



Female Students Representation and Challenges Encountered in Engineering Education

Rina J. Arcigal

College of Engineering, Laguna State Polytechnic University

Abstract— Gender-related challenges in learning technical courses are universal phenomenon. These challenges could restrain female students from achieving their fullest potential. The main focus of this study, therefore, is to examine self-recognized challenges faced by undergraduate female students in pursuing engineering at Laguna State Polytechnic University (LSPU). Quantitative and qualitative methods have been applied in this study. The researchers designed, administered and analyzed a 12-question questioner addressed to female undergraduate students of LSPU. Based on the findings and their analysis, it is apparent, that the female students, indeed, faced numerous gender-related challenges and even irritation from teachers and classmates in studying at LSPU. The study has made recommendations: in order to increase retention and improve learning environment in the field of engineering education, female student Support and Mentoring activities should be designed and incorporated at engineering school.

Keywords— females, gender-related challenges, undergraduate engineering education.

INTRODUCTION

Today, engineering graduates will have to resolve tomorrow problems that is, as never before, progresses much more rapidly, and facing on its way, new, critical challenges. This situation creates significant demand for engineering education to evolve, in order to, successfully train a diverse taskforce of engineers, to deal with these challenges. Importance of recruiting and retention of engineering students, to keep up with workforce demand and technological advancements, have been highlighted in several publications (Nerad & Miller, 2006). Importance of gender-diversity, in engineering profession and engineering education, has also been recognized. Increasing the number of female-students in engineering-education has always been a colossal undertaking. The main-challenges, are based on a remarkable-phenomenon: “when engineering-stereotype and gender-stereotype collide head-to-head”. Engineering-stereotype is whereby engineering perceived as “too hard”, “masculine” and “noisy and dirty” profession, and Gender-stereotype is whereby females perceived as inferior, weak, fragile, dependent, and less-intellectually-capable, than males, species. Furthermore, there are also numerous gender-related challenges in learning of technical courses, which additionally contribute to gender underrepresentation in engineering education. As a result, females are driven away from engineering and technology by the content and climate of technical institutions, referred to as an atmosphere of “dominant masculinity” (Livingstone, 2004; Blickenstaff, 2005).

Cultural Norms of Engineering

Engineering has historically been highlighted as a male dominated field, whereas women in the engineering field have been perceived as invaders (Bix 2004; Slaton 2015). Masculinity as a dominating feature of engineering has



been documented in numerous publications. This norm of engineering is socially constructed and communicated by the dominant group, namely men. Some norms are explicit and easy to identify, while others are more implicit (Cialdini and Trost 1998). Social norm theory has been extensively used in psychology, behavioral health, and counseling to explain the efficacy of perceptions (or misperceptions) about the behavior of individuals in social settings (Perkins and Berkowitz 1986). We use social norm theory to understand how women who choose engineering disciplines with above and below average female representation may have different characteristics explained by the disciplinary differences in engineering.

Climate of Engineering Discipline

Many studies have documented the various factors that contribute to the low representation of women in engineering. For example, the climate of engineering programs, shaped by social norms, often affects students' perceptions of inclusivity and feelings of being supported and accepted. Several studies have found that women were more likely to feel a lack of belonging than men (Seymour and Hewitt 1997; Geisinger and Raman 2013; Camacho et al. 2010; Smith et al. 2012). The ethnographic work of Tonso (2007) revealed the identity ascribed to engineering students, on campus, "served as a constant reminder of who belonged and who did not" (p. 250). In her study, students' mechanisms of belonging emerged in the form of labels used to identify engineers as 'Nerds' (design engineers), 'Academic Achievers' (best performance in core curriculum concepts), and 'Greeks' (social-achievers, concerned more with campus activities), women, despite performing well in their classes were often only recognized as Greeks, whereas "women student engineers who should have belonged among the Nerds became identified as [just] women" (Tonso 2007, p. 254). Being "highly visible as women yet invisible as engineers" is described by Faulkner (2013) as the in/visibility paradox (p. 172), which serves to highlight women as other in this male-dominated discipline

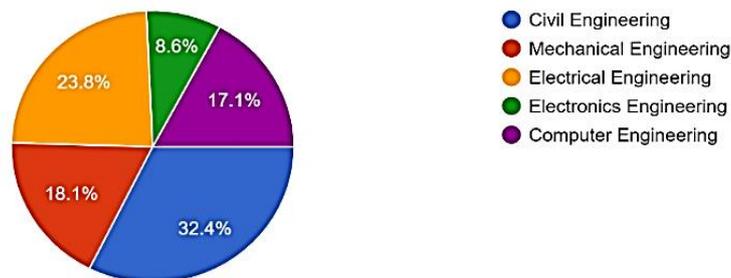
MATERIALS AND METHODS

This study is an explanation from a larger gender-related study. Quantitative and qualitative methods have been applied in this study. The qualitative part for the study also was used as a basis for the quantitative instrument (the questionnaire). Document analysis, another secondary method of data collection, was a necessary aspect of the study. The methods chosen are unique to this particular study. Researchers in qualitative studies look for patterns, and categories for use in other settings, but do not focus on replication. In-depth study of the phenomena (the gender-related challenges in engineering education) was conducted, where secondary sources of reputable information were critically reviewed. In this paper, however, the main focus is on the quantitative analysis of data (the questionnaire). The researchers designed, administered and analyzed a 12-question questioner addressed to female students of engineering of Laguna State Polytechnic University. The questions were based on the review of existing literature and researchers' interest, aimed to collect the information from female students about their educational background and how this motivates them to choose engineering, furthermore it investigates their learning experiences in a male-dominated faculty with an aim of identifying key issues that need to be addressed in order to improve the learning environment of female students, and to attract more female students to engineering. In addition, the study determined the future career aspirations of the female students. The focal point

(single-school, cross-sectional) sample was chosen at random, and was limited to 50 female pupils (about 20% of the population of the female students) at 2014/2015 academic year. Qualitative Data Coding Techniques were applied to interpret the collected data. The survey on demographic information was used strictly for statistical purposes, such as averages of age among other information. All participants were to read an introductory paragraph of the questioner, which guaranteed that their names would not be mentioned anywhere in the study. By acquiring information directly from the female students, some of whom might be experiencing challenges in their education, the authors anticipated to discover exactly what the barriers are, why they are still so prevalent, and how they can be broken down.

Number of students in survey group per Department

Program/Department
105 responses



Female civil engineering students dominates the number of respondents in the survey where 34 (32.4%) out of 234 answered the survey. Apparently, about 26 (23.85%) female electrical engineering students out of 90 included themselves in the survey, followed by mechanical engineering students at 19 (18.1%), computer engineering at 18 ((17.1%), and electronics engineering at 9 (8.60%).

