

# Women in Engineering

## (Women Choose Education in Engineering)

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**Abstract**—Education is a right for everyone, regardless of age or gender. The development of science and education goes hand in hand with the increasing number of women trying to choose education in the field of engineering. The purpose of writing this review literature is to find out more deeply the reason women choose the engineering field. This review literature uses journal analysis techniques. Journals obtained from 2002 to 2018 are 100 journals. There are several reasons why women choose education in engineering. There are obstacles to choosing career opportunities for women who take education in engineering.

**Keywords**—gender; engineering field; women; education

### I. INTRODUCTION

Education is the right of everyone, both men and women, there is no reason to discriminate against the education of Indonesian women. Education is one way to make women agents of change and not just passive recipients of empowerment programs. Gradually increasing the percentage of women in total students at technology universities might help overcome stereotypes about the division of professions into men and women, and support the process of providing equal opportunities for both sexes in the labor market [1].

The population of Indonesia in 2018 reached 265 million. Of these, 131.88 million are female [2]. Nearly 50% of Indonesia's population is women, in terms of education, especially vocational education in technology and engineering is still a minority. There are still many who think that the field of vocational technology and engineering is a field for men only. Even though in daily life, especially families, vocational skills education in engineering is very necessary in living life. The importance of technology and engineering into gender-neutral work areas must be realized and considered [3,4].

The increasing number of women who choose to study education in the technical field from year to year is still unknown where the real purpose of these women is entering the engineering field. Surveys show that students are influenced in their decisions to study E & T because: it provides an opportunity to do interesting work and 96.8% of respondents agree or strongly agree [5]. To get the main goal of women choosing to enter the field of engineering, more in-depth research needs to be done. One of the data collection methods that can be used is the 5-Whys for Root Cause Analysis method. A basic and always effective approach to

solving problems that encourage deep thinking through interrogation, and can be adapted quickly and applied to most problems [6].

Further discussion will be prepared for this study. The first contains the background by expressing a brief description of women and the field of engineering (Engineering). The second contains a report on how to select and search for relevant literature studies. The third study analysis in the method section. The four research topics were identified and the findings of this study in the results section. The fifth is ended with discussion and conclusions from the literature study that has been done.

### II. THEORETICAL FRAMEWORK

#### A. Women in Engineering

Women in Engineering is one of the gender issues in the world of education which is still often a debate between those who agree and those who disagree for women studying the field of engineering. Fields of engineering that require teamwork to solve problems that have the potential for gender bias [7]. In terms of self-confidence women feel less confident with their performance in the technical field, especially for technological and engineering jobs which tend to be the work of men [8].

While currently more and more women are interested in entering engineering education. Many reasons women enter the engineering field, to find out the reason they choose the engineering field. To find out more deeply the reason women choose the engineering field, research needs to be done to uncover the real reasons women choose the engineering field.

#### B. Method The 5-Whys for Root Cause Analysis

Method The 5- Whys for root cause analysis is a basic and always effective method of solving problems that encourage deep thinking through interrogation, and can be adapted quickly and applied to most problems. There are three key elements for the effective use of the 5-Whys, namely: accurate and complete problem statement; full honesty in answering the question, determination to get to the bottom of the problem and solve it. The technique was developed by Sakichi Toyoda for Toyota Industries Corporation [6]. One example of the five why analysis process is as follows:

- "Why did the robot stop?". The charge on the circuit exceeds the limit until the fuse breaks.
- "Why does the charge on the circuit exceed the limit?". The bearings are jammed because they are less lubricating.
- "Why are bearings less lubricant?". The oil pump on the robot does not circulate enough oil.
- "Why doesn't the oil pump circulate enough oil?". The inlet pipe is blocked by metal powder.
- "Why is the inlet blocked by metal powder?". Because the pump is not equipped with a filter.

Benefits of Five Why Analysis include: helping to identify the root causes of a problem quickly; determine the relationship between the different root causes of a problem; one of the simplest methods; easy to learn and apply; easily completed without mathematical statistical analysis [9].

### III. METHOD

The step used to explore the reasons for female students majoring in engineering is to do document analysis. Relevant documents are very important to be taken and studied, because lack or loss of information might lead to a lack of strong research results. However, it is also not possible to get any research results related to this study because some of the studies are not published and, therefore, the research may not be assessed. In this study, the results of the study were sought in electronic data bases such as ScienceDirect, Shagepub, Google Scholar with keywords. Women in Engineering, Female in Engineering, Method the 5 why dan Gender in Engineering as the main study. Details of research searches with keywords;

- Women in the field of engineering with the keywords "Women in Engineering" and "Female in Engineering" research related to women in the field of engineering are needed to find the reasons for their choice of engineering.
- Gender differences in engineering, with the keyword "Gender in Engineering", related research on gender in the technical field is needed to find the extent of the effects of gender differences in the field of engineering.
- Methods of collecting data with Five Why to find a problem to the root of the problem, with the keyword "method the 5 why", some research on method five is why it is necessary to find information / to detail with steps similar to interrogation.

