and engineering education in particular in the Arab World was one of the main limitations of this study. Interviews with some students who are enrolled in engineering PhD programs would offer more insights to this research and may provide a more complete picture of PhD students' attitudes as well as their lived experience. Interviews may confirm that the Professional attitude is the main predictor for pursuing PhD

while explaining the influence of the other predictors. Further investigations of other countries of the same region as well as abroad are needed to confirm the findings.

Bibliography

1. The Economist (2010), "The disposable Academic: Why doing a PhD is a waste of time" retrieved from http://www.economist.com/node/17723223.
2. Churchill, H. and Sanders, T.(2007). "*Getting your PhD: An insiders' guide*", Sage Publications.
3. Gill, U. and Hoppe, T. (2009). "The business professional doctorate as an informing channel: A survey and analysis", *International Journal of Doctoral Studies*, Vol.4, pp. 27-57.
4. Carpinelli, J. D., Hirsh, L. S., Kimmel, H., Perna, A. J.and Rockland, R. (2007). A survey to measure undergraduate engineering students'attitudes toward graduate studies, In *1st International Conference on Research in Engineering Education*.
5. CGS (2009). First-time enrollment flat for international graduate students, (Council of Graduate Schools).
6. Chehade, S.M (2001). "Lebanon as an engineering educational center in the Middle East", In B. R. D. Weichert, and R. Schmidt, ed., *Educating the engineer for the 21st century*, Kluwer Academic Publisher.
7. Ajzen , I. and M. Fishbein, M. (1980). "*Understanding attitudes and predicting social behavior"*, Prentice-Hall.
8. Sheppard, B., Hartwick, B. and Warshaw, P.R. (1998)."The theory of reasoned action: A meta-analysis of past research with recommendations for modifications and future research", *Journal of Consumer Research*, Vol.15 No.3, pp. 325-343.
9. J. Hilpert, J. Stump, G., Husman, J., Kim, W, Chung,W.T. and Lee,J. (2009). "Steps toward a sound measure of engineering student attitudes: Pittsburgh enginnering attitudes scale-revised", In *39th ASEE/IEEE Frontiers in Education Conference*.
10. Hirsh, L. S., Gibbons, S. J., Kimmel, H. Rockland R. and Bloom, J. (2003). "High school students' attitudes to and knowledge about engineering", In *33rd ASEE/IEEE Frontiers in Education Conference*.
11. Baytiyeh H. and Naja, M.K. (2010), "Students' enrollment in engineering: Motivational factors", *International Journal of Engineering Education*, Vol.26 No.5, pp. 1192-1199.
12. Stiber, G. (2000). "Characterizing the decision process leading to enrollment in doctoral programs: Theory, application, and practice", *Journal of Marketing for Higher Education*, Vol.10 No.1, pp. 13-26.