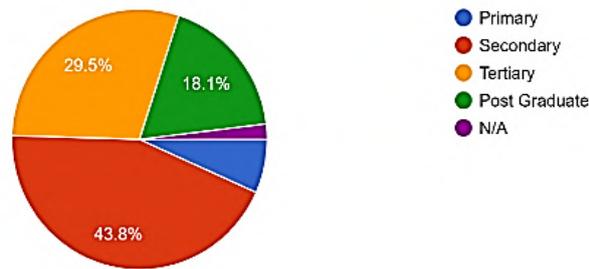
In a study of Marshall, (2007) he found that men and women had similar reasons for enrolling in engineering. They describe being good at math and science in high school and wanting interesting, well-paid professional opportunities in the future. However, women, more often than men, add that they want to become socially responsible engineers, working to solve major problems and making a difference in people's lives, which is consistent with other research showing that women are significantly more likely than their male counterparts to be interested in engineering work that is "socially conscious" (i.e., specializations such as environmental vs. electrical engineering).

Women were also much more likely to look to others such as: teaching assistants, professors, and advisors to affirm, and reaffirm, their confidence. Men did talk about doubting themselves, but they did not necessarily seek reassurance from others. It is found that this search for positive cues carried over into expectations for feedback from supervisors in internships and jobs. For many women engineering students, however, their first encounter with collaboration is to be treated in gender stereotypical ways, mostly by their peers. While some initially

described working in teams positively, many more reported negative experiences. When working with male classmates, for example, they often spoke of being relegated to doing routine managerial and secretarial jobs, and of being excluded from the “real” engineering work.

Parental education level (both your father's and your mother's).

Parental Education Level (Mother)
105 responses



Parental Education Level (Father)
105 responses

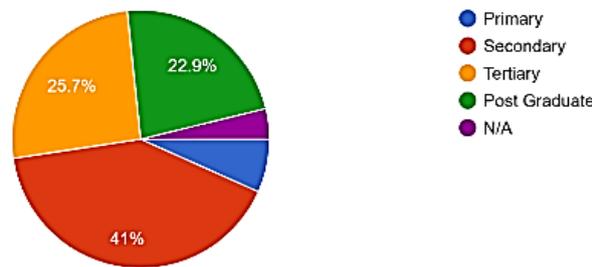


Table 1: Parents Level of Education

Level of Education	Father's level of Education		Mother's Level of Education	
	Frequency	Percentage	Frequency	Percentage
Primary	9	8.6	11	10.4
Secondary	31	29.5	27	25.7
Tertiary	46	43.8	43	41
Post Graduate	19	18.1	24	22.9
No Answer	0	0	0	0
	105	100%	105	100%

In the case of fathers' level of education, it showed that the highest number, (43.8%) were under tertiary or university graduates, while 8.6% completed primary education. For the mothers, secondary education was the highest (25.7%), followed (22.9%) by post graduate education. Overall tertiary level of education was prevalent, giving a highest total for fathers and mothers (84.8%), very closely followed by secondary level of education of 55.2%. Surprisingly, 0% of the respondents did not provide any answer to this question. Children usually very

proud of the achievements of their parents, logically, in this case the authors hypothesize that the parents of these students might have reached even post graduate level of education.

Table 2. Current Parent's Occupation

Occupation	Mother %	Father %	Total	Occupation	Mother %	Father %	Total
Teaching	10	13	28	Farming	23	28	51
Engineering Related	5	8	13	Agriculture (other than farming)	18	7	25
Business	5	9	14	Catering	20	4	24
Office Work	14	3	17	Retired	1	2	3
Banking/Finance	5	2	7	Construction	-	10	10
Administration	1	2	3	No Answer	-	9	9
Public Servant	3	3	6	Total	100	105	

Out of the total students who responded to the question, only 8% had their fathers employed in engineering related field, while 5% had their mothers employed in engineering or related field. It was expected that most female in engineering pursued engineering because their parents are in such engineering and related fields. The rest of the students had their parents employed in non-engineering related fields. For fathers' occupation, the highest number, 28% having their fathers in and the second highest number 15% into farming. They are among the occupations of the father of the respondents. However, the top three occupations by the respondent's mother are also farming, office worker and catering, ranges from 10%- 23%. Again, large fraction of students did not provide any answer for their mothers' occupation, and again, the authors could theorize that the mothers were just staying at home housewives.

Hence from survey reports, we can conclude that parents being in other occupation, especially teaching and related fields and business and related fields somehow had influence on female students pursuing engineering, hence such influence and factors should be look into.

Number of siblings in the Family

Number of Siblings in your Family
105 responses

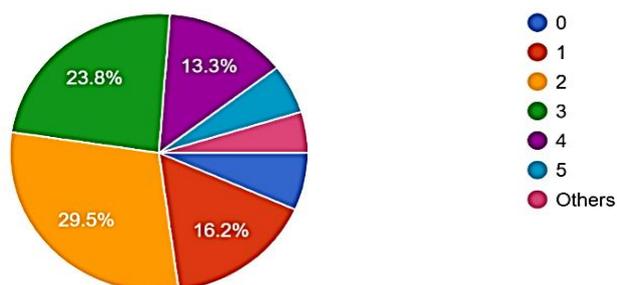


Table 3. Siblings in the Family

Number of Siblings	Frequency	Percentage
0	4	3.60
1	17	16.2
2	31	29.5
3	25	23.8
4	14	13.3
5	8	8.25
Others	6	5.35
Total	105	100%

Concerning the number of siblings comes from the families with 2 siblings had a frequency of 31 or 29.5 % , it shows that the number of the siblings in a family somehow influenced one choice to pursue engineering, where those with siblings between 3 had the second highest number of female students pursue engineering, while as the number of siblings increases beyond 5 the number of those female students who pursued engineering decreases and also as the number of siblings goes below 3 the number of female students who pursue engineering decreases.

Q1. Why did you enter engineering as profession? How did it become an interest for you?

P1. My mother is a civil engineer, she's my role model and motivation. I want to be like her.

P2. Before I was influenced by my cousins but as time goes by, I became much interested because it was challenging to learn about.

P3. I did enter because this is my dream since high school. I like to design houses and like to compute even though I'm really not good on it.

P4. My mom's choice to enter engineering and besides I am fascinated into buildings so I chose civil.

P5. Because this is where I see my future. I am always wondering how structures are build, so my interest to those kind of things made me realize that Engineering is the path I should take.

P6. I entered engineering education because it's my dream to become an engineer and to have that four letter and one dot before my name. I was interested not because of what people say "malaki ang sahod pag engineer", but because of the people around me especially my family who became my inspiration to keep going.

P7. I entered engineering because I am interested in engineering since I was in elementary. It became an interest to me when I have always go with my parents to Manila and I have seen tall buildings that when I started interested in infrastructures.