The flow in the search for the results of the research document is carried out as follows:

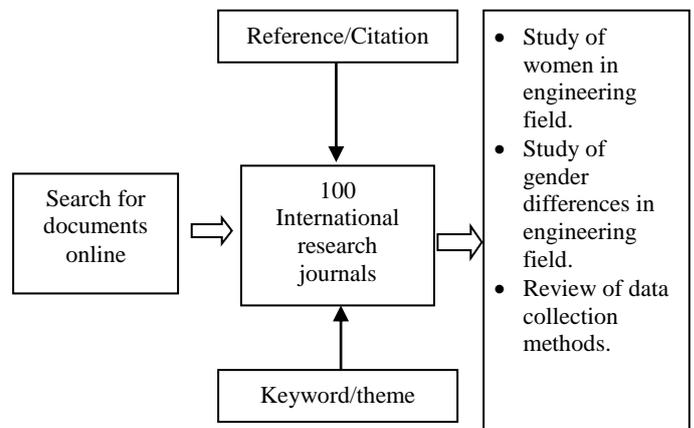


Fig. 1. Document Search Process Chart.

The results of the research documents were accessed on 17 September 2018 until 16 October 2018. The results of the studies examined in the form of documents starting from published in 2002 up to new ones were published online in 2018. The results of the studies studied were limited to obtaining current and relevant information with current conditions.

### IV. RESULTS AND DISCUSSION

This discussion reviews sub-topics concerning: (1) some reasons women choose the field of engineering in their education, (2) women's opportunities for a career in engineering.

- Some reasons women choose the field of engineering in their education.

This discussion will review some of the reasons women choose education in engineering. The Engineering Department is identical to strong and strong men. The entry process requires extra intelligence, strong physical, and resilient mentality because it will be exposed to tasks and extra lessons, making Engineering majors enough to be a "challenging" department.

Here are some reasons why women choose engineering. Starting from because of the direction of parents until there are those who do not like chemistry lessons. Some of the results of interviews conducted by Rizki Ramadhan (in April 2018) obtained the following data:

**TABLE I. SOME REASONS WOMEN CHOOSE THE FIELD OF ENGINEERING**

<b>RESPONDEN : 1</b>	
Name	Siva Hulwun
Departement	Civil Engineering Itenas Bandung
Reason	<p>I entered Civil Engineering, actually a suggestion from my parents. This department is a department that is identical to men, but there is no harm in women entering a majority male department, so it's fun to try something different and get out of our comfort zone. Even though in most classes it was male, I felt normal and looked equally flat, instead I felt that all women in the department were specialized, maybe because there were rarely women.</p> <p>My expectation was when I first entered this department "Difficult, difficult, coolies, rarely sleep, speed learning" it turned out the reality was not that bad. I feel like a technical kid, I feel proud. The problem is that in the future I will build roads, bridges, buildings, until your home. The World would be a better place if it was run by civil engineers.</p>
<b>RESPONDEN : 2</b>	
Name	Kezia Leyder
Departement	Regional and City Planning Engineering of Itenas Bandung
Reason	<p>My department is essentially focused on planning a city / region to be better for the future. I am in this department, it is my own desire, there is no compulsion from parents or anyone. When I found out in class that there were mostly men, I thought it would be uncomfortable, or what. But it turned out that after adapting, I was happy to cooperate with men because it was simple and not complicated.</p> <p>At first I felt weird and didn't match the direction I chose. Initial expectations, I thought I would learn a lot on paper. The reality turned out to be a lot of surveys and presentations, quite tired too. My message is for women who are still hesitant to choose engineering majors, don't hesitate because women can also work in the world of engineering. For those who are still hesitant because of the perception "The technique is for men", let's prove that women are equal to men. "</p>
<b>RESPONDEN : 3</b>	
Name	Alya Awanis
Departement	Mechanical Engineering, State University of Jakarta
Reason	<p>UNJ Mechanical Engineering is a new family for me. Usually here if you call the male brother, and the female one, it feels family. In senior words, there are 2 challenges in this department, the Machine Drawing course and the thesis. I entered the technique myself, but first I wanted Shipping. The technique woman is cool, because from my observation so far, they can be feminine in their place and strong in time.</p> <p>So the woman in mechanical engineering major is really special. The machine woman aka cemes (Machine Girl) of my campus is called treasure. Most are guarded, valued, prioritized, others are the main. Maybe I will not feel if I enter another study program. But that doesn't mean we are spoiled. It feels like a great technical kid. For entry into the technique, it takes a somersault of the brain. Then the assignments that you will carry out later. College is not just looking for imu, but maturing.</p>