P8. Because I want to become a Civil Engineer someday. When I was in JHS, we had specialized course in TLE and that is Drafting, and then I enjoyed it.

P9. Aside from the influence of my brother who is an Engineer, I've also been fascinated on buildings especially on how it is built and as time passed by that created an interest to me to take this course.

P10. Because I want to be an engineer someday and make good income to my family. I was interested in how everyday machineries work when I was younger and my parent's kind of push me to pursue this field later on.

P11. I entered engineering education because of the influence of my parents. I did become interested because my parents discuss me on how the machines were fascinating and amazing in the industry.

P12. I entered engineering because of one of my grandfathers. He became one of my inspirations to pursue engineering. Also, I love solving even though I'm not really good at it, especially in analyzing some problems.

P13. When I'm junior high school I decided to pursue the dream of my father and also my dream.

I entered engineering education because of my father. I grew up seeing my father do construction works whenever he is staying in our home.

P14. At first, I entered engineering because my sponsor say so. But now, I want to learn more about machines and its parts & functions. Back then, it was only a choice between Engineering or Medicine program. I just don't see myself in the med field, so I took up Engineering.

P15. Because I want to plan my own house and also make a contribution to the society. It became interested to me by inspiration of the other student and share their story for us to push our goal.

Civil engineering is my first choice course, ever since, it has become my interest because its description really got my curiosity.

P16. I became interested in engineering when I was in junior high school. We had a subject called "Technical Drafting" in which we taught about the structure of houses, their floor plans, and how to use AutoCAD. I became interested in structures after that and went into engineering.

Because this is my dream and I want to expand my computer knowledge

P17. I entered engineering education because I was influenced by my father. It became an interest of me because ever since I was a child, my dad lets me play with his wirings and electrical stuffs.

Because my father is an electrician



P18. My sister is an Electronic Engineer and my Father is a Marine Engineering graduate. It became an interest for me because some of my cousins are also a Civil Engineer, and when they are talking about the course, it makes me feel like I want that as my profession.

P19. Other courses doesn't spark my interest. I was genuinely curious how machines and other stuffs in mechanical engineering works, so it brought me here. I entered engineering education in order to learn more about what interests me most and to learn useful skills in this field.

P20. I was inspired by my uncle who are currently working in CBK because I saw that there is a great opportunity working there. I saw that I will be able to give my family a better future if I will take engineering as a course and after I graduated and received mg license there is a chance that I can work in CBK as well.

P21. I can say that I am pretty good in Math and Science, that's why I took this course. During my first year in college, I was hesitant and thought that Engineering may not be for me, but I fell in love with it eventually, the subjects may be hard but learning and studying Engineering is so fun.

I want to challenge myself and also, I got encouraged by my family.

The survey shows that it become of interest to them because the long to carry out all that entails to engineering for example coming up with technical solutions to the problems and challenges they come across in their real life situation. Ten (10) students (20%) said they enter to engineering because of their good performance in mathematics, physics and chemistry at high school which made them suitable to pursue engineering and formed a strong foundation for them to pursue engineering. This shows that perception of students towards science and mathematics while at high school had great impact when it comes to pursuing engineering. Fifteen (15) students (30%) said their entry to engineering was through the motivation, guidance and inspirations they received from different people for example role-models, parents, relatives, successful engineers in the field already, other siblings, motivational speakers they came across while in high school and inspiration they received while in high school from their former students who had gone before them and become successful in engineering.

The study concludes that motivating people to pursue engineering plays a critical role especially to those who lack confidence to pursue engineering or those who have not made up their minds on the fields to pursue. Three (3) students (6%) considered joining engineering because, the course according to them looked prestigious and they wanted to earn the title of being an Engineer.

One of these students said: "When you tell your parents and relatives that you are planning to study engineering, they, as you would expect, smile with pride and happiness-in their eyes engineering is really a prestigious profession. 3 students (6%) said they had to pursue engineering because it was their dream-career. While two (2) students (4%) joined engineering because they had no option of taking any other courses. Two (2) students (4%) said that they choose engineering as their second option after missing chances to pursue their dreams-careers of medicine.



Q2: Do you find engineering both interesting and comfortable to you? If not, explain why.

1. It interesting at first and not comfortable but for more than 3 years on it I can say that I am more comfortable less interesting.

2. Yes, because this is what I want and I am so happy that i am taking my dream course because some other students don't due to their parent's request.

3. Yes, because if you're interested on that particular course, even if it's hard, you can finish it no matter what.

4. Yes, I find it interesting and comfortable since I like what I am doing but there are times when it gets hard but I know I'll get through of now in this pandemic situation and online class, no because of I can't keep pace with today's pandemic studies. Also, online class isn't effective for me.

4. Not totally. Because my subjects are so hard to understand sometimes. But if I'm going to practice solving and analyze every problem, I can manage it sometimes.

5. It's interesting, but not as comfortable as I would've want it to be. Maybe it's the setup of the classes or I was just not ready for any of it when I enrolled.

6. Yes, I do find engineering interesting but at the same time challenging especially in the midst of the pandemic.

7. Interesting, but not comfortable. Engineering is a tough course. You really need to study hard.

I find it interesting and comfortable even though it's really difficult for me.

8. Yes because I have some background in some construction works and I can solve Math problems.

9. Somehow. Sometimes yes, sometimes no. Because there are topics that I can't really understand especially during synchronous classes.

10. I am in between of these feelings. Engineering still interest me but I am a bit uncomfortable now since the lessons are getting difficult and online classes are a bit burden for me.

11. I find with my friends that help each other even we failed or passed in exams or quizzes.

I find it interesting and comfortable since it is my first choice. That's why I am willing to learn more even though it is difficult.

12. Both, I enjoy being able to know more about engineering but I always get mad on most of the subjects because they are hard to understand and I'm quite slow on understanding or recalling knowledge or information.



13. Sometimes, because I find it very hard but sometimes some lesson is very interesting.

In first no but while I'm learning on it, I'm becoming used to, its enjoying and feels interesting to me

14. It is very interesting, but what makes it uncomfortable is the amount of pressure. There's a lot of concepts and principles that you should understand and know in just a very little amount of time.

15. Yes, engineering really caught my attention and interest to study. But the hard subjects and projects made me uncomfortable in this program. But I knew that it is part of my development, so I will just accept every uncomfortable situations. *may pagsisisi dahil hindi yun yung dream ko at nahhirapan ako mag adjust kasi slow learner ako pero nagugustuhan ko rin naman lalo na kapag mahihirap na mga gagawin pero nagagawan ko ng paraan*

16. Yes, it is interesting because I enjoy learning engineering related topics, but somehow uncomfortable because male dominates the course population.

17. Engineering was interesting for me at first but it was not comfortable for me as expected. It was a tad bit hard, well to be honest it was really hard. There were various of lessons needed to be learn and to be experienced. It was also hard for me to cope to college because of the pandemic. It was hard to keep the burden all to yourself and you had to stay home and be pressured with the people around you.

18. To be honest, it wasn't interesting for me. I am having second thoughts about transferring into another course but the amount of processing time and adjusting will be much more difficult for me. I do often feel comfortable because my friends help me with subjects that I'm not good at. Interesting, but not comfortable i guess

19. At first, not because I am not good at mathematics. But after my first semester, I find it challenging and satisfying to solve a problem without any help. I find it interesting but definitely not "comfortable" for it requires quite the hard work.

20. Yes and No. Yes, because this is what I want and I chose this course. No because there's nothing easy in this world, I want to be an Engineer so I have to work hard to be one.

Q3: Do you like being in engineering field? What do you like most or least about being involved in engineering?

1. I like being in engineering field, I liked learning about the aspects of engineering most especially in computer engineering because its my course. On the other hand, the least are the other subjects that I've never fully understand because it was difficult.

2. Yes, I like how engineers put their best in their certain field of work and afterwards see the result of their hard works. I also believe that engineering is one of the key foundations for having a community progress. Being involved



in engineering made me feel like you must always strive hard to get what you wanted. Not everything can be achieved in just a snap.

3. Yes. Engineering might not easy to understand at first but as you keep going it became interesting and fun as well. I like how broad the knowledge it gives to the students and how it teaches us to become more creative and imaginative.

4. Yes. What I like the most is that, I'm able to strengthen the knowledge I need by learning and keeping focus especially when teachers were discussing. I also like how Engineering department still finds some resources and time to continue the organization's events like CE Festival and Tulong ACADs.

5. I love being in the field of engineering. I love everything about it. I think the very one thing I like the least is the catching up. I didn't have a good fundamental knowledge in mathematics before so, it was really tough to keep advancing without understanding the basics.

6. I do like in engineering. Maybe the least thing I like in this field is presenting about your work but I really need to accept the fact that I should deal with it, because there are times that I will be presentating some projects in front of other people in the future.

7. What i like the most in engineering field is that you have friends that will help you to comprehend or teach to solve the problems when you don't understand some things, The least thing i like is failing

8. Yes and what I liked the most when there is no activity and the least is when our subject teacher discuss the topic of the week so fast and also chemistry and calculus subjects

9. I didn't regret being and choosing to be in engineering field. I like learning stuffs related to machines, and practices involved in it. However, I dislike stuffs like computations and physical activities.

10. Yes. I like the most about engineering is the challenges in exams or quiz and being friends or being comfortable with guys. While the least is the profs.

11. Yes, I do. I would say that engineering is where I find myself, what I am capable of and what I can do more. Ofcourse I like the engineering not just as my educational field but also this is where I find my best of friends.

12. Yes, I like being in engineering field it is so challenging. I like the fact that we can learn and discover many things in this field, we can also discover talents.

13. Yes, I do. I would say that engineering is where I find myself, what I am capable of and what I can do more. Of course I like the engineering not just as my educational field but also this is where I find my best of friends.

14. Yes, I like being in engineering field it is so challenging. I like the fact that we can learn and discover many things in this field, we can also discover talents.



15. Yes, because computer engineers not only knows how to code or program but to respect and spread unity in every department. It feels really cool and its like a dream about being involved in Engineering field

16. Yes I liked it. But I'm being confused right now if engineering is really for me. I like that in engineering I will be able to design and build things to solve problems and achieve practical goals.

17. YES, I ABSOLUTELY LIKE IT HERE. What I like the most is the amount of learnings, and what I like the least is the amount of pressure and the difficulty of the subjects.

18. Yes, I really like. The most I like in engineering is the real life applications of the lessons, and the the way that it can help solve community problems While the least I like is the gender inequality especially during job interviews.

19. I do. What I like the most in being involved in engineering is the fact that the department and the community revolving around it is providing a lot of information for us students to learn, what I like the least is the stereotype that people think all engineering students are math wizards and insanely smart in numerical knowledge.

20. Yes i somewhat like being in the engineering field. I was encouraged to experience laboratory works and chemical experiments but that did not happen. Also liked about how there were other things to be learned about math. My least liked being involved in engineering was physics, statics, thermodynamics and etc. I know it was the most needed topic/ lesson about engineering but i cant seem to be leaning something about the topics there needed to be discussed.

From the report on the survey out of the total respondents, 42 students (84%) like being in engineering and 8 students (16%) don't like being in engineering, some of the likes from the focus group included, the ability to think critically when it comes to getting technical solution to some problems, involvement in a project from start to finish provides satisfaction; they like having an impact; it is challenging; there are many interesting and diverse problems to solve which often require creative thinking; financial benefits provide a sense of success, comfort and reasonable living and certain amount of respect, the dynamic nature of the field due to technological advancements each and every day, and many pinpointed the exciting part of the practical work and fieldwork, especially during industrial attachment, which is compulsory 12 weeks exercise for 3rd and 4th year students in LSPU. They pointed that when one is in engineering field one tends to receive respect from people as one is termed to be tough and clever. Those who dislike the field, gave some dislikes concerning engineering, for example some say it is a dirty field since it entails working with hands, some dislike the perception people have for female in engineering now that the field is perceived as a male field and others do not like the toughness and complexity of engineering profession.

Q4: Do you think curriculum for engineering courses favor both genders equally?

1. Yes I think It favor both gender equally since there are already some female engineers nowadays and I think we should not let our gender hindrance our dreams



2. Yes, engineering favor both genders since it give every engineering students the chance to be able to learn.

3. For now, yes since I'm just a first year college student and don't have an actual experience of things because we are having online class

4. Yes, I believe that practically anything that males can accomplish, women can do as well.

Yes, i think so and it have to because being an Computer Engineer doesn't need to know or choose what gender you are but if you have skills and want to learn for it, you should be a successful computer engineer.

5. Yes. In engineering, regardless of your gender, you will be treated equally. The workload for men and women are the same. Men won't look down on you just because you are female, sometimes iaadmire ka pa nila.

6. In my opinion there's a gender equality in engineering course but in work of engineering there is no equally because boys is in the field and girls is in the office

7. I think yes, especially when it comes to choosing between ROTC and CWTS because it gives the individual a freedom to choose what will be comfortable or suitable for them.

8. There is still this stigma that this course is mainly for men but I can see the times changing just by seeing the amount of women in our class.

9. At first when we heard engineering courses always male gender dominated with it because a lot of people always says that it is for men. I think we shouldn't close our perception with this, because we as women are great thinkers and great for solving problems not only in exam, relationships etc but we are the one who provide the best decisions in our family.

10. Definitely yes! yes all of us male or female has an equally opportunities when it comes to the task that they do for the students

Q5: Do you think females are treated differently in engineering education?