**Table 1. Cont.**

	Order me for potential assets, prepare yourself. If you are still in doubt, just be sure to find as much info as possible. Ask parents' opinions too. Then don't be afraid that you will find it difficult to work. I used to come in here. Only the rest of the laughter because I was rejected a lot of tests. Now I just live as well as possible what God gives. So, wherever life plants you, just bloom and thrive.
<b>RESPONDEN : 4</b>	
Name	Gina Iskandar
Departement	Industrial Engineering Itenas Bandung
Reason	<p>In my opinion, Industrial Engineering is truly complex. The reason, because we are here, learn about things that are in other engineering majors. It's like that, when you want to create a company, you have to know everything, from management, goods and buildings that you need.</p> <p>Initially I entered industrial engineering because it was directed by my parents and brother, finally I wanted to because the job prospect was very wide.</p> <p>My first Impression when I entered industrial engineering, I exclaimed. Because at the beginning there were still basic questions about the lesson. There are so many men in class, the ratio is 3: 1. I think it's really a rare woman in engineering. My expectations will initially be fun and not complicated. The reality, must be strong until graduating. I have only been in semester 1, so far so far it is still very happy, still the basis of what he taught, maybe next semester is more complicated. My message is for women, techniques don't always have to be men, if your passion is here, why not.</p>
<b>RESPONDEN : 5</b>	
Name	Citra Ashilla
Departement	Metallurgical Engineering of the Surabaya Institute of Technology
Reason	<p>My department is usually called 'mamet', Metallurgical Material. So here, I study the properties of a material and how it is processed, also related to metal extraction, manufacturing processes, and analysis of the failure of a material. I entered the technique of my own volition, my parents wanted me to enter the FK.</p> <p>The question of engineering majors that are identical to men, in my opinion, is because it feels like a very field technique, using physics too. So, people like to technique the male department. When I was just in college, I thought at first, it was hard to shake his hands and couldn't get over here. Then also, my expectations were initially going to study manufacturing right away, immediately practiced to the lab. apparently, at the beginning I had to meet basic physics, basic chemistry with 11 12 lessons with high school, just deeper and more complicated.</p> <p>It feels like it's a technical kid, it feels like it has power because there is a label "Anak Teknik" and it doesn't affect the day to be independent and resilient. For women who are still confused about choosing engineering majors, just like that! Women and men have the same contribution here. Don't be afraid to lose, don't feel weaker. Show your girl power!.</p>

Table 1. Cont.

RESPONDEN : 6	
Name	Santi Azzahra
Departement	Geodesy Engineering of Itenas Bandung
Reason	I am a Geodesy Engineering student, a department that not many people know. The point is about mapping. The work often has to go down to the field, from mapping rice fields to the ocean. The heat has become an obligation. But, this department is really exciting. Although the number of women is still very small compared to men. I chose the geodesy department because there were no chemistry lessons. Studying in a department with a majority of men is fun, so I can get along with men and understand the difference between the way women think and men. Although sometimes it's sad because I feel like a lack of friends to talk about makeup and other girl stuff. Lecture the Technique, If you're not tired then you're not doing it well. The first time I entered felt heavy. All men, all assignments, all math. I used to expect that I would be happy because I was separated from chemistry and become a strong, resistant, independent woman slam, and be independent with engineering lectures. The reality is happy not to find chemistry, but it's pretty dizzy too, because it turns out to keep counting and playing time is limited. For women who just want to enter the technique, try to fix it first. not all techniques are hard, but there are still many majors that are hard for women. So yes, just adjust it.

- Women's opportunities for a career in engineering.

No doubt, the number of women working in the industry in the fields of Science, Technology, Engineering, and Mathematics (STEM) is still considered minimal. According to the Chairperson of the Femme in STEM Community, Miranda Rivienna said that she wanted to enlighten and share insights with other women, that the issue of gender equality in the STEM work field existed and could be an obstacle when knitting career paths in the future. "If during the lecture such an issue had not been felt, but in the world of work the issue would only be felt. We do not want this kind of issue to limit women who want to be concerned about pursuing careers in the STEM field, so they feel limited. "

There are still few women who have a career in the STEM field, one of the reasons is because of the gender stereotypes of buyers and less family friendly workplaces. Some women who work in the field for Civil Engineering still experience unpleasant behavior, such as being seduced or made uncomfortable.

Not only that, there is still a lack of a female role model that has successfully pursued a career in the STEM field as one of the factors in the lack of interest of women working in this field. Even though on the education level, women who take the STEM field as a chosen discipline are quite numerous. The minimal number is very influential at the level of advocacy in fighting for the rights of women working in the STEM field.

V. CONCLUSION

Women in the field of engineering turned out to choose this field more and more determined their choice to enter the world of engineering on their own accord. Women choosing the technical field of their own volition have been a distinctive progress without any coercion from parents or other people. Some of the reasons women want to learn life from a field of engineering that is known for being hard, strong and resilient. However, for career opportunities there are still some obstacles for women in the field of engineering, which turned out to be more refusal of women in the technical field when entering employment than in college.

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