1. Yes, because they thought that female can't do better than male students.

2. I hope not. Based on our interviewer's story before classes started, the females in her class do the same as the males do. Sometimes even the males pay the females to do some work for them. So, I really can't say for sure females are treated differently.

3. Yes, for we are treated like boys. People always say that engineering is for male only, thought when it comes to learning, there is equal treatment.

4. *In my experience as an engineering student, we are treated fairly. I haven't experienced unequal treatment from my classmates nor my professors.*

5. *I think males, females and non-binary genders are treated differently in all sectors of education, the world is not as fair as everybody wants it to be.*

6. *If pertaining to the professors, I think both genders are receiving the same treatment. But the challenge here in Mechanical Engineering knowing that male dominates the population, is how females cope up with this type of environment, because in high school we are used to equal and balance number of both genders.*

7. *Some male professors tend to act differently on female students. Some maybe a little flirtatious in private messages, not just me but with my other female friend but I want them to have the anonymity until the day they are comfortable to talk it out to other people.*

8. *As I can remember when there is face to face in our school there is no such thing females are treated differently in engineering department. Because women are treated equally in engineering education.*

9. *Thankfully I have not experienced it in our university, so I don't think we are treated differently here. But I can't speak for the female students in other universities.*

10. *In past years yes it has treated differently in females they say that females cannot do it, but as the years goes by all females prove that females can do everything even in the males can do.*

When it comes to educations, I think it's not because everyone treated equally. And it's in the student if he/she performed and studied well because that's in his/her part to do.

Out of those who agreed that female where being treated differently, 3 students (6%) said they were being treated differently by their fellow male-counterparts who mostly consider them as the weaker objects when it comes to engineering. 6 students (12%) responded that the lectures treated them differently either positively or negatively, some lectures kept on encouraging females, being the rare species, to work hard, on the other hand some lectures discouraged female students and at times even make sexist comments which make ladies feel that their dignity is lowered. In addition, female students said, that most of the times they being referred to as Miss "so &so", whereas the male students are typically referred to on a first name basis. 2 students (4%) respondents said technicians in the laboratories treat female differently during practical lessons where some time females were being exempted from some work just on the fact that they are female and they do not have capability to handle some of the practical work, or even worse that they can spoil equipment. Three students (6%) said that some lecturers and technicians tried to suggest to them (masqueraded as a joke) an exchange of increased marks for a sexual favor. Although this had never materialized, the mere fact of this kind of offensive suggestions left some shocking memories and disgust (as affected students revealed).



Q6: Do you think the field of engineering is a field for both male and female students? Why or why not?

1. Yes. It is your choice in the first place whether you think it fits you as a woman or not, you wouldn't enter engineering if does not anyways

2. Yes. We lived in a world where everyone must be treated equally. Engineering is not ONLY for male, neither for female only. Your gender won't dictate the field you should choose. If you're a female, go for engineering. If you're a male, go for it too. Follow your dreams, pursue it without any hesitations.

3. Yes. Because every student has the right to choose the program and course they want. For me it doesn't matter whether you're a female or male as long as you are eager to learn and be part of the engineering field you wanted. Both female and male students must be treated equally especially in engineering field and must be given a chance to choose and prove themselves.

4. Yes, like I said nowadays gender is not a big deal anymore the important thing is that we can cope up with the work we are doing.

5. Yes, for me women can do anything men can do, and a man can do anything a woman can do. I think both male and female students can do better in Engineering field. Because there's no gender in taking Engineering course.

6. Yes, because pursuing your dream doesn't have to require what gender of students should pass. For me, as long as you are happy, capable and enjoying the course you are into, both genders are included and suitable even in engineering field.

7. Yes i do think engineering is a field for both male and female students because i have seen so many graduated engineers that are female and they seem to enjoyed it.

8. Yes. We are in the era of constant development and change, and that is where the creative minds of engineers come in handy. I think both male and female students have their own potential to contribute to that change and make everyone's living a little better.

Yes, there were chances that female engineering student can outran male students.

9. Yes. Engineering field requires management, decision making, designing, dealing with people and solving problems. I think everyone can do it. The work that requires strength can be done by laborers and not by the engineers.

10. Yes, because as long as the students can understand and apply the lessons, it is good regardless of the gender. Strength of male is just the bonus factor for them. Not because the majority of students is male it doesn't mean that the said field is just for them.



11. Yes, engineering is a field that can cater both male and female. For me, gender has got nothing to do with engineering education since the basis will still be the ability and skills that can be seen in the field.

12. Yes. No matter what the person's gender is, we are capable of doing everything. It's not based on gender but on how we want to pursue something. The important thing is that we are persistent in achieving our goals.

13. Yes, because both women and men are capable of. We can see that engineering is not exclusively for men because there are many women who have achieved success in this field.

Yes, because it is possible also for female in this field.

Yes, because Engineering is for all genders.

14. Of course yes, both female and male have their different talents. Both gender have their own advantages that they can used to contribute in the modern world and technology.

15. Yes, because women are capable of performing tasks that males are capable of performing. We all have diverse skills, and I believe that every profession does not need the employment of only one gender.

From the survey report all participants, 50 students (100%) students, confirmed that engineering field was meant for both male and females. They pointed out on some strong opinions that both genders: had equal capability, were being subjected to the same curriculum, received equal basic education, both are equally tough and important and also they said no specific career was designated for any gender. Subject to this report, in the opinion of all respondents, engineering is a field is to be considered appropriate for both genders: males and females.

Q7: Do you think female in engineering perform equally well as the male counterparts pursuing the same engineering courses?

1. Yes, of course. We must not underestimate what female can do, not only in engineering but to any other field. Your performance will never be based on your gender. I believe that whatever a male can do in this field, it can also be done by a female.

2. I think yes since both gender studied the same curriculum and both gender can both learn things from the field.

3. Yes, I do 'nt think that it is the gender that affects most engineering students. On my encounters, its mostly the mental stability of the other students and their time management.

4. Yes, I've seen some female engineering students thriving equally same as the male students.

5. Nope, if you are using the same way as the boys but can do better if you made a comfortable way of doing the task



6. Yes. Genders doesn't mean anything in engineering field. However, skills, knowledge, determination, and capability of students does.

7. Yes, gender is never a hindrance in pursuing one's dream. As long as determination is there, one can surely perform regardless of his sexual orientation/gender.

8. Just by observing our class, I don't see gender as a determining factor of how well someone performs. Some women in my class perform better than other men and some men in my class perform better than other women.

9. In my previous observe they not treat equally the female engineers in terms in engineering field they say that females cannot do it but as I said female engineer can do everything as long as she loves what she's doing.

Q8: Do you think male and female students treat each other respectfully in engineering education classes?

1. So far, I've seen our uppers and even in our section treat each other with respect so I think most of engineering students do.

2. Yes, they do respect the female even though they were in the field where men dominated.

In our class yes, but i have no idea in different major or classes

3. Yes, like me as a student in computer engineer, I'm treated respectfully

4. Yes, we respect each other in our class, but I'm not sure about the situation in other classes. Gender is not an issue sa amin.

5. No. Because some male students think that they are more dominant than females because of there gender and role differences.

6. In our section, males and females are treating each other respectfully, you only loose that respect if your attitude is disrespectful. So as far as I am aware of, yes.

7. Yes. Based on my experience, there are gentlemen and both male and female respects and helps each other.

8. For my section, we have a circle of friends. The other one is Good and the other side is slightly good. I think No. because everytime na nasagot ako sa class is nag uusap sila sa gc nila like ang pabida ko daw sa class. Nalalaman ko dahil may nag screenshot ng convo nila. But I ignored them! Dahil hindi mawawala ang ganyan. Tuloy parin ang buhay!

9. Yes they, treat equally based on my experience as an ECE student



Some who disagreed that women are treated with respect said at times the female themselves are the cause of the disrespect they are facing. Some ladies carry themselves in such a manner that that they do not deserve respect from anyone ranging from their fellow female- to their male- counterparts (example indicated as some females exposing their assets in rather revealing outfits in the classroom environment, which can cause some diversion of attention from the lecturer to them; also, male students and even lecturers can get an erroneous perception of the ladies morals, leading to disrespectful signs and remarks).

Q9. Do you usually choose males or females to be in your groups when you are doing group projects in technology education classes?

1. *Not at all. But mostly I want to be in a group that have a determined members and a responsible leader.*
2. *We have no choice actually, it usually comes in alphabetical*
3. *No, I am contented with both*
4. *Not really. I don't choose my groupmates based on whether they are male or female, I choose them based on what they can do and share in the group. It's always based on their dedication, not their gender.*
5. *For me I choose my friends which is compose of both gender.*
6. *Yes, but sometimes our professors chooses who will be in the group.*
7. *I usually choose both male and female students in my group because there are things that female students can do like researching and for male students, they can encode.*
8. *Most of our groups are usually at random and I also want to collaborate with everyone for a wider perspective on our group projects.*
9. *No, I don't really care whether my groupmates will be men or women.*
10. *I choose both male and female.*
11. *We stick with our friends as possible, our group is mixed of both gender*
12. *I choose someone who can comply and do the task regardless of their gender.*
13. *In group activities, sometimes male students have more counts than female.*
14. *No, everyone have their own unique capabilities and knowledge that'll be helpful in group projects.*



14. *I would say yes because I particularly pick my girl friends because I believe in women power.*
15. *No. I believe that both gender can help and contribute.*
16. *I don't have to choose because all of us want to learn*
17. *I don't get to pick the members since our lecturer divides us into groups, and because many of my classmates were male, there's a good likelihood that my groupmates will be male as well, but that's alright.*
18. *We have more males in our block so in groupings, mas marami talaga yung makakagroup mo na lalaki.*
19. *Whenever I chose my group mates, I don't judge them by gender. I chose them randomly and based on their skills and intelligence.*
20. *I don't choose groupmates i believe in everyone's ability*
21. *I choose who I think would do things with me in equal effort if not better.*
22. *or being only one girl in a group because it can enhance your skills on communicating others and keep your confidence rise.*
23. *Yes, I usually choose either males or females because they can do it.*
24. *Our groups are randomly chosen. I'll also choose randomly, just to be fair.*
- They said that both gender is a good mix when it comes contribution of ideas, since all of them are subjected to the same curriculum then either genders can fit comfortably to the groups as long as one is committed to working and they also had a strong opinion that working with either gender was comfortable to them.

Out of the total who responded to the question, 7 students (15.22%) of the respondents said that they prefer only male counterparts in a class project group, this is because they say male are brighter than female.

Male have better understanding when it comes to technical aspect of the course, male is hardworking and this group of respondents also pointed out that a class group with more than one female tends to divert the agenda of the group project to talking of social life issues.

Out of the total students who responded, 2 students (4.35%) are for the opinion that they can choose only female students to their class project groups because they feel comfortable working with close female friends, also that it is easier and convenient to work with same gender when it comes to group project.



Q 10: Do you think there are specific barriers that keep females and women from pursuing careers in engineering? If yes, what are some of the barriers?

1. Yes, because people always think engineering is for men only, engineering-stereotype is whereby engineering perceive as "too hard", "masculine", " and nosy and dirty while female perceive as inferior, weak, fragile, very dependant and less- intellectually capable.

2. Yes, because in the past years when they heard the engineering course they always think that it is for the male because of the heavy duty work but they dont know that we, female can also do that sometimes they do better than males. So engineering can be female or male.

3. I think for some reason they think Engineering ay for males because of the workload and the type of work especially when you think of engineering as your future job yes, the gender inequality

4. Maybe, yes. I can only think of one, for me it's the society. It's how people around us continuously underestimating females on their chosen field. They always have that mentality that when we say engineering, it's a difficult field, that women doesn't fit there. And because of that thinking, some women questioned themselves whether they can really suit in the field or not. At the end, they will not try to pursue it.

5. Yes, I think there are some barriers. It depends upon the situation of the person whether they wanted to pursue that career but their parents don't. Also, some of them wanted to pursue engineering career but affraid to do that because they lack confidence and knowledge, they affraid to try because they are not mathematically intelligent.

6. Yes, for me peer pressure is one of the barriers for female students because they thought that female can't do better than male students.

7. Yes. I think there is still this thinking that females should choose a "feminine" course and engineering is seen as a masculine one.

8. None, based on what I see now, there are a lot of females in engineering field that perform beyond expectations.

9. When you thought of engineering the first thing that comes to mind is, it's hard to perrsue and you need to be good mathematically

10.It is the preference of companies to hire males more than females because they are physically stronger while other companies prefer females because they easily adapts to their surroundings.

Lack of confidence and strength

11. Yes, I think there's still an unequal treatment between female and male engineers in the corporate world and I think this is this one barrier that keep females and woman from pursuing careers in engineering.



12. Yes. In terms of strenght, the gender role thingy and the parent's/relative's toxicity, some people think that men are better in terms of leadership

13. Yes, I think yung part na sinasabi ng society that Engineering is panglalaki lang na trabaho, hindi raw bagay ang mga babae dito.

14. Even today, limited females are accepted by the companies. Most of the engineers that works on the projects are female. They also belittle the capability and skills to do work of the females

15. I think, the barrier is those people who doesn't trust you and always saying that you can't pursue it.

For me no. But for some, yes. Barriers like their parents think engineering is only for boys.

16. Yes. Usually, its misogynism and sexism. Female engineers are tend to be underrated most of the times because engineering fields are usually a "men's field".

17. Yes, because when requiring more strength in field works, engineering is more in favor of males as they are more suited with this type of work.

18. YES 1. Women in male-dominated fields such as IT often lack self-confidence and suffer from feelings of inferiority 2. They need to diligently transform their corporate culture into one that respects all employees, regardless of gender, and make discrimination and harassment socially unacceptable. 3. Female IT employees often report feeling as though they don't have the full support of their coworkers.

19. Maybe in the past, but today i think none or maybe some, like in their mind maybe they would think "engineering doesn't look good in me, wearing hard hats etc."

20. I think there are no specific barriers that keep females and woman from pursuing carrera in engineering. I know that engineering is not a good joke but I know that we females can pursue our goals just have faith and work hard to achieve our own goals in life.

Some of the major barriers that were pinpointed by the respondents include: Stereotypes that exists that engineering is a male and hard profession; Societal expectation, family backgrounds and cultures; Lack of motivation from society and people around; Mathematics and science are hard for most females; Roles that female play in a society restricts them to do technical course which are always demanding; Cut-off marks to join engineering are too high and it therefore discourage off many from joining engineering courses; Lack of self-confidence amongst most females to pursue engineering; and that in male dominated field female are being looked down on.

Q 11: Rank the following factors that lead to female drop out from engineering careers here at university

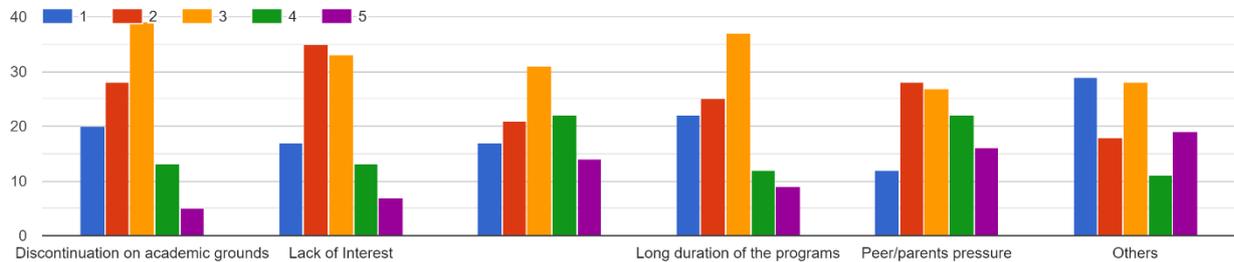


Table 4: Perceived Factors for Female Drop Out from Engineering Education

Factors	Rank				
	1	2	3	4	5
Discontinuation on academic grounds	40%				
Lack of Interest		20%			
Lack of Confidence to continue the program			16%		
Long duration of the Program					
Other Reasons					
No Answer					

From the survey of perception of female students on the dropout phenomenon at LSPU, discontinuation on academic ground is indicated to be the main reason (40%), followed by lack of interest (20%) and lack of confidence (16%). A substantial fraction of female students (16%) did not provide any answer. It can be viewed as a fear of even discussing the subject of dropouts.

Q 12: In your opinion, what do you think must be done in order to encourage more women to pursue courses in engineering?

1. Treat them same as male student and do not encourage them to pursue their dream be courageous.
2. Give them a lot of support and encouragement.
3. Instead of letting girls' math and science interests lie dormant or go ignored, we should present them with science projects based on their interest.
4. In this modern day, there's no need to encourage women because nowadays a lot of girls are in engineering field. For me, I don't think there's specific way but posting is enough.
5. In my opinion, they just need to follow what their hearts says because it is hard to take that course if you don't really like it. But I must say that in engineering it is fun and you will learn many things.



6. *The first thing to do in order to encourage more women to pursue engineering is to talk to their inner self. Always put in mind that being a woman doesn't make you less of a person, so don't under estimate yourself. Always choose what your heart wants and put aside the opinion of other people. You are the only one who knows yourself truly and if you think Engineering suits you then why think twice?*

7. *I think there must be a female role model. In that way we can be motivated to pursue engineering. Follow their dreams, don't be discouraged by someone who mislead you to reach your goals. Give them proof wherein women who graduated engineering is possible.*

8. *Encourage them that being a female will never be a hindrance to pursue their dreams. That they should not be afraid to try these courses. Empower them that the title ENGR. is also for them.*

9. *Maybe, by giving them advice, advice from an experienced FEMALE ENGR. so that they have their role model. By showing them a successful female Engr. can uplift their confidence that this field is for them also, for us. Because I believe, if there is someone who can truly understand a female, it's also a female. Conducting a career guidance webinar can also be put into consideration.*

10. *I think I can become an example to them by sharing my stories where age, intelligence, and experience doesn't matter. I will teach them to be confident because engineering is not a race rather a survival. It doesn't matter whether you're a bright one or not as long as you believe in yourself and in your ability.*

Show them that gender is not a hindrance in what they like to do or to their dreams for example is inspiring speech from different female engineers

11. *My opinion is don't let others look down on you, just keep pursuing your dreams. We, female students can do better in this field.*

12. *In my opinion, we can show articles that there are women that have been successful and known after she graduated in an engineering course. We can also start educating female students that engineering courses is not just for male students but it is for all. If they can do that, we as a female student we can also do that. Another is that, we can give some points and inspirations that will uplift their confidence like being in Engineering field has an edge in society, we are the ones who handles most building's planning, construction and finishing. Lastly, having a mentor or the one who will guide them on the right path especially on studying subjects in Engineering also gave some confidence to any students.*

13. *Allow others to see what a woman can do in an engineering field, and show them that even if others believe that engineering is only for male students, females can enjoy and become engineers as well.*

14. *Be strong enough to pursue their dreams. No matter how age we are, we can be an engineer someday. Just believe in our own strength.*

15. Universities and companies alike should introduce programs where both males and females can experience what engineering courses offer; they should give them an overview to spark interest among women and cultivate a culture of equality in the field.

16. We do promotion and advertisement that many female engineers succeed in this career path, and discrimination here won't be tolerated.

17. In order to encourage women to pursue courses in engineering, first, you should be an example or inspiration that women can really be good, better, or best at it, and that engineering field is not just for men but also for women.

18. I can encourage other women to take the engineering courses by myself. setting an example of myself that even though other people think is weak but here I am now standing and resisting because I believe in myself and to those who believe in me.

Have some programs or webinar for female to encourage them in engineering field. Nad maybe for the long term, lessen the discrimination.

19. I think professors and student should be more sensitive and more inclusive in all activities.

20. It is good to declare what engineering courses have to offered. Engineering courses are for both male and students. And it is all about efforts and determination to be able to take and finish engineering courses.

21. I think female engineers must be exposed to women for them to understand that there are a lot of female engineers not just in our country but in the whole world. This will make them realize that engineering is not only for men, but for all.

Clarifying the notion that engineering is for men and female cannot perform well in the fields through seminars, conferences and workshops; Mobilization of women to do engineering as well as giving a free waiver to all women willing to do engineering; Creating awareness amongst high school girls by involving them in forum that encouraged them to join engineering as a career; Encouraging and advice girls at high school to take all the sciences and mathematics which in turn will prepare them in pursuing engineering at the university; More mentorship to be provided not only to those who want to join but also those already in the field of engineering; Creating a more active science group and clubs at high school to enhance familiarity with science and hence prepare students to pursue engineering and related careers; and Creating awareness among female on the opportunities available after the pursue engineering this will encourage more to join because of clear future among others.

CONCLUSIONS

The primary goal of this study was to create a rough sketch, and not a detailed and polished portrait, of the female undergraduate engineering learning experience, using a variety of research methods and relying on the students 'own words for much of the data.



Based on the findings, it is apparent, that the female students, indeed, faced numerous gender-related challenges and even harassment from teachers and classmates in studying at the University. The findings presented are essentially tentative, exploring the women's experiences from a gender perspective only (in part to ensure secrecy of the women), and should not be interpreted as representational of all females' experience of engineering education. The study, however, attempted to contribute, in its small way, to the growing body of knowledge on 'predicament of women and engineering education'.

Women bring a much desirable and exceptional zest to engineering and therefore they should be supported, motivated, protected, respected, appreciated, and promoted. Although currently the female students at LSPU make up on average 17.9 %, there is still need for much more females in engineering in order to satisfy ever-growing demand for gender-balanced engineering workforce. Diversity of the student body at academic institutions has immediate economic benefits. In an age where many academic institutions compete for enrolments, in particularly in engineering, not drawing on the pool of women, for example, reduces revenue. Equity, however, does not just mean an equal number of women and men; it means equal chances of success and career opportunities and development.

RECOMMENDATION

The study, therefore, has made two key recommendations:

To increase retention and improve learning environment in the field of engineering education through female student support and mentoring, and in particular:

1. To provide unified student support services, including mentoring, tutoring and advocacy. To establish a mentoring program within the faculty where senior female engineering students could mentor junior female engineering students to nurture the progression of the younger engineering students and lower their dropout rates. Mentoring appears to be a strategy that also helps increase women's confidence in their abilities (MentorNet, 2002).
2. When one sees discrimination, harassment, or unsafe working conditions, they need to speak out against them openly and with no fear of victimization or being ridiculed, and also support others who speak out. Awareness campaign should be conducted at LSPU to make sure that students (both males and females) and employees understand the sorts of behavior prescribed by discrimination laws and policies, and provide safe avenues for them to report inappropriate and illegal behavior.

REFERENCES

- [1] ATMAN, C. et. al. (2010). Enabling Engineering Student Success: The Final Report for the Center for the Advancement of Engineering Education. San Rafael, CA: Morgan & Claypool Publishers, 2010. [Online] Available: <http://www.engr.washington.edu/caee/> (June 11, 2016)
- [2] Bell, A.; Spencer, S.; Iserman, E.; Logel, C. (2003). "Stereotype Threat and Women's Performance in Engineering", Journal of Engineering Education, October. pp. 307-312.

- [3] Besterfield-Sacre, M., Atman, C. and Shuman, L. (1997). "Characteristics of freshman engineering students: Models for determining student attrition in engineering", *Journal of Engineering Education* 86:139– 149.
- [4] Correll, S. (2001). "Gender and the career choice process: The role of biased self-assessments", *American Journal of Sociology*. Vol 106 No. 6(2001): 1691–1730.
- [5] Cronin, C. and Roger, A. (1999). "Theorizing progress: Women in science, engineering, and technology in higher education", *Journal of Research in Science Teaching*, 36: 637–661.
- [6] Donaldson, K.; Chen, H.; Toye, G.; Clark, M. and Sheppard, S. (2008). "Scaling Up: Taking the Academic Pathways of People Learning Engineering Survey (APPLES) National", In *Proceedings of the 38th ASEE/ISEE Frontiers in Education Conference*, Saratoga Springs, NY, October 22–25, 2008.
- [7] Duderstadt, J. (2008). *Engineering for a Changing World. A Roadmap to the Future of Engineering Practice, Research, and Education. The Millennium Project. The University of Michigan.* [Online] Available: http://milproj.dc.umich.edu/publications/EngFlex_report/download/EngFlex%20Report.pdf (June 17, 2016)
- [8] Hill, C.; Corbett, C.; Andresse, R. (2010). "Why So Few: Women in Science, Technology, Engineering and Mathematics." AAUW
- [9] Jamieson, L. & Lohmann, J. (2009). *Creating a culture for scholarly and systematic innovation in engineering education: Ensuring U.S. engineering has the right people with the right talent for a global society.* Washington, D.C.: American Society for Engineering Education.
- [10] Klein, S. (2007). *Achieving Gender Equity in Technical Education Through Education.* New York: Sage Publications.
- [11] Livingstone, D. (2004). *No room at the top: Under representation and under-employment of highly qualified women and minorities.* [Online] Available: <http://www.walnetwork.ca/inequity/nycms230804.html> (July 2, 2016)
- [12] Lockwood, P. & Kunda, Z. (1997). "Superstars and me: Predicting the impact of role models on the self", *Journal of Personality and Social Psychology*, 73, 91–103. doi: 10.1037/0022-3514.73.1.91
- [13] Marshall, C. (1997). "Gender Issues in Technical and Vocational Education: Mathematics, Engineering, and Technology", *Science Education* Vol. 79 (2002): 79-104.
- [14] Reuters. (2010). "Is woman's place in the home? One in four say yes". [Online] Available: <http://www.reuters.com/article/2010/03/07/us-women-poll-idUSTRE6261ES20100307>(May 24, 2015)
- [15] Schaefer, A. (2006). "A new approach to increasing diversity in engineering at the example of women in engineering", *European Journal of Engineering Education*, 31 (6), 661–671.
- [16] Schemerhorn, P. (2001). *Feminism means more than sexual equality.* [Online] Available: <http://migreens.org/awog/2001/2001summ/feminism.htm> (June 21, 2015) Seymour, E. (2002) "Tracking the Processes of Change in US Undergraduate Education in Science, puzzle", *Active Learning in Higher Education*, 6(1), 46–59, 2005.
- [17] Yurtseven, H. (2002). "How does the image of engineering affect student recruitment and retention? A perspective from the USA", *Global Journal of Engineering Education* 6 (1): 17–23, 2002.
- [18] Zepke, N. and Leach, L. (2005). "Integration and adaptation: Approaches to the student retention and achievement", *Education*, October 2005, 17(4):369-386.